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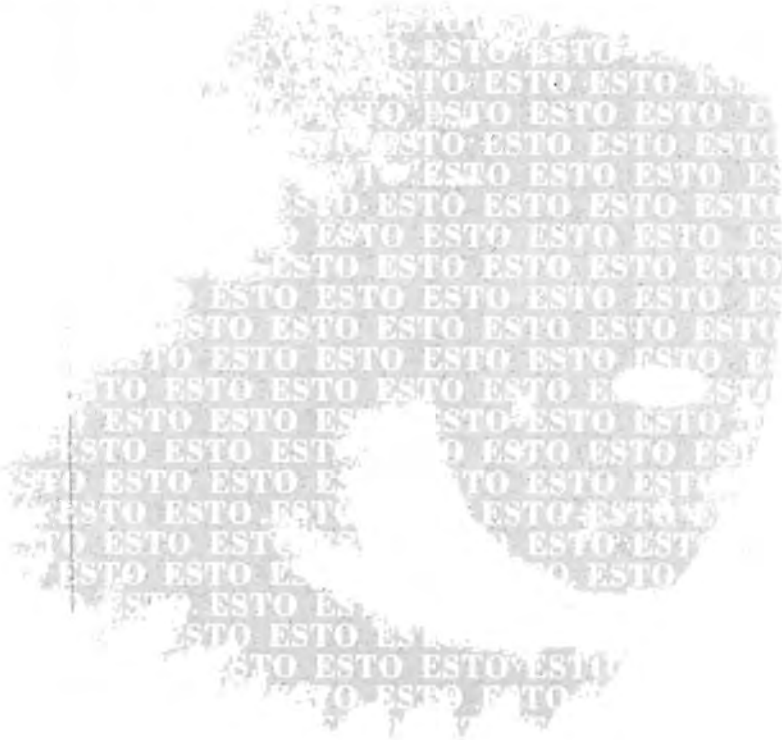

EUROPEAN COMMISSION
Joint Research Centre

ENGLISH VERSION

ABOUT THE IPTS REPORT

The IPTS Report was launched in December 1995, on the request and under the auspices of Commissioner Cresson. What seemed like a daunting challenge in late 1995, now appears in retrospect as a crucial galvaniser of the IPTS' energies and skills.

The Report has published 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 long 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. Issue 00 (December 1995) had a print run of 2000 copies, in what seemed an optimistic projection at the time. Since then, circulation has been boosted to 7000 copies. Requests for subscriptions have come not only from various parts of Europe but also from the US, Japan, Australia, Latin America, N. Africa, etc.

The laurels the publication is reaping are rendering it attractive for authors from outside the Commission. We have already published contributions by authors from such renowned institutions as the Dutch TNO, the German VDI, the Italian ENEA and the US Council of Strategic and International Studies.

Moreover, the IPTS formally collaborates on the production of the IPTS Report with a group of prestigious European institutions, with whom the IPTS has formed the European Science and Technology Observatory (ESTO), an important part of the remit of the IPTS. The IPTS Report is the most visible manifestation of this collaboration.

The Report is produced simultaneously in four languages (English, French, German and Spanish) by the IPTS; to these one could add the Italian translation volunteered by ENEA: yet another sign of the Report's increasing visibility. The fact that it is not only available in several languages, but also largely prepared and produced on the Internet World Wide Web, makes it quite an uncommon undertaking.

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 out 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.

Preface

Much effort is already being made in Europe towards a higher efficiency of our production system and the use of cleaner technologies. However, there is a growing awareness not only among avant-garde thinkers but also among the general public that these measures by themselves will not bring us onto a sustainable path of development. Instead, we need to find ways to transform the economic activities from the current levels of materials use and environmental impact and to assure a high degree of involvement in this process by the citizen.

The development of information and communication technologies, and the emergence of new models of economic activity in the information society provide opportunities to organize society in a way that improves material use, and to stimulate participatory action by citizens.

This growing awareness is reflected also in the way that research agendas and topics are prioritized by the Commission, most recently in the Fifth Framework Programme for Research and Development. The general policies for this programme have aimed at improving the base of European competitiveness within a perspective of sustainable development. Sustainable development is a multi-faceted target - development should be sustainable economically, socially, culturally, as well as ecologically.

Research on sustainable development can take many forms. One of the topics in the Fifth Framework Programme deals with creating a user-friendly information society. A critical aspect in this regard is

convergence - the merging of media, communications and computers through digital technologies. Convergence opens up a host of possibilities in which media and services are recombined and reinvented, offering prospects for truly user-centric communication that utilize materials and energy in increasingly sustainable ways. Research on the information society within the Fifth Framework Programme for R & D aims at the development of such converging technologies, infrastructures, services and applications that will contribute to the development of decentralized and individualized activities opening up new perspectives for all citizens.

The Fifth Framework Programme for R & D is an offer to the scientific community to contribute to a sustainable Europe for us all.

Erkki Liikanen

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The IPTS Report Secretariat
IPTS, JRC Sevilla
World Trade Center
Isla de la Cartuja
E-41092 Sevilla, Spain
Tel: +34-95-448 82 97
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E-mail: ipts_secr@jrc.es
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ERRATUM

Due to various technical as well as processing/publishing failures the map included in issue 25 (page 6) was of poor quality, and used borders and shadings which could be read to (mis)convey erroneous information; we apologise for any misunderstanding.

EDITORIAL

Dimitris Kyriakou

In debates regarding pollution and the possible role of government and government intervention, the economic notion of externalities is bound to appear. This concept refers to consequences of actions taken by economic agents which do not accrue to the agents themselves, but to others, or often, to society as a whole (or a suitably defined geographic subset). Externalities may be positive (the impact of a scientific discovery allowing innovation, growth, etc.) or negative (e.g. pollution in a river downstream by a factory discharging waste upstream). Since these external costs/benefits do not accrue to the instigating agent, the latter does not have the incentive to modulate them in accordance to society's preferences (i.e. more of them, in case they are positive, or less, in case they are negative).

One solution, the standard one, to this discrepancy between private and social preferences, is to impose taxes/subsidies to bring individual preferences in line with social ones. A less obvious one, dating from the early sixties, dubbed the Coase theorem after its inventor, was largely responsible for getting Ronald Coase the Nobel award in Economics, in the early nineties.

Since externalities are often invoked (in their positive guise in innovation debates, or their negative one in environment debates) it may be worthwhile to understand what the Coase theorem says.

The Coase theorem has been deservedly hailed as the critical breakthrough in the process of adoption of economic efficiency arguments in the resolution of legal issues, and in correcting externalities. Since externalities constitute one of the broadest and most visible areas of market failures, which, in their turn, are the only cases in neoclassical economics in which government intervention is justified on grounds of efficiency, the implications of the theorem extend beyond legal issues into politics, the role of the state and the nature of social organizations.

The Coase theorem states that for two economic agents A, B when A's actions generate a negative externality for B, and transaction costs are zero for both parties, it is optimal in terms of social welfare to allow the two agents to negotiate a payment to resolve the issue - either through A's compensating B for the damage A's activity inflicts upon B, or through B's compensating A for the benefits A will forego by discontinuing the activity.

Moreover, and quite crucially, whereas if transaction costs are zero the social welfare is invariant to the property rights allocation - which would dictate who compensates whom - in the case of positive transaction costs, the theorem states that optimality would dictate the allocation of the property right to the side with the higher transaction costs.

This is the key issue: allocation of property rights. The standard solution (often associated with the British economist Pigou) faces two sorts of problems: the tax-imposer must overcome both the calculational difficulties in estimating the cost of the externality, and the political obstacles to imposing a correcting tax. The Coase approach relieves the authorities of the computational problem. The political one however still remains, only this time in the form of assigning property rights to the side with the highest transaction costs (which may not be necessarily the politically most expedient one). Which goes to show that it is not easy to disentangle the invisible hand of the market from the hidden fist of the state.

6 Biotechnology

Protecting Biotechnology from Biological Weapons

J. P. Perry Robinson, *SPRU*

Issue: Much biotechnology is as applicable to biological weapons as it is to more beneficial products and is therefore causing mounting concern both inside and outside government regarding biological-weapons terrorism and proliferation. Thus, on 4 March 1998, the Council of the European Union adopted Common Position No 98/197/CFSP, which requires Member States actively to promote conclusion of the current negotiations in Geneva, which aim to strengthen the suppression of biological weapons, by the end of 1998.

Relevance: The industry itself is a useful source of advice on the necessary controls, but it has not yet become sufficiently involved in the present intergovernmental negotiations. These negotiations, will succeed only if controls are placed on biotechnology-based industry. But, unless appropriately designed, such controls could damage *bona fide* industry and harm the future development of biotechnology.

Introduction

International controls on Weapons of Mass Destruction have been growing since the 1960s, and since the end of the cold war attention has shifted from nuclear weapons to chemical and biological technologies

Weapons of mass destruction (WMD), meaning nuclear, radiological, chemical or biological weapons, draw from technologies whose extreme potential harmfulness if so exploited necessitates their control, even suppression. International controls on WMD have been growing since the 1960s when the nuclear-weapons Non-Proliferation Treaty, for example, was concluded, but, with the ending of the cold war, the growth and spread of WMD-applicable technologies have been generating demand for much more control. When the United Nations Security Council met in summit session on 31 January 1992, the assembled heads of state or government declared that the 'proliferation of all weapons of mass destruction constitutes a threat to international peace and security'. Those last six words meant that collective military action against proliferators could now be justified under Chapter VII of the UN Charter. The declaration went on to commit members of the Council to 'working to prevent the spread of technology related to the research for or production of such weapons and to take appropriate action to that end'.

A process was thus set in motion which will increasingly affect the context of policy for science and technology. The first really concrete manifestation of this process happened in April 1997, when the Chemical Weapons Convention of 1993 entered into force. To oversee this elaborate

disarmament-cum-antiproliferation treaty, now signed by 168 nations, nearly 500 international civil servants staff the headquarters, in The Hague, of a new Organization for the Prohibition of Chemical Weapons. A further major step towards tighter WMD controls has been under negotiation between governments since 1995: international action against biological weapons. The objective is a Protocol to the 1972 Biological Weapons Convention which will transform that norm-setting declaration into a suppressive regime akin to the Chemical Weapons Convention. In January 1998 President Clinton's administraton finally announced a US position for this negotiation. Earlier (and subsequent) EU initiatives may now come to something. The Council was acting in consonance with the UN Security Council summit declaration on proliferation of weapons of mass destruction. Yet that new Common Position stands in contrast to the current EU policy of promoting a European biotechnology industry. The negotiation will also require reconciliation with the existing EU regulation on exports of dual-use goods.

The Problem of Dual Use

The chief obstacle is that the particular technologies to be controlled are often as applicable to benign peaceful activities as they are to WMD. Their outright suppression is therefore unthinkable, and even lesser means of control could prove harmful to worthwhile industry, and to broader society. The duality is especially evident in the case of biological weapons, for their production rests on adaptation of industrial fermentation methods that are used throughout biotechnology-based industry. As more commercial purposes come to be served by the growing of micro-organisms under precisely regulated conditions, so could the industry become increasingly problematic for WMD control and, perhaps, increasingly vulnerable to it. This is so for the sectors in which the micro-organisms themselves are the product, as with bacterial or viral vaccines, or in the sectors where chemicals are produced by the micro-organisms, as in the case of antibiotics, enzymes or yet other chemicals produced by means of such enzymes. The vaccine sector could in principle be diverted to production of, say, plague or Ebola weapons; the chemicals sector, could be adapted, for example, to the production of toxin weapons. Industrial use of genetically modified organisms is extending both the product and the processing range, thereby increasing the control challenge.

It hardly needs saying that the biotechnologies are supporting a socially beneficial, rapidly growing, investment- rich, wealth-creating and therefore enormously competitive industry. Europe, where in 1996 the industry was valued at 40,000 MECU, is struggling against US dominance of the biotech market. It is a science-intensive struggle, especially (but not exclusively) in the pharmaceutical sector. Firms belonging to the trade association Pharmaceutical Research and Manufacturers of America (PhRMA) are estimated to have spent $18.9 billion on research and development, more than double what they had spent in 1990. PhRMA reports, too, that US pharmaceutical manufacturers now put 19.4 percent of sales into R&D, as compared with 3.8 percent across all industries. One reason is that a medicinal drug entering the marketplace today will have cost $350-500 million to develop and satisfy US regulatory requirements, an investment that will have been initiated 12-15 years previously. Only about one in five novel drugs recoup their R&D investment. WMD controls could in principle threaten the competitiveness of individual companies if they came to be applied unevenly across the global biotech industry and marketplace. Industry spokespersons have also expressed fears that, by offering cover for industrial espionage or by otherwise compromising the privacy of commercial proprietary information

The issue is complicated by the fact that many technologies, particularly biotechnologies, have both military and non-military uses, thus making a complete ban unthinkable

The technology needed to produce biological weapons is basically the same as that used to produce vaccines and similar dualities exist in the chemicals industry

Inspection regimes face the problem of how to ensure the secrecy needed by the biochemicals industry in order to recoup the ever increasing investment needed for new product development

(CPI), WMD controls could have a particularly negative impact on companies that have invested heavily in R&D. Yet just as the industry might be damaged by WMD controls, so also might it be damaged if the public came to regard it as a dangerously accessible repository of biological-warfare capability. The dependence of the Iraqi government's biological- weapons programme on Western exporters is now widely known. So also is the fact that its principal anthrax-weapon factory, at Al Hakam, masqueraded as a civil biotech facility before the United Nations razed it to the ground. Other examples may be drawn from the Cold War years. Demand for controls is now too strong to be disregarded. The important thing is to ensure that any harm they may bring to the industry is minimal, but without at the same time rendering them useless.

The Chemical Weapons Convention Solution

The problem is how to tread the fine line between retaining the benefits of biotechnology whilst suppressing their possible belligerent uses. The Chemical Weapons Convention sets out how its negotiators thought it could be done for dual-use chemistry. Analysis of what the Convention provides shows it to be a mechanism with three main elements, as follows.

The Chemical Weapons Convention has three main elements

First, the technologies to be controlled have been defined in terms of the purposes to which they are put, not in terms of their inherent characteristics. In contrast to the EU Regulation on Dual-Use Goods, the Chemical Weapons Convention is not directed only against listed items. Thus, a chemical weapon within the meaning of the Convention is not simply a bomb filled with nerve gas or anything else that a military person would necessarily recognize as a chemical weapon. It is instead any chemical that is toxic, or from which a toxic chemical can be made, of a type or in a quantity that has no justification for purposes not prohibited under the Convention, namely 'industrial, agricultural, research, medical, pharmaceutical or other peaceful purposes' as well as certain other purposes which the Convention also lists. Besides accommodating dual use, that general purpose criterion also means that technological change will not render the treaty obsolete.

Firstly, it is not based on a particular list of goods, but focuses on the use to which any goods are put; this accommodates dual use and means that technological change will not render the treaty obselete

The second element follows from the focus on purpose. Ascertaining intent requires intrusive investigation: a degree of access to the facilities and books of dual-technology users liable to make them nervous for the security of their CPI. The Convention therefore places the primary burden of compliance monitoring on the 'national authorities' which each state party is required to establish 'in order to fulfil its obligations' under the treaty. The chemical industry is accustomed to governmental inspection and was considered likely to have confidence in the integrity of governmental inspectors. In order to ensure that each national authority is in constant close contact with dual-technology users, the Convention requires the national authorities to transmit to The Hague periodical returns of detailed information collected from their industries. And it requires each state party to enact penal legislation to ensure that its industrial corporations, and all other natural and legal persons under its jurisdiction, are in proper compliance: that they will cooperate, in other words, with the national authorities in the discharge of the latter's implementation duties, however intrusive they may have to be. Some states' parties have made special arrangements for ensuring that their legislatures also play a role in these delicate arrangements.

Secondly, the burden of monitoring is placed upon the national authorities who must make periodic reports to the Hague

The third element is an international inspectorate required and empowered to validate information about dual-technology utilization

declared to it by the national authorities in accordance with the terms of the treaty. On-site inspection of industrial facilities is the primary instrument. The inspectorate operates under very closely regulated conditions designed to safeguard all confidential business information that it acquires. The implicit function of the inspectorate and its headquarters staff in The Hague is of course to keep the national authorities mindful of their duties. And the national authorities themselves are, in effect, inspectors of the inspectorate.

The Biological Protocol

It cannot yet be said that the international controls on dual-use chemical WMD technology are fully functional. The current work on implementing the Chemical Weapons Convention is still at an early, formative stage. The focus everywhere is on the most obvious task, the routine inspections of declared facilities. These are merely an ancillary part of the overall dual-technology controls, but it is essential that they be got right in order to build confidence in the total treaty regime. Presumably the proper balance will be achieved in the end, and the national authorities will then be able to perform their duties to the full. The routine international inspection of industrial sites should then appear less menacing than it does now to the biotechnology-based industries that could be most affected by the projected biological Protocol. Negotiation of the Protocol is proceeding, as did the Chemical Weapons Convention, through a 'rolling text'. This is still in a preliminary state, but it is hard to see how governments that have accepted the principle of the three dual-use control elements under the Chemical Weapons Convention could ultimately come to exclude that principle from the biological Protocol. It is good to see that the recently announced US position does not point in that direction. Exclusion therefore seems an unlikely outcome, so what now needs to be examined is whether the final fine print of the Protocol is likely to provide sufficient control — that it will not be merely a token political agreement.

Two criteria of success may be posited from the special standpoint of dual-technology control. First, would whatever is finally agreed commit states parties to national implementation measures strong enough to preclude the supply of any export market that might exist in goods destined for development or production of biological weapons? In other words, would the Protocol increase the protection of individual companies against the subterfuges and blandishments that have allowed certain countries to import Western products for biological-weapons purposes? Second, would the information-declaration and international-inspection regime of the Protocol be likely to deter those who might otherwise seek to exploit for biological-weapons purposes the more obviously exploitable parts of biotechnology-based industries. Would it, in other words, force cheaters out of industry and into the 'black', where they would then become more conspicuous to national-security intelligence measures and liable, then, to attract challenge inspection? The necessary mechanism is a set of rules and procedures that operate to increase the transparency of activities involving key dual technologies.

Impacts on Industry

A biological Protocol that satisfied those two criteria could thereby bring benefits of great value to the biotech industry. Voices from within the industry have, however, drawn attention to countervailing costs: of having to collect information for the national authorities; of having to prepare facilities to receive inspectors;

The third element is an international inspectorate required and empowered to validate information about dual-technology utilization

International controls on WMD technology are far from being fully functional, and the details of the inspection regime have to be designed in a way that builds overall confidence

To be successful the controls need to be able to prevent rogue governments from being able to obtain the materials they need to produce their own weapons, and they also need to be able to validate the information supplied to a sufficient degree to detect cheating

The biotechnology industry is concerned about the cost of information collection, inspections, disruptions and above all the threat to the security of their proprietary information

The industry needs to be actively engaged in the process of designing the regime in order for its fears regarding CPI to be assuaged

The dangers for the industry if the protocol negotiations fail are also great. Controls would probably tighten and scientific cooperation would be undermined by the lack of safeguards against abuse, not to mention the impact on the industry's public image

of accepting possible disruptions to production-schedules necessitated by inspections; and the possible loss of CPI. The last of these costs is sometimes portrayed as intolerably high, despite the high level of inspection to which parts of the industry are already subject under health and safety legislation and under regulations for the licensing of medicines and other such products. Biotechnological processing often involves unpatented trade secrets. In parts of the pharmaceutical industry, a single microbe could be a prize of great worth to competitors. A genetically modified organism used in the United States for commercial production of insulin has been valued at more than a billion dollars. Public disclosure of stolen research information could preclude as-yet-unsought patent protection, meaning loss also of intellectual property rights. Investment in this sector of manufacturing industry can thus be seen as altogether more vulnerable than in the rest of the chemicals industry.

Thanks to the active involvement of people from industry in the negotiation of the Chemical Weapons Convention, that treaty makes massive provision for the protection of CPI. The inclusion of similar provisions in the biological Protocol, plus detailed industry attention to the sampling rights of international inspectors and to their permitted equipments and on-site behaviour, could minimize this set of costs. The task ahead is therefore to negotiate the stringency of such security measures up to the point where the residual risks from inspections would be an insignificant augmentation of the risks which the industry already faces today. These, it should be noted, are not small: according to one US authority, the annual sales for pharmaceutical products compromised by detected instances of corporate espionage over the past several years exceed three billion dollars.

The process of detailed consultation between government and industry has been slow to get under way in most of the countries negotiating the Protocol. However, in January 1998 the UK government reported the successful trial inspection under the projected Protocol of a large private-sector pharmaceutical research facility. The report concluded that 'the company protected CPI throughout the visit: at no time did it come close to losing control of CPI'. Similar experience gained during the negotiation of the Chemical Weapons Convention shows how valuable such trials can be in engaging the industry constructively and in counteracting misperceptions of entailed dangers. Beyond all that, the industry is also confronted by the possible costs of the Protocol negotiation ultimately failing. Such costs could become severe if the industry itself were perceived, even incorrectly, to have stood in the way of international agreement. Failure in the negotiation would probably bring about a tightening and extending of those export controls on the industry that are currently harmonized by the Australia Group in its assigned task of inhibiting proliferation of chemical and biological weapons. There would be pressure to bring on the many other controls mandated by the Chemical Weapons Convention that are not in fact being implemented in the biotechnology-based part of the chemicals industry. Failure could also weaken the industry's science base. Scientists could become reluctant to cooperate with particular firms or to pursue particular lines of research in the absence of safeguards against abuse. The industry would have more difficulty in projecting a reassuring or attractive image of itself. Even now there is, in the words of a recent study, 'significant unease about the technology as a whole, and about potential implications of its trajectories'; pharmaceuticals are one thing, it seems, but genetically modified foodstuffs

quite another. Were biological WMD actually to be used, these backlashes against the industry would be sudden and intense.

Conclusions

The present drive for controls on technology applicable to biological WMD could impact adversely on biotechnology- based industry if the Geneva negotiators were to produce a poorly crafted biological Protocol. The impact could be no less severe if the negotiation were to fail. Either way the industry needs to prepare itself. The costs of inadequate preparation could reach beyond industry into society as a whole. It was possible to conclude the Chemical Weapons Convention because key chemicals-industry CEOs had come together and decided, in the mid-1980s, that both the industry and the public interest stood to benefit from the then-projected treaty, even if it were to place CPI in some jeopardy. Nothing like that has yet happened for the projected biological Protocol. It should; and the European Commission can play a role in stimulating it.

Keywords

Biotechnology, weapons of mass destruction, WMD, dual use, Chemical Weapons Convention, confidential proprietary information, CPI

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Contacts

J.P. Perry Robinson, SPRU
Tel: +44 1273 686758, Fax: +44 1273 685865, e-mail: **J.P.P.Robinson@sussex.ac.uk**
Ineke Malsch, The IPTS
Tel: +34 95 448 82 57, fax: +34 95 448 82 79, e-mail: **ineke.malsch@jrc.es**

About the author

J.P. Perry Robinson, a chemist and patent lawyer by training, has been a Senior Fellow of SPRU, University of Sussex, since 1977. He has served as an advisor or consultant to a variety of national and international organisations, governmental and nongovernmental, including the World Health Organization, other parts of the United Nations system, and the International Committee of the Red Cross. In association with the Belfer Center for Science and International Affairs of the Harvard University School of Government, he directs the UK end of the teaching and publication activity focussed on chemical and biological warfare armament and arms limitation. This is a subject on which he has published some 350 papers and monographs since 1967.

12 Information and Communication Technology

Content vs. Distribution: The Medium loses to the Message

Dimitris Kyriakou, *IPTS*

Issue: Continuing technological innovation and liberalization drives have caused a reduction in distributors' expected profit margins, and increasingly improving prospects for content providers (and packagers).

Relevance: The repercussions for policy of the dual prognosis stated above are substantial: content is at present still a small part of the telecommunications market, but it may well reap the lion's share in the future. On the other hand distributors (many of them public telephony operators) will need to adjust to leaner times - though not necessarily as desperately lean as some scenarios present them.

Although distributors of information used to have the upper hand...

Technology and liberalization are reducing the power of intermediaries, undermining the 'natural monopoly rationale' for telecommunication services provision, and favouring the 'message' over the 'medium'. The content provided is becoming increasingly crucial in the consumer's decision to opt for one among several rival distributors, i.e. intermediaries providing access to the carried content. The room for growth of the content part of telecoms is tremendous, since, according to the Boston Consulting group, the larger part of the telecoms market is still data-transport based, and only a small part is content-based. The prognosis need not be bleak for all distributors however. First through alliances, which are an interesting development though not the central topic of this article, they can hope to diversify their business; second, the key to survival and success will be product differentiation - and technological innovation provides opportunities for such differentiation; and third, an eventual consolidation in the marketplace should ameliorate prospects for the survivors.

The multimedia information society (MIS) is an all-encompassing concept that attempts to capture an all-encompassing transformation. The Information Society is a concept reflecting the resultant of a series of developments on both the demand and the supply side, centred around the increasing ease, speed and affordability - for technological as well as (de)regulatory reasons - of manipulating data in various forms, through increasingly efficient conduits/processors. The concept encompasses the increasingly interactive nature of the services and the applications riding on them and providing the added value that justifies the launching of such conduits/processors; it encompasses the work of

the builders of this infrastructure and of the interacting users, producing and consuming information. Last, but not least, the Information Society concept entails the ubiquitous impact on the socio-economic sphere of these pervasive though Protean technoeconomic developments, that not only change form continually, but also reshape the social context which gives rise to them.

The MIS network of networks, late 20th century's Holy Grail, can be sketched out as a multi-layered structure that will be based on infrastructure providing access and connections (optic fibre, coaxial, copper, satellite, radio, microwave, etc.). This grid is the backbone of the MIS. Service providers (public or private) will have access to the grid, and will use it to provide services (e-mail, teleshopping, tele-education, telebanking, etc.) to their customers who will be receiving information through the grid. Application developers will be fashioning new application packages for the network which they will be able to sell to consumers through the service providers.

In order to assist us with the eventual evaluation of prospects for various players in this supernetwork one can project, for analytical purposes, the following production chain:

...deregulation and technology are undermining their position...

a) Content originators (artists, writers, movie studios, etc.)
b) Content packagers (TV stations, cable channels, On-line service providers)
c) Gate-keepers at gateways to the network (navigation software, encryption specialists)
d) Distribution providers who own the conduits to consumers (cable companies, telecom operators)
e) Access devices (TVs, PCs, etc.)
f) End users

...and enhancing the prospects for content

As mentioned above, this breakdown serves analytical purposes; in practice firms are not limited to one part of the chain. We will, for simplicity, collapse the first two categories into a large 'content' category, the last two into one 'end usage' category and will not explore deeply the otherwise crucial function of the gatekeepers, which may develop into the most strategic and attractive area of activity - unless ease of entry into it undermines its profitability.

One of the clearest statements about the emerging MIS, and its value/production chain presented above, is that content will be vindicated, in the sense that for a long time ideas, creators, as well as the businesses that marketed the products of human creativity, were often at the mercy of intermediaries/distributors, who controlled the means of access to the public, in textual, audio, video, computer file, etc. format. The distributor of the package created by the content provider could often dictate his terms on the latter, because it was technically, legally or financially impossible for the content provider to bypass the distributor or assume the distribution task himself.

The transformation undermining the power of the distributors is due to two factors. First of all, the deregulation/liberalization drives over the last decade have been undermining the privileged, and often legally endorsed, monopoly position of distributors, and have facilitated entry of new players in the market for distribution/transportation of information. The new players' basic market penetration strategy has been to beat the

There is room for projected growth in the market for content, since distribution still claims the lion's share

incumbents on price, since in terms of infrastructure and coverage they are often, at least initially, at a disadvantage. Furthermore the captive market enjoyed by the monopolists, and intricate settlements accounting schemes for international calls/connections/transactions, had led to heavy overpricing that left room for newcomers to offer lower prices.

Second, and perhaps most important, technological developments increasingly undermine one of the basic pillars of monopoly treatment of telecoms operators, namely the natural monopoly character attributed to the telecoms industry for a very long time. The fixed costs of start up were deemed to be so high, and economies of scale so strong, that it made sense for the state to have one distributor and regulate it (often through direct control/ownership). Falling marginal costs for transmission, storage, retrieval, and processing of information are questioning the validity of such claims. The convergence of telecoms with one of the most fiercely competitive markets (information technology) has further weakened the foundations of monopolistic structures in the telecoms industry.

Entry in the content industry has always been easy (although success has not)

On the other hand, the increasing, and increasingly affordable, information carrying capacity is leading to a proliferation of intermediaries who are fundamentally in the business of selling a 'connection' to a 'pipe', a conduit (or parts of a conduit). In order for the users to pay, directly or indirectly, for such connections however, the content they will be receiving should be attractive. Since the number of creative producers does not seem to have kept pace with the proliferation of intermediaries, there will be more distributors chasing after the same (more or less) number of content providers. To put it simply whereas in the beginning magazines (content providers) paid intermediaries in order to get their publications on-line, they now sell their intellectual product to intermediaries - often dearly, as the recent Microsoft deal with the NBC television network showed. To avoid confusion note that large firms such as Microsoft may have both content providing parts as well as intermediary functions. In setting-up its own on-line network Microsoft enters the business of selling connection, of 'intermediating' - not necessarily an optimal move as both its legal troubles as well as its most recent Internet-espousing commercial moves seem to indicate.

These developments in supply and demand explain why 'content will rule' in the MIS, in the sense that it will be at a premium, at least when compared to its relative weakness in earlier times. And there is room for restriking the balance in the market in favour of content; according to the Boston Consulting Group, although the telecoms market is worth more than 400 billion dollars, only ~50 are devoted to content, whereas transport of information claims the lion's share - ~260 billion dollars (Le Soir, Dec. 2, 1994, p.6, Economie). These numbers reflect the hitherto enviable position of intermediaries/distributors. The attractiveness of content benefits content packagers in multiple ways, since they can exploit content by repackaging it in various guises (e.g. movie, video, soundtrack, t-shirts, etc.). Intermediaries, such as on-line services may well suffer as the much cheaper and more populous Internet becomes increasingly attractive; they may be forced into lower profit margins and into selling connection to the Internet, instead of competing with it.

The search for 'content' applications however should not focus on entertainment; killer applications may likely belong to the domain business rather than that of entertainment through (what ultimately boils down to) enhanced TV sets.

For instance, an emerging new service that combines the electronic presentment of bills with the electronic payment of those bills promises big

savings. Electronic Bill Presentment and Payment (EBPP) systems eliminate paper entirely from the billing/payment cycle as billers create electronic versions of their statements directly from their internal billing system. These electronic bills can then be available to consumers over the Internet or another network. The consumer accesses a special Web site, reviews individual bills, and schedules them for electronic payment. This new combined approach of electronic presentment and payment promises to deliver the type of dramatic efficiencies for billers and consumers that most people thought were available only through electronic bill payment. The potential cost reduction is dramatic: An EBPP service provider that charges 35 cents per bill to 3 million customers can save more than $2 million per year if only 10% of the biller's customers convert to EBPP. In addition, EBPP can remove four to seven days from the average billing cycle, resulting in very sizeable savings for large billers. Such savings potential will be a powerful force for market expansion. ('Electronic Bill Presentment and Payment: The New 'Killer App' in the U.S. E-Commerce Market', Thomas F. Horan, SRI BIP report D98-2135, 1998).

Note, however, that eventually the gap between supply and demand and the high returns enjoyed by and projected for content providers (e.g. Microsoft, US film industry) will stimulate others to join the content provision club, in order to share in the good fortune of content providers, and this would in the longer run bring down the profit margins for content (at least for the less creative content-packaging part). Furthermore whereas telecoms, and in general the more 'hardware' oriented parts of the industry, could enjoy some legal/regulatory/technical protection, the more creativity-based, 'software' oriented activities have always had the lowest barriers to entry. Note however that entry does not guarantee success, especially in 'creative' industries, where product attractiveness is notoriously hard to predict, where star performers receive huge rewards, attracting masses of emulators which, however, must survive on meagre rewards and grand aspirations, hoping their time will come.

The very characteristics that make commercial appeal unpredictable a priori for creative products also shield these products against 'reverse engineering' by competitors seeking to decipher the elemental 'formula' for success, so that they can then apply it themselves. The flip side of intellectual products' resilience against 'reverse engineering' is their vulnerability with respect to sheer, crude copying, to which they have fallen victim throughout the ages. This points to one factor that may taint the rosy scenario painted above for content, and hence points to the importance of adequate protection of intellectual property rights for the full realization of the potential of content provision, which is gradually being liberated from the grip of distributors, as suggested above. The recent emphasis on Intellectual Property Rights (IPR) protection, is partly attributable to the fact that European policy makers and entrepreneurs, as well as their US and Japanese counterparts, increasingly realize that high returns, and the comparative advantage of the industrialized countries, lie with knowledge-intensive activities, including intelligent, flexible MIS-informed manufacturing, and not with traditional mass manufacturing. In the latter East Asian - and other - competitors learn extremely fast how to outsell their First World teachers.

There are a few hitches in the above scenario, though not enough to undermine the validity of the main argument. First, as mentioned already above, the culture of the content industry and the fleeting, character of product attractiveness -impossible to pin down *a priori* to any particular formula or characteristic- makes content a risky business, and this preoccupies investors. Second, from a macroeconomic perspective, since personal disposable income edges up only slowly,

Creative content products cannot be reverse-engineered...

...but they are vulnerable to crude copying

The prospects for distributors can be mitigated through product differentiation, inter-industry alliances and eventual consolidation

expenditure would have to be displaced from cars and houses, etc. in order to pay for content. If however consumer spending on leisure increases then content should benefit. Finally, in the longer run the distributors, currently competing among themselves, and bidding up prices for content, are likely to consolidate and limit content providers' power.

This leads us directly to the second clear proposition that is often heard regarding the MIS value chain presented earlier. As already explained above, distribution is generally projected to suffer from falling profit margins, due to technological breakthroughs and deregulatory drives, that will virtually turn it into a commodity business. Is the future indeed that dire for distributors? Not necessarily. The need for continuous technological updating and the technological requirements of high quality multimedia applications imply that not all distributors will be offering the same services. Product differentiability is the best antidote to commoditization, and at least some distributors may have the resources and capability to differentiate (e.g. offering not mere telephony but packages of services with special, even custom-made features). The problem of course is that if a large number of them are able to employ this strategy, competition among them in a globalized market will be fierce and the dire prognosis presented above applies in equal strength. It is quite likely however that eventually consolidation will improve prospects for the remaining consolidated distributors. Nevertheless, the high profit margins of days passed would be hard to come up with, because excessive price mark-ups will trigger market entry by new rivals (since set-up costs are falling) as well as competition by cellular, satellites, etc.

Finally in dealing with such challenges distributors are both forming alliances and sharpening their knives. They form inter-industry alliances (e.g. with content providers) to diversify their activities, and to gain a friend while they still have something to offer - market power, access, assets, etc. before competition erodes their attractiveness as partners. They also form intra-industry alliances in order to benefit from concentration, and to be able to promise global end-to-end, hitchless, seamless telecommunications, which can be a lucrative market, especially with respect to business customers. They also aim- through alliance formation - to spread risk better, to enhance their tactical advantage in the light of crucial negotiations (e.g. world-wide satellite distribution), to share costs of possible investments - or even through advertising blitzes, to intimidate rivals, or, defensively, to balance similar posturing by rivals (it should be noted however that more than 60% of such alliances fail within a year).

In summary, technology and liberalization are reducing the power of intermediaries, undermining the 'natural monopoly rationale' for telecommunication services provision, and favouring the 'message' over the 'medium'. The content provided is becoming increasingly crucial in the consumer's decision to opt for one among several rival distributors, i.e. intermediaries providing access to the carried content. The room for growth of the content part of telecoms is tremendous, since the larger part of the telecoms market is still data-transport-based, and only a small part is content-based. The prognosis need not be bleak for all distributors however. First through alliances, which are an interesting development though not the central topic of this article, they can hope to diversify their business; second, the key to survival and success will be product differentiation - and technological innovation provides opportunities for such differentiation; and third, an eventual consolidation in the marketplace should ameliorate prospects for the survivors.

Keywords

Content providers, distributors, product differentiation, market entry, IPR, reverse engineering, natural monopoly, falling marginal costs

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Contact

Dimitris Kyriakou, The IPTS

Tel: +34-95-448 82 98, fax: +34-95-448 83 26, e-mail: **dimitris.kyriakou@jrc.es**

About the author

Dimitris Kyriakou holds a BSc in Electrical Engineering and Computer Science and a Ph.D. in International Economics from Princeton University. Before coming to the IPTS, where he is a scientific officer and is responsible for advising on economics issues and the editing of the IPTS Report, he worked as an economist at the World Bank. His main research interests include information technologies, employment, regional development and sustainability.

The Management of Intellectual Property in Publicly Funded Research

Pietro Moncada Paternò Castello, Jaime Rojo de la Viesca and Eamon Cahill, *IPTS*

Issue: The successful management of intellectual property rights (IPRs) has emerged as an area of particular interest for all partners involved in collaborative research. The sharing of the IPRs deriving from publicly funded research activities is a quite sensitive issue; various conflicting views exist on how to share IPRs and their effect on the potential commercialization of technology. Equally important for Research and Technology Organizations[1] (RTOs) is the implementation of clear strategies in this area which are unobstructed by managerial practices, restrictive legislation or administrative policy rules resulting from cultural reticence towards applied research and limiting ideas of public property.

Relevance: Although the primary purposes and *raison d'être* of many public RTOs is non-commercial research, potentially marketable R&D results may arise incidentally and may deserve IPR protection. Within a new context characterized by less government support for R&D and increased private sector interest, the correct management of intellectual property is likely to play a fundamental role both in the stimulation of the generation of knowledge and its translation into economic and social benefits.

Introduction

Europe shows excellence in scientific performance (as measured by number of publications per unit investment) but its technological and commercial performance (as measured by patents issued per unit investment) is low and even declining with respect to its principal competitors (notably, the USA and Japan). The ownership and exploitation of rights in intellectual property are key factors in determining the success of technological innovations introduced in the market place and provide the means for technological progress to continue to be made and thereby support the competitiveness of industry.

In the case of RTOs, IPRs make it possible to develop strategies for dissemination and transfer in such a way as to maximize social welfare. The efficient management of IPRs is crucial to providing the right incentives for continuing technological innovation. One of the major opportunities brought in by technological advance is the appearance of whole new economic sectors and business opportunities for

value-added generation in European industry. An efficient system has to adapt rapidly to the challenges posed by a continuously evolving technological environment.

This situation today is marked by the paradox that market requirements drive industry to focus on short term results whilst competitor nations are making significant investments in science and technology. In addition to traditional S&T areas, there are many new areas of basic research which are oriented toward supporting long term or social needs. Others hold little prospect of short-term commercial application and therefore do not comply with the return on investment horizon expected by private firms. There is an identifiable need to find the right balance between fundamental research and target-oriented research, and this issue is becoming even more important as many areas move their centres of gravity closer to users' needs and applications. Thus a management culture is required which stimulates an understanding of research-related IP issues. This culture must also clearly signal the value placed by the institution on the development of exploitable results and the appropriate handling of the procedures for protecting their results.

Intellectual property and the evolving role of public funded research

The ability to conduct basic research that will directly or indirectly provide overall benefit to society represents the primary role, the essence and the unique feature of publicly-funded research programmes. Nevertheless, there is a need to put in place the measures needed to make this possible within the European research system in a way that is more efficient than it has been in the past. This entails the detection, identification, protection, dissemination, promotion and transfer the new discoveries that result from these research activities.

In the past, a large part of the public R&D effort was primarily directed towards defence, energy, and to a lesser extent public health, education, and other social purposes. The IP which resulted from these R&D investments notably in the case of military/defence R&D, was therefore fairly easy to control and manage.

Nowadays there tends to be a greater focusing of public R&D on more socially-oriented objectives, providing scientific results which address citizens' major concerns (e.g. the environment, biotechnology, health and life sciences, social development & services) and ensuring economic security & development (which also includes favouring competitiveness) and this trend looks likely to continue into the future. In accomplishing these objectives, it should be noted that the environment in which S&T results originate is undergoing rapid and dramatic change. This is another result of the internalization of research and of the globalization of markets, human resource limitations, privatization of several public RTOs, etc. These are all factors which could make the management of IP from public funded research more difficult.

In discussing the identification and protection of discoveries, full recognition should be given to the fact that *marketable* discoveries can be considered to be an exploitable 'by-product' of basic research (the fundamental purpose of which is broadening the human knowledge-base) and that public research institutes should pursue programmes of research which are not primarily aimed at developing targeted products. However, research institute managers should monitor/investigate these emerging markets and evaluate the possible economic and social benefits arising from technological innovations.

The granting of licences for the exploitation of research results is a very sensitive issue. On the

Intellectual property rights allow research and technology organizations to develop strategies for the dissemination of technological innovation in a way that maximizes social welfare

As market forces encourage companies to focus on short-term results, basic research directly or indirectly benefiting society as a whole is an essential feature of publicly funded research programmes

In the past, the emphasis of publicly-funded research on defence purposes made intellectual property easy to manage. Today, with research being directed towards a wider variety of social goals, the issue has become more complex

Competitiveness is nowadays recognized to come from the ability of firms to exploit innovation, however, as government funding to R&D declines, an intellectual property framework promoting private investment needs to be set up

one hand, companies investing in a certain technology are interested in blocking their competitors' access to the same knowledge and will request exclusive licences to develop a technology which incorporates risks and uncertainties that are transferred to the company. On the other hand, publicly-funded knowledge resources should be rapidly disseminated in order to benefit the largest-possible share of society.

Centrality of IPRs in a changing techno-economic environment

The competitiveness of firms today is largely determined by their ability to capture the economic benefits of scientific and technological innovations. As the role of governments in R&D decreases, the need for stronger private incentives augments and therefore stronger IPRs are needed to provide the private incentives for the creation of new nowledge.

Several initiatives have been launched at the Commission level to adapt the system to current changes in the techno-economic environment. Initiatives to support the completion of the internal market also take intellectual and industrial property matters into consideration. An example showing the centrality of IP matters to the development of an emerging sector is the recent approval by the Council of Ministers of the long-awaited Commission directive on the legal protection of biotechnology inventions.

The case of biotechnology

Because of the long-term investment horizon, the potential commercialization of biotechnology inventions are *only* based upon the *exclusivity* given by patents. Public Research Organizations cannot play a role in line with their mandate in this important (publicly sensitive) sector if they don't patent inventions and do not provide companies with exclusive IP protection. In addition, the general EU regulatory framework/patent system has been unfavourable to the development of biotechnology within the EU and at present the USA holds 65% of the world patents in biotechnology, while the EU only has 15% (*European Patent Office*, 1998). Consequently, Europe is becoming one of the best markets for USA biotechnology based products, instead of being a competitor on an equal footing.

Regulatory initiatives to promote innovation and European competitiveness in other significant economic sectors will follow, as has been indicated by the recent proposal of a directive on copyright and related rights in the information society and a debate has started on the need to launch a directive on software patenting. A stable framework definition for the regulation of copyright and related rights as well as protection of the new forms of technological know-how - as software - is particularly important if support is to be given to the new added-value generation opportunities brought on the scene by the rapid development of new technologies and systems, such as the information society and electronic commerce.

Patenting new technologies provides - even in the present highly competitive environment - the most robust 'barrier to entry'. Nonetheless, it has to be mentioned that copying technologies is becoming ever more frequent (*De Kare-Silver*, 1997):

- 60% of all patented innovations are imitated on average within four years
- The ratio of imitation time to innovation time is on average 70%

- The ratio of imitation cost to innovation cost is on average 60 %.

This is one of the reasons why - where applicable - companies could decide to protect their discovery by other means (e.g. 'non-disclosure' in the case of the Coca-Cola formula) or not protect their IP at all (e.g. new technologies with a very short life-cycle).

While it is clear that basic research performed by RTOs acts as the reservoir of knowledge that will enable the generation of new inventions, there has been a drawing closer to more application-oriented research. The EU 5th RTD Framework Programme proposal clearly reflects the recent trend towards more targeted science and technology which has been experienced world wide. This trend also responds to a common series of observed facts; reduction of government supported defence expenditures, government willingness to balance budget deficits, tax-payer interest in seeing how R&D contributes to their well-being.

At the same time industry, due to the complexities of the technological processes and the competitive pressures it faces, has expressed an interest in establishing partnerships collaborations with RTOs. All these facts contribute to explaining why the management of IPRs has become a priority in the strategy design and planning of an increasing number of RTOs world-wide.

Efficient intellectual property management in the technology transfer processes

The process by which publicly funded technological knowledge is transferred from RTOs to industrial applications should be better structured if adequate returns from public investment are to be obtained. The emergence of Technology Transfer centres associated with publicly funded research institutions is one of the new features of the organization of research transfer.

Recognition for the researcher or inventor responsible for an innovation is a key aspect. Frequently, subsequent commercial exploitation relies heavily on the input of this person to the process of transferring the knowledge to the industrial partner and throughout the development process. The organizational culture of RTOs must be such that the necessary personnel arrangements in support of this phase of the work (secondments, transfers, leaves of absence, etc.) are smoothly introduced and in such a way as to coincide with the interests of all concerned. This transfer of 'soft technology' is the type of technology transfer most needed by industry.

RTOs also need incentives to transfer their inventions to commercial products. In the past both the invention and the associated revenues belonged to the government. This situation is no longer true for many RTOs now that the system allows a fixed amount of the royalties from licences to go directly to the RTO to fund further research activities. New formulas of rewards are also being tested, an interesting example is the recently launched initiative of the Heidelberg-based European Molecular Biology Laboratory (EMBL), which is the first international research organization to take a stake in a venture-capital company (10% of its shares) in exchange for intellectual property based on its research (*Nature*, 5 February 1998).

In general, public authorities do not claim directly the ownership of IPRs which result from publicly-funded research. Instead they delegate the management as well as the dissemination and transfer of the new knowledge to the RTOs.

Despite the existence of patent protection copying technologies is becoming more frequent. This causes many companies to resort to secrecy as the most reliable means of protection

The process whereby publicly-funded technology is transferred to industrial applications needs to be better structured, with greater individual recognition and smoother transfer of personnel to and from private industry

New reward structures for RTOs need to be examined, such as allowing them to reinvest income from licensed technologies into further research

Sharing of IP in the RTD Framework Programme

The EU 4th RTD Framework Programme has incorporated not only strong provisions for the exploitation and diffusion of results into its structure and regulations, but clear guidelines about the ownership of the results in the form of IPRs. In general, it provides ownership to the contractor when EU funds are less than 50% of the costs involved in the research while ownership is shared according to the terms of the contract and use by either side requires public recognition and acknowledgement of the contribution of the other. In practice it is not clear whether this affords the EU the flexibility which each individual situation might require.

In the US and Japan publicly-funded research envisages commercial arrangements and incorporates the necessary management procedures and IP controls

The commercial exploitation of research results from publicly-funded research institutions has also been undergoing a gradual change in recent years as a result of the increasing financial pressure to obtain returns from public investment. Considerable modifications to traditional practices have been introduced and there is an apparent convergence in practices world-wide. The United States and Japan have had long-standing commercial arrangements which include a number of basic concepts which underpin a wide range of flexible commercialization practices:

a) All publicly funded research activities have clauses in established agreements which envisage the sharing of IPRs from the achieved results.
b) The management process for the research projects include procedures for the management of the resulting IPRs and for the exploitation of results.
c) There are no restrictions on the rights of the owners of the IPRs, including governments, public bodies or their agents from entering into commercial arrangements for the use of these rights by others, provided existing laws and general policies regarding public procurement and contracting are complied with.

In general, the European IP protection system could benefit from simplification, harmonization and a reduction in the cost of obtaining and maintaining patents

These findings derive from a brief study performed by IPTS (Cahill, 1997) covering a sample of case studies in the EU, Japan and the United States involving public financial support for research. In all of the identified case studies there was a clear policy commitment directed towards promoting the commercial exploitation of discoveries and knowledge generated through publicly funded research. The study also found that excessive bureaucratic or administrative procedures acted as constraints on the transfer of IP to industry.

On a more general basis, other factors which will clearly facilitate the use of the IPR system include the simplification and harmonization of the IP protection systems in Europe (EC, 1997) and also a reduction in the costs involved in obtaining and maintaining patents.

Organizational management & intellectual property

The current application procedure for both patents and other forms of IP protection is both time consuming and administratively cumbersome and although many institutions have whole departments dedicated to the task, it inevitably constitutes a heavy burden on the research staff involved. One possibility is to adopt a similar option to the one existing in the US system, which permits the filing of provisional patent applications at one-fifth the cost of a conventional patent application while preserving the date of invention. This permits RTOs to expand a search period for identifying potential licensees for their technologies before applying for the conventional patent.

Management of IPRs in the US system

The US system has a longer tradition in the process of dissemination, transfer and utilization of Federal Technology than the EU. The most relevant pieces of US legislation covering aspects relating to IPRs in RTOs include:

- Stevenson-Wydler Technology Innovation Act of 1980, focused on the need for dissemination of information requiring federal laboratories to take an active role in technical co-operation and establishing the Offices of Research and Technology Application and the Centre for the Utilization of Federal Technology.
- The Bay Dole Act of 1980, permitted universities, non-profit research organizations and small business to obtain IPRs covering inventions developed with governmental support and also allowed government-owned and government operated laboratories to grant exclusive licences to patents.
- Federal Technology Transfer Act of 1986, established a principle of royalty sharing for federal inventors, introduced technology transfer as a responsibility of all federal laboratory researchers and an aspect to be considered in the evaluation of the performance of laboratory researchers.

The government, according to US legislation, can provide exclusive or non-exclusive licenses on government-owned inventions and requires that a major portion of the royalties revert to the laboratory.The law also gives preference to Small Businesses when granting licenses. The potential licensee should equally present plans to commercialize the technology. Nelsen (1998) has found support for the positive effects deriving from RTOs licensing activities enacted by the Bay-Dole Act. In particular, positive effects were found in terms of business start-up and job creation in the development and manufacture of products resulting from university licences. Networking of federal laboratories is also possible under the US system. The Federal Consortium for Technology Transfer in the US comprises over 700 research and development federal laboratories and provides a forum for the development of strategies and opportunities for linking government technologies with the market place.

The US system has lately focused in the development of public-private partnerships in order to transfer the IPRs from public laboratories or universities to industry. The Co-operative Research and Development Agreements (CRADA) aim to improve the commercialization of RTO-developed technologies by creating synergies and working closely with industry. According to Nelsen (1998) allowing academic institutions and small companies to retain ownership of inventions from federally funded research has unequivocally fostered the rate of patent applications by RTOs.

The design of incentive mechanisms that will guide researchers' efforts to obtain IP rights for inventions and discoveries is a fundamental aspect. In many research institutes, advancement is based primarily on publication procedures and the system does not envisage the possibility of implementing reward schemes aimed at the inventor. Altogether, the existence of separate units within the institute facilitates the identification of research results for exploitation possibilities that may have gone unrecognized.

A cheaper provisional-patent system would allow RTOs the time to identify potential licensees for their technology before filing for a full patent

The costs of obtaining and maintaining a patent portfolio are relatively high, therefore criteria that permit the selection of the technologies for protection are necessary. Equally important for the exploitation of results is the identification of a market for RTO output. The most obvious and best known market for any RTO is that of its partners in sponsored research. These companies can also provide contacts to their supply chains and customers. The more difficult areas are in sectors with which the institutions may have little or no previous experience of contact. In these cases they might have to rely on the services of intermediaries such as technology transfer agencies or venture capital companies. In many countries in Europe such agencies form part of the array of publicly funded organizations that make up the industrial development and support network, particularly for SMEs. An interesting example is the European network of Innovation Relay Centres funded by the European Commission, which acts as a clearinghouse for supply and demand of technologies available for exploitation throughout Europe.

RTOs could learn from the way private companies organize product management through dual technical and customer liaison facets

Many private companies supplying products and services which are of standard types and which are subject to frequent modifications organize themselves in such a way that each product (system) family has a product manager who represents the technical specification facet of the product over its life-cycle and a customer liaison manager whose orientation is guided by the customer specification facet of the same product. The customer liaison manager harnesses the customer/user inspired innovations for the supplier company. RTOs could undoubtedly learn valuable lessons from this approach.

A specific office within RTOs responsible for handling IP issues would allow the process to be made selective, avoiding the loss of credibility that indiscriminate filing might cause

The existence of an office in the organization responsible for the management of intellectual property allows a process of identification and discrimination in the process. Not everything that can be patented or protected should be. For instance, the indiscriminate filing of provisional patents in the hope of licensing them after 12 months or using them as bargaining chips in some other transaction can debase the whole process and damage the reputation and credibility of the institution with its potential industrial partners.

Conclusion

IPRs - and the way in which they are disseminated and transferred- are likely to become an increasingly important topic for the competitiveness of European industry, and they have a role to play in helping RTOs exploit the results of their research which may be commercially exploited (although this is not the central aim of their research). The trend towards reduction in public support for R&D, and the urgency of translating innovative R&D results effectively into commercial goods and services will be probably be offset by a larger involvement of the private sector in R&D activities. For these reasons a redefinition of the role and management of IPRs within RTOs is necessary. The fruitful exploitation of IPRs deriving from publicly funded research requires the full introduction of managerial and organizational practices and attitudes that enhance the generation and rapid commercialization of technological knowledge.

Several issues identified in this article can facilitate the smooth transfer of the knowledge generated in RTOs to the private sector in the form of IPRs:

- Providing the necessary incentives and rewards to the individuals who generate the inventions.
- Introduction of new types of contractual arrangements that permit RTOs to capture the benefits from their inventions -e.g. taking equity in start-up companies as a form of royalties.
- Providing partial or exclusive licences to firms interested commercializing the technology.
- Focusing awareness by disseminating information to the private sector on the technological knowledge held in the form of IPRs.
- Promote technology partnership arrangements with the private sector.
- Guarantee a clear definition of the IPRs that may result from research activities.
- Where applicable, and without compromising the public character of RTOs, learn from private sector approach, orienting research at an early stage of development.
- Develop mechanisms to identify technologies with commercial impact and pursue IP protection for them.

Thus, summarizing, in the past the results of basic research were freely disseminated and public-domain knowledge predominated, but nowadays as the complexities and the costs of the innovation process have increased, industry and tax-payers want to see a more direct impact of public funded research on their socio-economic well-being. In this context IPRs have acquired a central position as the mechanism that facilitates the transfer of knowledge from RTOs to the market and therefore to society at large.

Keywords

Public funded R&D results, patents, management, organization, commercialization, innovation, technology transfer

Note

1- Research and Technology Organisations (RTO) include public research laboratories and universities performing research and technological development.

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Contact

Pietro Moncada Paternò Castello, The IPTS

Tel: +34 95 448 83 88, fax: +34 95 448 82 79, e-mail: **pietro.moncada-paterno-castello@jrc.es**

About the authors

Pietro Moncada Paternò Castello holds a Master's Degree in Management of Technology from the MIT Sloan School of Management and the MIT School of Engineering. Before coming to IPTS he worked, as President, in the Agency For Natural Resources, Energy, and Technology (ANETEC, Belgium), and previously in the MIT Energy Laboratory, Electric Utility Program. His current S&T interests include innovation and technology transfer.

Jaime Rojo de la Viesca holds a degree in Economics from the Universidad Autónoma de Madrid and a Master's degree in Industrial Economics from the Universidad Carlos III de Madrid. His main areas of research interest include the relationships of technology and economic growth, economic geography, and the economics of intellectual property rights and intangible goods.

Eamon Cahill holds a primary degree in mechanical engineering and an MBA from University College Dublin and a Ph.D. in industrial engineering from University College Galway. His industrial management career was spent in multi-national companies, GEC, Pilkington and Rockwell International. Most recently he has spent 20 years in management consultancy including seven years as Chief Executive of the Irish Productivity Centre. He is currently a Visiting Scientist at IPTS working in the areas of technology, industrial efficiency and competitiveness.

Social Technology Foresight: The Case of Genetic Engineering

O. Todt and J.L. Luján, *University of Valencia*

Issue: The acceptance of products and research programmes by wider society is becoming a key factor for their success. Avoidance of social resistance and its associated costs can be an important issue in research and development in the genetic engineering field. Any developments in technology that do not sufficiently take into account the preferences and values of different social groups can lead to conflict, as shown by recent debates over the products of genetic engineering.

Relevance: Decision making in technology policy can be influenced by the positions taken by different groups in society. Understanding these positions and taking them into account during policy or project design could help to improve the effectiveness of research programmes and technology development projects. Socially oriented technology foresight could provide important information for steering policy and overall technology development towards socially accepted goals, thereby avoiding conflict.

Introduction: Social Technology Foresight

This article makes the case for a technology foresight strategy that actively integrates different social values and objectives. First, a short analysis of some aspects of the social debate surrounding the introduction of genetically engineered food products into the European market will be presented. The importance of non-technical issues for the technology's acceptance will be demonstrated. Based on this, some of the advantages and limitations of the involvement of social groups in foresight will be discussed.

Foresight as an exercise in analysing future technological options and their alternative paths of development over the mid- and long-term could benefit from social involvement. Social Technology Foresight, as understood here, would be a foresight strategy which actively involves *all* potentially affected social actors (representatives from non-governmental organizations, consumers, etc. in addition to experts from industry or government) in:

- The definition of the (social, economic, political, environmental, etc.) objectives of technology policy.
- Mapping out the alternative future paths of technology development and their implications (especially their acceptance by society).
- Determining a normative framework for the foresight exercise, and contributing to the social shaping of technology: technology

Social Technology Foresight, as understood here, would be a foresight strategy which actively involves all potentially affected social actors

development (and policy) here is understood as an active and conscious procedure oriented towards certain desirable social and economic objectives (Todt, 1997).

Social Technology Foresight would run parallel to social involvement in technology assessment, but rather than concentrate on particular applications, would cover whole technological areas

Social Technology Foresight, in this sense, has to be seen as running parallel to social involvement in technology assessment (TA). However, TA with social participation has been concerned more with questions concerning the development of concrete applications of a given technology. Participatory TA has only in part tried to convert broad-based and organized participation into a general and fundamental base for policy development for future overall technology strategies. On the other hand, a few preliminary attempts at broadening the social base of national foresight programmes already exist (for instance: Georghiou, 1996). However, the social involvement has remained very limited, and subject to an overall expertise-centred approach.

Social Technology Foresight would be an iterative process, starting with identification of the actors and definition of the objectives and culminating in the drafting of a report

The general process of Social Technology Foresight would be iterative. It would take place concurrently with, and as a fully-integrated part of, regular foresight activities, following these steps:

1) identification of the actors concerned,
2) definition of the objectives of the foresight exercise by all participants,
3) treatment of the issues and elaboration of alternatives futures and policy options by each actor-workgroup,
4) debate with all the actors of the different proposals (workshop-style meetings),
5) drafting of a report.

The present debate in many European Union member states on genetically modified organisms (GMOs), i.e., plants or animals developed by genetic engineering techniques, highlights the role that social groups can play in technology development. Especially the recent confrontations on the issue of labelling of transgenic foods (i.e., food products made from GMOs) demonstrates the susceptibility of certain technologies to public critique. Social groups which were not directly involved in the development of a technology but are affected by it (as in this case, certain consumers) can successfully resist the adoption of that technology if they feel their demands were neglected during the technology's development.

Genetic Engineering and the Public: The difficulty of characterizing public attitudes towards biotechnology

Public perception of genetic engineering: What do the industry and the public institutions know about the public attitudes toward biotechnology? Numerous studies on public perception can serve to answer this question (Zechendorf 1994; Biotechnology and the European Public Concerned Action Group 1997; Davison, Barns & Schibeci 1997). The conclusions show ambivalent attitudes toward this technology. Let us look at some examples from a Spanish study.

Important differences appear among the ethical valuations, perceptions and attitudes toward the consumption. For example, when the Spanish population was asked for a general valuation of the applications of the genetic engineering to different organisms; 56% agreed with applications relating to plants, and 25% with the applications relating to human cells. However, only the 39% of interviewees would be willing to consume potatoes genetically modified to be more nutritious, while 57% would be willing to undergo a genetic diagnosis, and 70% to gene therapy (Atienza & Luján 1997). The general valuation and the attitudes are different. This example is indicative of the kind of problems studies on public perception face.

Social Influence on the Development of Genetic Engineering

While studies of public perception are not sufficient to describe social attitudes to a technology accurately, the public does nevertheless exert an influence on technology development. Two examples of important areas for social factors having an impact on a technology's success are:

a) the social debate on the technical characteristics of the products (and their impacts),
b) and the influence of the debate about secondary characteristics of the products, like labelling.

a) The Debate on Herbicide Resistant Crops (HRCs) and Other GMO Products

Herbicide Resistant Crops (HRCs) are among the first products based on genetic engineering techniques to enter the market. They are plants that have been made resistant to a specific herbicide, so the application of the herbicide on the field does not damage the crop, but only the weeds in the field. The debate on HRCs like soy beans or maize started because its critics contended that these crops would have negative environmental impacts, and might lead to increased herbicide use. To date, no conclusive scientific study on the overall long-term effects of these plants exists.

However, the groups critical to genetic engineering were successful in their opposition to HRCs in several EU member states because of an under-appreciation of the benefits to consumers of these plants (while some consumer groups might face perceived possible environmental and health risks). Other factors that favoured the critics were scientific uncertainty about the long term effects of these plants. The debate about uncertainties persists, among other reasons, because publicly financed specific risk assessment research on a number of issues which have been pointed out by the critics (like gene transfer to wild relatives of some genetically modified plants) were only put underway when the overall debate on GMO products had already started, and not before.

This example shows how the negative social perception of a technology can endanger successful application if questions important to that technology's consumers (like the relation between costs and benefits or environmental effects) are not adequately addressed during its development. Examples from other technologies show the dangers of not addressing possible problems from the outset. The social dimensions of nuclear power, for instance the question of nuclear waste, were not addressed during research and development of nuclear technology. A social foresight exercise upon which the development of an overall energy strategy was based before the all-out development of that technology might have pointed out possible problems and alternatives (obviously, only if the situation in society had been the one we find today).

b) The Labelling debate

Even though labelling genetically modified food products is not an issue directly related to the technical development of these products, it has turned out to be a major social issue that is currently affecting the markets for these products in many EU member states. The debate on what products to label, and how, has lead to even more uncertainty on the consumers' side. Industry has been affected by the discussion of the possible complete segregation of GMO and non-GMO products during production. Labelling has even been one factor in creating markets for non-genetically modified products in some European

Debate on the characteristics and impacts of products and a reflection of this debate in the form the products take (e.g. labelling) are important factors for acceptance

The case of herbicide resistant crops shows how lack of perceived benefit with which to offset real or imaginary fears can result in products being strongly opposed by the public

Aspects which are secondary from a technological point of view, such as labelling, may nevertheless prove to be crucial social issues

countries. Labelling is an example of a 'secondary' social aspect of a chosen technological path. Even though it is not a technical characteristic of the technology or product, it could be as important as any technical feature for the success of a given alternative foreseen technology development strategy.

A Social Foresight strategy

Different trajectories of development for the same basic technology may meet with differing degrees of acceptance or resistance, and organized debate early on may highlight which directions are more socially acceptable

The conscious and organized debate on issues related to future R&D-strategies with all the affected groups could give important insights into what directions of technology development could be socially more acceptable, and which technical or non-technical aspects might create rejection. Different development trajectories for the same basic technology can have very different levels of social acceptance. This is the reason, why overall society (and not just the most vocal groups) should become involved at a very early stage, to inform policy-making about the acceptability of different alternatives. Foresight with the involvement of all social actors, especially the ones which tend to question the current lines of development of technology together with those who tacitly approve of them, could provide a wider base for decisions when choosing among these alternatives. For each alternative, it would give the following information which would reduce the uncertainty regarding its social, political and economic effects:

- Level of social acceptance/rejection of each alternative future technology policy path, and social resistance to be expected.
- Identification of non-technical ('secondary') issues which might condition a chosen alternative and create social problems in the implementation of that technology paths.
- Identification of related research (beyond the specific technological development) for each alternative path to avoid possible social problems.
- Issues on which close contact would have to be established between developers and wider society during the development process.

Among the potential drawbacks of this process are its inherent complexity, costs and slowness. One of the most difficult challenges would be making the process efficient and self-organized by the participants themselves. Efficient management would be crucial, and this includes active moderation of the discussions. The process does not need to lead to a consensus on all of the issues: even a clear definition of the social problems in relation with policy options from the point of view of each actor, or a partial consensus on a number of questions would give valid input for policy making: a clarification of which negative social impacts (if any) could arise. However, if the actors do not reach a minimum of consensus in a sensible time frame, the foresight exercise could lose its usefulness for all actors involved in policy-making.

Clearly the process needs to be adequately managed to prevent it becoming excessively complex and slow. Its credibility also has to be protected by ensuring it does not become the vehicle of public relations exercises

One of the conditions for making the process work is avoiding its abuse for simple public relations (PR) purposes by any of the actors. This, however, could be assured precisely by an open and public process: all of the actors (industry, NGOs, etc.) are under sufficient scrutiny by the general public in today's society that any strategy centred around PR instead of solving the problems is likely to become apparent.

Social foresight could benefit both industry and public policy making. For policy makers, at stake are the efficiency of public investments in technology development, and the social acceptability of their management of technology development for society's good. Social foresight could help to avoid the public questioning of technology policy, which happens invariably when technologies developed with public R&D assistance create controversy (as happened in the case of genetic engineering). It would also help to ensure the effectiveness of public R&D

programmes by guiding industry towards socially acceptable developments. In addition, based on such a foresight strategy, research projects concerning the social problematic of contested technologies could be defined. One of their aims would be to investigate what scientific evidence would be necessary to clarify the social debate on the technology in question. Another outcome of the process would be information on future regulatory needs. Regulation could then be devised in parallel with the technology development itself. This would give all actors, especially industry, a stable framework from the outset.

For industry, the value of Social Technology Foresight would a greater concentration on the specific applications of a technology. Within the overall framework set by a public foresight exercise, industry could use this strategy to define acceptable uses for a given technology, as well as product lines. The main use of this strategy for public policy-making would therefore be in the first phases of the process, in the definition of overall technology goals and social and technical objectives. For industry, it would become important in a later stage, for the more detailed foresight of specific technologies.

Naturally, the involvement of social groups would not supplant the existing foresight methodology, rather, it would complement it to improve its effectiveness in particular cases. Moreover, social participation would remain limited to certain areas of foresight, particularly the definition of the objectives of future technology policy and the identification of alternative development paths and their social aspects. As the experience with genetic engineering has shown, this kind of foresight could help in particular by making all those involved aware of benefits as well as the costs, and so lead to the establishment of alternative development paths with high social acceptance in the case of technologies identified beforehand as critical, and that can be expected to have a wide-ranging impact on society.

Social foresight could benefit both industry and policy-makers, whom it would help reduce the risks involved in funding unpopular research

Keywords

Technology foresight, genetic engineering, citizen participation, technology policy

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Contacts

Oliver Todt, University of Valencia, Department of Philosophy of Science/ Institute for Research on Science and Technology (INVESCIT)
Tel: +34 96 386 4437, fax: +34 96 386 4809, e-mail: **todt@uv.es**
Héctor Hernández, IPTS
Tel: +34 95 448 82 92, fax: +34 95 448 83 26, e-mail: **hector.hernandez@jrc.es**

About the authors

Oliver Todt holds a systems engineering degree. He is currently working as a researcher at the University of Valencia (Spain) on the regulation of genetic engineering and the influence of public debate on the development of that technology. His other research interests include public control of decision making in technology development, and technology assessment.
Jose Luis Luján is professor at the Department of Philosophy of Science at the University of the Balearic Islands (Spain). He has done extensive research and teaching in the area of Science, Technology and Society (STS) studies. His current research work is centered on public perception of science and technology, specifically in the area of genetic engineering.

Technology as a Key Factor for Employment and Regional Development

L. Crespo, *CEX*

Issue: The role of technology acquisition in existing companies in terms of job creation is controversial, especially in mature industrial sectors. However, in less-favoured regions (LFRs) technology can be used as a tool for economic development and job creation. However, one problem is access for SMEs to funds that will help them obtain up-to-date technology.

Relevance: In order to increase the efficiency of the industrial innovation and regional development public support programmes, the continuous improvement of management procedures is necessary. The correct selection of beneficiary companies, matching project scope with their needs and the speeding up of support mechanisms should be the main goals. Local management of a transnational technology transfer programme (e.g the TRANSTEX model) can be very efficient in terms of employment and competitiveness, showing a way from which valuable lessons for a widespread dissemination might be learnt.

The ambivalent relationship between employment and technology

It is widely perceived that technology is constantly contributing to improving welfare and creating jobs, reducing employment only during crisis situations when rapid change upsets existing patterns

It has come to be a widely held view that as well as being a fundamental characteristic of humankind, technological knowledge makes a constant contribution to welfare, increased output and, correspondingly, job creation. Only, in periods of crisis, when radical innovations are being introduced rapidly, may the situation appear otherwise. This may well appear to be the case in some regions when assessing the potential influence, unpredictable to some extent, of the information and communication technologies on the future model of our society.

Macroeconomic policies, regardless of the theories on which they are based, tend not to address regional problems effectively (Sánchez, P. 1997). However, one basic macroeconomic idea remains useful; that regional development is only possible if the local companies sell more and obtain greater profits.

When and how do new technologies have a positive net employment impact?

Looking at the issue from the perspective of the macroeconomic approach alluded to above, any increase in regional GDP will basically depend on

increased sales by local companies. However, in the existing global market, these sales will in turn depend on the competitiveness of the companies in the region.

Competitiveness is often based on the use of modern technologies for the production of goods and delivery of services, and therefore the higher the level of the technology, the more possibilities there will be to increase market share. Nevertheless, while success is not guaranteed for all companies that try to bring their products and processes up to date, difficulties are certain for those who do not.

However even in terms of employment, the fact that a company increases its sales does not automatically mean more jobs, as increased competitiveness is normally associated with a lower ratio of labour per unit of product. Therefore the implementation of technological innovations will only have a global positive impact level in a given region when the increase in sales compensates the associated unit reduction in labour content.

From this schematic description the complexity of the problem is clear. The number of possible combinations and particular cases depends on the specific characteristics of the regions and the business sectors. It is no surprise then, that there is a major debate about the role of new technologies on the development of LFR (Crespo, L., Mogollón, R., 1996). The importance of local management is reflected by Regional Policy Commissioner Monika Wulf-Mathies comment that "regional and local representations in particular are to be much more involved in the planning, implementation and monitoring of Structural Funds".

A short cut: the TRANSTEX model

The TRANSTEX project was conceived after the shared insight by European Commission D.G.s XIII and XVI that intelligent, direct promotion of technology transfer to Objective 1 Regions could result in positive development and employment impacts.

The funds (1 million ECU) came from the Article 10 framework of ERDF and represented 50% of the total project costs, (the other half being financed by the receiving companies). The project lasted for 18 months and was also formally supported and supervised by the Regional Government.

The Corporacion Empresarial de Extremadura (CEX), a partly publicly-owned investment capital firm, was pleased to act as Operating Agent for this project which consisted of the implementation of advanced European technologies in five openly selected companies in Extremadura. CEX assumed the responsibility for reporting to the E.C. acting as beneficiary for the financial aid and as subsequent distributor to the companies according to prior, jointly-defined rules, clearly stated in the contractual conditions between the E.C. and CEX.

The company profiles and project scopes of the five TRANSTEX sub-projects are given in the box below.

All the five sub-projects were completed on-schedule, within budgetary limits and the expected technical results were obtained. The five companies were able to solve specific problems through technology acquisition, and were subsequently able to offer new products on the market or to substantially improve their production processes. This has resulted in a significant sales increase and the direct creation of around 100 new jobs. Recently a financial control mission from the Commission checked the technical and contractual aspects *in situ* and it included highly favourable comments on the achievements and management of the project in its report.

The bottom line for regional development is that if a region is to develop its companies need to sell more and generate more profit. In a global market this depends on their ability to compete

Competitiveness depends upon using technologies so as to enable greater production to be obtained from the same or fewer resources. As this normally entails less labour per unit, jobs will only be created if sales increase proportionally

In the TRANSTEX project the Corporación Empresarial de Extremadura acted as an intermediary between the European Commission and the SMEs receiving funding

- **Agro-food company producing dried products**. By implementing new British technology it achieved a reduction of the level of impurities, which allowed it to supply to new customers and markets.

- **Slate company**. By installing Swedish extraction equipment it was able to put into operation a high added value quarry producing a type of black granite which is unique in Europe.

- **Consumer goods production and catalogue sales company**. By installing advanced German automated shirt production equipment it was able to start competing against Asian manufacturers and include its own shirts in its sales catalogue.

- **Agro-food company producing and marketing cherries**. By introducing a special British-made film the company's cherries can withstand longer periods in the special packages without degradation, allowing them to be exported to more distant countries and improving its offer on the national retail market.

- **Multimedia company**. By acquiring French microchip card and German CD-ROM technologies it was able to offer advanced application projects in the region and in the rest of Spain.

As well as supporting traditional sectors, TRANSTEX enabled companies to move into new ones

The TRANSTEX project was also in harmony with the regional development strategy as it not only supported well-established sectors (agro-food and ornamental rocks) but also broadened the range of goods supplied by the region (textiles) and introduced new business activities (microchip cards in this case).

As a summary of the project, the E.C. contributed 1 million ECU, Extremadura imported 2 million ECU-worth of know-how and advanced-technology equipment from northern European member states and Spain is saving around 1 million ECU per year in unemployment subsidies no longer required thanks to the 100 new jobs.

Successful microeconomic development projects depend on selecting the right firms, flexible funding management and responding to real needs

Reasons for success

Public policies in the field of technology transfer to companies must meet the following criteria in order to be successful:

- Selection of the right firms.
- The project content should respond to real and immediate needs.
- Agile management of aid funding.

Although these criteria seem obvious, it is not easy nowadays to find public support programmes where the three criteria are fulfilled simultaneously. Furthermore, the chances of achieving them decrease when one moves from local to national cover and even more from national to European level. However, this is not an impossible task as the TRANSTEX project has shown.

Before starting to present the lessons learnt, it is essential to mention that in order for future actions of this kind to be sound there is a basic need to respect the subsidiarity principle. That means that the E.C. should be involved only when its role is necessary and complements the role of the relevant Administration, at national or regional level.

It is clear that in this project this criterion was fulfilled. In particular, in all of the five TRANSTEX companies, the contacts between receiver and provider firms would have never occurred without European-level intervention.

But there is another important piece of added value at European level to be mentioned. Both regions, the supplier and the recipient ones, benefited from the same single subsidy. This is, therefore, a good example of fruitful actions aiming to promote North-South co-operation within Europe, and one which also might be taken as a reference for Third Country support programmes and, especially, for the Mediterranean and Latin American regions.

A brief description of the fulfilment of the success criteria by the TRANSTEX project is given below.

Selecting the right firms

Firstly, the programme has to get the necessary credibility to stimulate the firms to participate. Good firms (which also exist in Objective 1 even though they are not regular clients of the European innovation programmes) do not like to waste time answering calls for proposals. This procedure usually takes a long time to be evaluated and requires prior negotiations in order to arrive at a trans-national team which can be put forward, moreover the chances of being selected are perceived as being very slight. In addition, having a good project is not enough. The firm and its current circumstances are also relevant and this is hard to assess at a distance.

These requirements were automatically fulfilled in the TRANSTEX model when the firms were visited and given the relevant information (besides the publicly available information) at their own premises. The companies knew that a prestigious local organization, CEX, was acting as the intermediary for European financial aid, that this aid had already been received, and that their proposals would not have to be evaluated thousands of kilometres away. Therefore they could enter into negotiations with the foreign supplier optimistic about their chances of being selected.

It is crucial to bear in mind, however, that if this methodology were used widely for the management of public support programmes, the concern over how to protect the process against "favouritism" would have to be given considerable thought.

The Operating Agent (O.A.) should be willing to take on considerable responsibility with regard to the financing institution. It certainly helps if the intermediary is a public or semi-public organization with control mechanisms already built in to it. Although this should not prevent a private company from becoming an intermediary. Publication in the regional or European official journals might be carried out to demonstrate publicity but the only practical way to promote participation will be the direct contacts between the O.A. and the companies.

The financing institution should be prepared to receive and study potential claims from companies that could have presented proposals and which were not chosen by the O.A. The O.A. must clearly assume its own responsibilities, not only at the selection phase but at the implementation phase as well, but the involvement of selection or programme control committees might reduce agility.

Achieving a project matched to the beneficiaries' needs

CEX did not define the thematic project lines. Its only role in this respect was to assure a a spread of projects and companies among sectors

It is quite clear that European level intervention was appropriate for this project, as without it the receiver and provider companies would have never come into contact

Targeting the right companies is made difficult by the fact that SMEs in LFRs believe procedures are complex and time consuming and that they have little chance of success

A local Operating Agent is able to target companies in the region more effectively as it can combine its local knowledge with the credibility given by EC backing

Application for normal subsidies requires a great deal of preparation, and subsidies do not normally exceed 20% of the total investment. Using an intermediary simplifies and speeds up the process, which is particularly important for SMEs

in line with Regional Government industrial policy (assuming a strategy at that level exists), without forcing project contents at all. The companies selected for themselves the technological innovations they considered might help overcome their problems. They also knew that a quick, on-the-spot decision would be given, rather than have to undergo a lengthy wait for a bureaucratic process, at the end of which their circumstances would probably have changed. It also helps in general if technological/economic intelligence principles are also used to define a short-to-medium term strategy.

In the general case it should be possible to translate the company's strategic objectives into clearly defined added value, which could be linked to a measurable gain for the company in terms such as product characteristics, increased productivity, decrease in process costs, etc. This clearly identifies the need for the use of suitably defined performance indicators.

Achieving agile management of funds

Company participation on a 50% basis normally means in effect that the company has to support 100% of the costs for what can be a lengthy period. This fact, along with a long drawn-out proposal evaluation period, normally implies that the project does not run as initially planned and that the cost statements will generate work for the financial controller at the Commission.

The current situation with respect to the ERDF aid (participation in the last framework innovation programme was negligible) to SMEs in objective 1 regions, no matter whether they are for conventional fixed assets or technological ones, is the following: 2 months for preparing the dossier (a consultant is normally required due to the complexity for optimizing the subsidy and the whole procedure); 7 months for receiving the approval communication, although the corresponding implementation period could run somewhat in parallel; 3 months between the execution and the approval of certified costs and, finally 12 more months until the money is received. Innovation programmes at European or national level do not provide quicker schedules either.

Moreover, the current subsidies within the regional incentive programmes hardly exceed 20% of the total investment, while it used to be as much as 40%. Under European rules TRANSTEX was able to provide a 50% subsidy.

In this respect the intermediary (CEX in this case) negotiated directly with the company and met the contractual partial payment commitments immediately after the company had paid the total milestone cost to the supplier. This payment was never delayed more than one week and in some cases both payments, i.e. to the supplier and to the recipient companies (50%), were made simultaneously.

Conclusions

This pilot project has shown, above all, the great innovation potential that exists in Objective 1 Regions and which is often unexplored by European Innovation Programmes owing to the difficulties of promoting the participation of SMEs from LFR in these action lines.

Moreover it underlines how a decentralized management model can obtain participation from SMEs which, under normal circumstances, would have never benefited from this kind of support. Additionally, awareness of the companies' needs and proximity to them, can

ensure that project funds are really applied where they are effective, i.e. to the projects with the best guarantees of obtaining the hoped-for positive socio-economic impacts.

Another important conclusion is that business people involved in innovation programmes of this kind are in general aware of their own companies' technology needs. They are usually kept informed by trade fairs, suppliers and by keeping an eye on their competitors. This might imply that studies of demand, diagnosis, etc., do not always provide real added value in preparing the actions and may even in some cases be a hindrance to the participation of SMEs.

Nevertheless, as has been mentioned, the TRANSTEX project was a pilot and, of course, its management model for public support can not be automatically extrapolated, for instance, to the management of the Innovation Action Plan. Moreover the lessons learned in the TRANSTEX project might help Regional Administrations to understand the great impact on employment and economic development that technology transfer programmes might have.

The accent on the transnationality of such programmes is sufficient justification for the role of the European Commission, either through the innovation funds or through the regional development funds.

Keywords

Technology Transfer, Employment, Regional Development, Innovation Policies

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Contacts

Luis Crespo, Corporación Empresarial de Extremadura
Tel: +34 24 248250, fax: +34 24 248290, e-mail: **lcrespo@net64.es**
Ioannis Maghiros, The IPTS
Tel: +34 95 448 82 81, fax: +34 95 448 83 39, e-mail: **ioannis.maghiros@jrc.es**

About the author

Luis Crespo has a PhD in Aeronautical Engineering (Univ. Politécnica de Madrid) and a degree in Sociology (Univ. Complutense de Madrid). He has worked in the space industry and in a number of renewable energy fields in CASA, ASINEL and IER (CIEMAT). Afterwards he was involved in various aspects of technology management, first at the CDTI and later in AENTEC. He is currently general manager of the Corporación Empresarial de Extremadura and has promoted the establishment of 17 new companies, some of them technology based, in the region.

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ABOUT THE IPTS

The **IPTS** is one of the seven institutes of the Joint Research Centre of the EU Commission. Its remit is the observation and follow-up of technological change in its broadest sense, in order to understand better its links with economic and social change. The Institute carries out and co-ordinates research to improve our understanding of the impact of new technologies, and their relationship to their socio-economic context.

The purpose of this work is to support the decision-maker in the management of change pivotally anchored on S/T developments. In this endeavour IPTS enjoys a dual advantage: being a part of the Commission IPTS shares EU goals and priorities; on the other hand it cherishes its research institute neutrality and distance from the intricacies of actual policy-making. This combination allows the IPTS to build bridges betwen EU undertakings, contributing to and co-ordinating the creation of common knowledge bases at the disposal of all stake-holders. Though the work of the IPTS is mainly addressed to the Commission, it also works with decision-makers in the European Parliament, and agencies and institutions in the Member States.

The Institute's main activities, defined in close cooperation with the decision-maker are:

1. Technology Watch. This activity aims to alert European decision-makers to the social, economic and political consequences of major technological issues and trends. This is achieved through the European Science and Technology Observatory (ESTO), a European-wide network of nationally based organisations. The IPTS is the central node of ESTO, co-ordinating technology watch 'joint ventures' with the aim of better understanding technological change.

2. Technology, employment & competitiveness. Given the significance of these issues for Europe and the EU institutions, the technology-employment-competitiveness relationship is the driving force behind all IPTS activities, focusing analysis on the potential of promising technologies for job creation, economic growth and social welfare. Such analyses may be linked to specific technologies, technological sectors, or cross-sectoral issues and themes.

3. Support for policy-making. The IPTS also undertakes work to supports both Commission services and other EU institutions in response to specific requests, usually as a direct contribution to decision-making and/or policy implementation. These tasks are fully integrated with, and take full advantage of on-going Technology Watch activities.

As well as collaborating directly with policy-makers in order to obtain first-hand understanding of their concerns, the IPTS draws upon sector actors' knowledge and promotes dialogue between them, whilst working in close co-operation with the scientific community so as to ensure technical accuracy. In addition to its flagship IPTS Report, the work of the IPTS is also presented in occasional prospective notes, a series of dossiers, synthesis reports and working papers.

The IPTS Report is published in the first week of every month, except for the months of January and August. It is edited in English and is currently available at a price of 50 ECU per year in four languages: English, French, German and Spanish.

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The European Science and Technology Observatory Network (ESTO):
IPTS - JRC - European Commission
W.T.C., Isla de la Cartuja s/n, E-41092, Sevilla, Spain
tel.: +34-95-448 82 97; fax: +34-95-448 82 93; e-mail: ipts_secr@jrc.es

- ADIT - Agence pour la Diffusion de l'Information Technologique - F
- CEST - Centre for Exploitation of Science and Technology - UK
- COTEC - Fundación para la Innovación Tecnológica - E
- DTU - University of Denmark, Unit of Technology Assessment - DK
- ENEA - Directorate Studies and Strategies - I
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