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The IPTS REPORT

EDITED BY THE INSTITUTE FOR PROSPECTIVE TECHNOLOGICAL STUDIES (IPTS)
AND ISSUED IN COOPERATION WITH THE EUROPEAN S&T OBSERVATORY NETWORK

EUROPEAN COMMISSION
Joint Research Centre

ENGLISH VERSION

ABOUT THE IPTS REPORT

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

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

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

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

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

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ERRATUM

The Catalogue number that appeared in isuue 51 and 52 of The IPTS Report should be corrected to LF-AA-01-051-EN-C, LF-AA-01-052-EN-C for the English version.

EDITORIAL

Mobilizing Human Energies in an Institution: The Role of Leadership

Dimitris Kyriakou, *IPTS*

Having levelled criticisms in the editorial of issue 51 at the mechanistic, assembly-line, reward-and-punishment approach to mobilizing human energies in an institution, one should however note that although it may have its merits they are limited to the completion of repetitive tasks and to periods of "normal" operation. To successfully rally human energies towards tasks that are out of the ordinary, however, the mechanistic model must be supplemented by leadership. In this case this perennially vague requisite quality – leadership – translates to the achievement of two fundamental goals.

Firstly, a clear, reasonable, workable and reassuring vision must be provided to the members of the institution whose energies the leader wishes to mobilize. That vision must be able to not only to raise morale, and not only unite all through reinforcing a common reconstruction of a collective identity, but it must also set up an attractive, appealing image of the collective self as an achievable target. That ideal collective self would act as a beacon to guide the group in its efforts to realize its potential. That vision must be positive in its reconstruction of reality, convincing in its presentation intermediate steps –which must be reasonably spaced out along a well thought-out, and viable, path– and reinvigorating in the way it shows the path to a desirable goal.

The foregoing is clearly quite hard to achieve, it in effect entails adopting a holistic Weltanschauung in whose framework questions will be answered, issues will be dealt with and which, in its comprehensiveness, will show that the efforts of the leadership do not amount to just a few superficial changes and then a return to 'business as usual'.

The second major task of the leadership is to establish a bond with the members of the institution, strengthening the bonds between them at the same time. It must persuade all concerned that they are all in the same boat together, that they all have a stake in the common undertaking. The leadership must be careful to combine a modicum of authority in its voice with familiarity and empathy for those whose energies it wants to mobilize. It must never be perceived to be condescending or distant, if it wants to rally people behind its cause.

Finally, beyond these general attitudinal prescriptions there are a few more particular recommendations that can be made regarding the functioning of the institution. Firstly, following the lines of the criticisms of the limitations of the mechanistic approach we presented above, people should not be treated as objects. Objectifying others not only constrains their capacity for originality and creativity, it also renders the interaction itself devoid of the human sparkle that allows participation to flourish, and mobilization to succeed. Secondly, people should be allowed/ encouraged to take responsibility for their activities instead of having them hide behind the veil of bureaucratic hierarchy, and non-zero-sum climates should be created regarding rewards. Third, one should promote spontaneity of communication of ideas in a way that prevents their being stifled by hierarchical bureaucratic channels (e.g. ideas could be communicated informally in all directions, instead of following strict channels and procedures).

This analysis in favour of a less mechanistic approach to managing and mobilizing human energies becomes more relevant in knowledge-driven and knowledge-based organizations, (increasingly central growth-drivers in developed economies), where the key asset is the staff's grey matter – a factor notoriously impervious to assembly-line management schemes.

In closing, we will reiterate that the leadership of the institution must exhibit the commitment it requires from its members as it tries to mobilize human energies in the institution. It must create, or reinforce, team spirit among the members of the institution and it must clearly assign responsibility and define the goals towards which the mobilization is helping. Interestingly, the foregoing analysis applies not only to large organizations but also to states, but since space is limited we will not elaborate on this here, but may perhaps take it up in future editorials.

Technology and Employment Revisited: against pessimism

Dimitris Kyriakou, *IPTS*

Issue: In recent years, technology pessimism has been on the rise, fed by unemployment problems in Europe, which are sometimes misleadingly and simplistically attributed to technology.

Relevance: A better understanding of technology and employment linkages would first shield policy-making from destructive anti-technology rhetoric. Moreover it would help policy-making vis-à-vis not only technology, but also employment issues.

Although it is widely accepted that the experience of the past shows that technology does not permanently reduce overall employment, there are those who argue that the pervasiveness of new technology today will leave displaced workers with no new sector into which to move

The perennial subject of Technology's impact on Employment (T-E) never fails to generate interest (and often strong feelings); in terms of long-lasting fascination it ranks together with Malthusian limits to growth. At least since the beginning of the industrial revolution people have expressed fears that machines would abolish jobs. In the early 19th century Fulton's steam boat attracted the wrath of ferrymen, and Luddites treated jennies and looms as sworn enemies. In the 1940s computer pioneer Norbert Wiener forecast that computers would bring about a crisis worse than the Great Depression of the 1930s. Notwithstanding the evident inaccuracy of such prophecies, technology pessimists insist that the new worker-displacing technologies (IT) –informatics, telecoms, etc.– are of a new, employment-devouring variety –an argument similar to Wiener's in pessimism. It is argued that the all-encompassing character of the present revolution will have an impact that will be felt throughout the economy; i.e. there will be no place left to hide, in the sense that the service sector 'hid' the workers displaced from manufacturing in earlier decades. This line of argument is oblivious to the fact that the all-encompassing term 'services' is equivalent to an 'all other' agglomeration, wherein jobs are created and destroyed without *a priori* quantitative limits. (Note that we are not here examining the issue of jobs being taken by cheaper labour in developing countries –an issue that is dealt with in the trade literature).

Most importantly, however, pessimists suggest that for the first time even skilled white collar workers are at risk, and it is this fact which helps explain why the recession of the early 90s, although milder in several countries than that experienced in the early 80s generated gloomier predictions, and a stronger sense of unease. This time around it was people with a voice who got hurt, or at least people close to the journalists, pundits and analysts with a voice, people who could more effectively fight being reduced to statistics –in earlier recessions star journalists would have been hard pressed to identify a friend who had lost his job.

We were arguing back in 1996, in the ninth issue of the IPTS Report that such 'techno-pessimism' was largely misguided. The arguments made at that time apply equally well today. Indeed not only is recent EU employment generation performance encouraging, but also the links between technology and growth (and through growth, employment) can be backed with numbers.

Technology and growth

There are broadly speaking three types of studies based on econometric approaches that aim to capture the impact of technology (often dubbed technical progress and as a first approximation associated with the so-called 'residual'–i.e. the part of growth not explained by increases in factors of production such as labour and capital).

They include: growth accounting, where data for capital, labour and output are examined over a long period of time and the residual is identified as technical progress; second, econometric studies on production functions for which data from many countries is pooled together and technical progress is reflected in time-trend terms; third, in industry-specific studies.

Bob Solow (incidentally, a long-term collaborator of the Commission's Institute for Prospective technological Studies (IPTS)), pioneered growth accounting with research on the rate of technical change in the US, which he found to explain nearly 50% of growth in the US for the first half of the 20th century.

Edwin Mansfield (1996) focused on key industries (information processing, electrical equipment, chemicals, scientific instruments, drugs, metals, and oil) for the period 1975-85 the rate of return to society (beyond that accruing to the industry itself) of the of results of academic research was approximately 28%.

Zvi Griliches (1994) reports regressions on three-digit Standard Industrial Classification (SIC) data for different post-WWII periods, regarding the impact of R&D expenditures on the residual (dubbed total factor productivity). He found it to be about 30%.

For the US, beginning in the 1920s, growth in conventionally measured inputs explained only a modest fraction of the observed growth and output. Moe Abramovitz dubbed this "a measure of our ignorance".

The three main assumptions employed in standard growth accounting work are: constant returns to scale, neutrality of technical progress (independence of the latter with respect to changes in the factors of production), and profit maximization with competitive factor and output markets.

Some results of well-known econometric studies of the residual based on the above assumptions are as follows: Abramovitz (1956) attributes 48% of growth to technical progress whereas Solow attributes 51%, Kendrick (1973) attributes 56%, Denison (1985) 46%, and Jorgenson, Gollop and Fraumeni (1987) 69%. (Denison allows for modestly increasing returns to scale in his calculations).

The differences in their findings are attributable not only to the differences in the measure of output (real net national product, real gross national product, real aggregate value added, etc.), nor merely to the different periods studied (in which technical progress might have moved or affected growth in different ways), but also to whether quality improvements in labour or capital are taken into account. In general if they are explicitly taken

The three approaches used in studies to capture the impact of technology rely on growth accounting, the econometrics of production functions and industry-specific studies

Some well-known econometric studies attribute between 46 and 69% of growth to the effect of technology, or technical process as it is referred to in the literature

Interestingly, when R&D capital is explicitly included as a factor of production alongside labour, capital and human capital, the impact of human capital is reduced

R&D is a poor indicator of the impact of technical progress. It is difficult to measure, and its effects may involve a time lag as R&D stock, unlike capital stocks, can be dipped into very profitably for a very long time while it is depreciating

Reaping the benefits of technological change depends on the ability of agents to learn and adapt so as to deal with the new conditions

into account, the residual is reduced. To the extent, however, that technical progress is responsible for quality improvements in capital (most obviously) but also in labour, quality improvements in the factors of production may be a proxy for the impact of technical progress.

In pooled data approaches, studies by Kim and Lau (1994), and Boskin and Lau (1995) give different results for different sets of countries. Whereas for East Asian newly industrialized countries (NICs) the residual does not seem to be important, the reverse is true for G-5 and G-7 countries. They find that even including human capital explicitly as a factor of production alongside labour and capital, technical progress accounts for 50.1 % of growth for Canada, 54.4 % for France, 64.8% for West Germany (pre-1990), 69.7% for Italy, 53.3% for Japan, 46.7% for the UK, and 50.7% for the US. Interestingly, when R&D capital is explicitly included as a factor of production alongside labour, capital and human capital, the impact of human capital is reduced (suggesting complementarity between human capital and R&D capital), but the role of technical progress is not taken up by the R&D capital. The latter is attributed 10% of growth in Canada, 11.6% in France, 15.5 in West Germany (pre-1990), 15.8% in Italy, 14.2% in Japan, 8.3 in the UK, and 9.9% in the US. Technical progress on the other hand is still attributed a very large part of growth (between 36.9% in the US to 53% in Italy).

This is the case because R&D capital in many ways is neither coextensive with technical progress nor does it measure well its impact. Firstly the residual includes things such as learning by doing, software development, organizational innovations, etc. Secondly it does not take into account the extent of the lag in the impact of R&D on output. Thirdly it does not account for efficiency losses resulting from temporary monopoly profits afforded by successful R&D, nor the push for aggregate innovation that the race for such temporary monopoly positions may generate.

R&D and its impact may not appear in the statistics to begin with. Much informal R&D is not captured, and neither is the impact of R&D in cases such as the public sector where output is measured by input cost and hence productivity increases due to R&D do not appear. The interaction and strong complementarity between R&D human capital and tangible capital make it very likely that the impact of R&D is being underestimated.

Finally there is a 'stock' aspect in the lagged impact of research. The R&D stock, unlike capital stocks, can be dipped into very profitably for a very long time while it is depreciating. The extremely useful algorithm in operations research known as Kuhn's Hungarian algorithm, (or as Kuhn himself used to teach it, Egervary's algorithm, after the Hungarian mathematician who worked on it in relative anonymity) was developed in the 19th century, and the efficiency gains from applying it far outweighed the cost of Kuhn's learning of Hungarian in order to be able to dip into and utilize this long-existing –albeit obscure– research capital...

Against this background, there are a few points that need to be kept in mind when thinking about technology and employment. These can be summarized as follows:

1. Technological progress generates new wealth.
2. Historical evidence does not show technology to reduce total employment.
3. There are many other factors behind Europe's employment problems.
4. Hiring people is akin to an investment, influenced by growth considerations just as all other investments are.
5. In general, countries which have experienced a slowdown in productivity growth have experienced a rise in unemployment.

6. Comparison of Europe and the US refutes the argument that unemployment is being aggravated by the fact that IT is being introduced more rapidly than other technologies were in the past.
7. Empirical evidence from the US indicates that firms using advanced technologies pay higher wages, offer more secure jobs and increase employment more rapidly.

The aim here is not to present an exhaustive list, since, for instance, certain organization theory aspects may deserve separate articles, nor simply to provide a source of interesting statistics; the emphasis is on the arguments themselves. Moreover, a very important aspect that is not looked at here, but which deserves more thorough treatment is the 'learning' process, through which agents deal with the new conditions brought about by technological change. Reaping the benefits of such change depends on the agents' 'learning capacity', an issue addressed partly by some of the points mentioned below, but which also deserves further treatment.

Technological progress generates new wealth

First, the implicit assumption behind the pessimistic claims is that there is a fixed amount of output to be produced. **What is not taken into account is that technological progress generates new wealth**; and increased wealth leads to higher effective demand, causing increased investment and labour hiring in order to satisfy this increased demand (most typically through selling new products or services)[1]. In the short term technical progress may destroy jobs in particular areas, but the increase in productivity and in disposable income leads to increases in effective demand and eventually to the creation of new jobs. More accurately, given the various other factors that may complicate this process, what technical progress will do is raise total income, and, with the exception of workaholics, it is income that people need and not jobs *per se*. 'Jobs' is often a shorthand name for 'income'. Now whether most people will effectively partake in enjoying parts of this higher total income –either in terms of more/better jobs, or through redistribution schemes –depends on the economic framework, and not on technology. The transition and adjustment period will be rife with mismatches. It will be made less painful if a number of conditions are met:

a) Growth picks up quickly, leading to higher demand and faster job creation across the board.
b) Labour markets, but even more importantly product markets, become more flexible.
c) Education and training/retraining becomes more widely available and better focused –Europe has to base its strategies on innovation and quality, developing total competence and enhancing ability to adjust through a commitment on promoting life-long learning.
d) A share of the benefits of technical progress and new wealth generation goes to those displaced by the market's implacable gale of creative destruction– favouring the creation of new and more efficient arrangements at the cost of destroying less competitive ones –to cushion them through the transition period.

The historical evidence

Evidence through the decades does not justify pessimism. The last 200 years have seen strong technical progress, accompanied by increased income across the socio-economic ladder, net job-creation, and reduced working hours. Robert Solow (1987 Economics Nobel Prize-winner) aptly observed recently that technical progress and productivity growth do not have to be associated with high unemployment; in fact the high productivity growth post war years (what the French call 'les trente glorieuses') were accompanied by very low unemployment.

One of the implicit assumptions behind pessimistic claims about the effect of technology is that there is a fixed amount of output to be produced. This fails to take into account the fact that technological progress generates new wealth, and that increased wealth leads to higher effective demand

The transition period during which a new technology spreads will be less painful if growth is rapid, markets are flexible, training is available and a share of the benefits of the technology are passed on to those displaced by it

Job creation or loss has more to do with the regulatory framework for labour and product markets, the ease of setting up a business, interest rates, the agility of the banking system and of financial markets, and of course training and education, than with the spread of technology

A multitude of factors

Technology in any case **cannot be singled out for blame for Europe's employment related ills over the last 15 years,** especially in light of the effects of the two oil price shocks, movements in the terms of trade, high taxes on labour-employment, an increasing mismatch between patterns of labour supply and demand, high real **interest rates, etc**. There are many reasons for the emergence and (more crucially) the persistence, of unemployment. The framework within which technology operates is usually much more important than technology itself.

Jobs represent an investment for employers

Importantly, since **hiring labour is akin to investing in people, low growth and low growth prospects, have not encouraged such investment since the seventies.** Firms impart training directly or indirectly to their employees, and wish their employees to stay long enough for them to reap the fruits of this investment, as in general an employee's performance/contribution curve rises with time. This is increasingly the case as Taylorist models of production become outdated in the organization of blue-collar work. In any case such assembly line models were never credible for white collar work, which is the type that new technological developments are supposed to threaten for the first time. Overall, to the extent that S/T and its adoption boosts growth, and growth prospects, it facilitates firms' investment in new people, i.e. hiring.

A slowdown in productivity means a slowdown in jobs

The fifth point is that, as the 1995 CEPR (Centre for Economic Policy Research) report "Unemployment: Choices for Europe" argues (CEPR, 1995), apart from Japan and Austria, which are the two outliers, statistical, and not anecdotal, evidence from the OECD countries suggests that those countries experiencing the greatest slowdown in (often technology-driven) productivity growth also experience the strongest rise in unemployment.

The speed of change

It is also argued that information technology (IT) is being introduced much more rapidly than earlier technologies, not giving time for economies to adjust, especially in recent years when the cost of computing power has fallen sharply. However, the evidence does not justify panicky reactions against technology. Clearly, the US has been adopting IT faster than Europe, and the unemployment differential between the US and Europe has not reflected this speed difference. On the contrary, unemployment has behaved much worse in technology-tardy Europe than in the US. As suggested in point 3, above, there are many other factors that determine job-creation/loss, apart from technology, and they are the key determinants. They have to do with the regulatory framework for labour and product markets, the ease of setting up a business, interest rates, the agility of the banking system and of financial markets, and of course training and education. Part of our employment problems now come from the fact that technical progress has been 'unskilled-labour saving' to an extent that was not matched by the progress of education.

Education is undoubtedly the key for the achievement of a smooth transition in which new job opportunities can be identified and exploited. The more controversial issue is the type of education best suited to the changes the information society will be ushering in. The standard apprentice schemes, teaching or retraining people in order to endow them with a particular skill, may only make them more vulnerable if this particular skill is of a mechanizable, repetitive nature.

Technology and quality of jobs

The seventh point concerns technology and the quality of jobs. This was raised by an illuminating publication (winter 1994/95) from the US department of Commerce ("Technology, Economic Growth and Employment: New Research from the Dept. of Commerce", Lewis Alexander, USDC Chief Economist) which spells out a number of points clearly. Using firm-level time-series data, collected since 1978, the study concludes that **firms using advanced technologies pay higher wages, offer more secure jobs, and increase employment more rapidly** than other plants. Technology is found to contribute to the creation of more good jobs. Advanced technology firms hire workers with more skills and pay them better wages (even when taking into account the skill level). Plants using advanced technologies have a higher probability of survival (i.e. failure rates –and the consequent employment losses– were found to be substantially lower for such plants). Overall employment growth was observed in conjunction with the use of advanced technologies. The plants with increased productivity AND increased employment have an employment impact which outweighs that of those plants which have increased productivity and reduced employment (downsizers). Interestingly, and perhaps surprisingly, the smallest plants were over-represented among those with increased employment and reduced productivity, whereas large plants were over-represented among those with increased productivity AND increased employment. It is also shown that regardless of the size of the plant there is a strong positive correlation between the number of advanced technologies used and employment growth. Dynamic high growth plants were found to be crucial for industry performance. They provide well-paid and relatively secure jobs; the fact that they are often both high-tech and active in export markets may indicate that both trade and technology contribute to their success.

A US Department of Commerce study suggests that firms using advanced technologies pay higher wages, offer more secure jobs, and increase employment more rapidly than other businesses

Finally, it is worth comparing the results of investing in new technology and not doing so; the US Commerce Dept. report mentioned above found that **regardless of the result** of investing, **the outcome is much less attractive if the investment is not made.**

Conclusion

Analysing the technology-employment link actually can provide a view of the related role of competitiveness in all this. It can be seen that firms which fail to compete (e.g. because they are slow to adopt new technology) will be deservedly punished –which indeed provides a 'competitiveness' rationale for the adoption of technology and the prevention of employment losses due to business failures. Indeed it can be argued that unemployment in Europe is not due to technology, but rather to the slow adoption of technology (and of an appropriate accompanying framework) in Europe.

Keywords

Technology-employment, productivity, jobs, long-run impact, competitiveness

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Note

1. Note here that we set aside Kaldorian interpretations of the effect of growth on productivity which may have a negative impact on employment in a quite peculiar fashion, through the impact of growth on the division of labour. We set it aside, not only because of its peculiarity but also because, since it operates through the division-of-labour mechanism it is best dealt with in the literature on international trade to which we referred earlier.

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Metadata on Education and Training at the service of Lifelong Learning

Rocío García Robles, *IPTS*

Issue: The growth of the World-Wide Web has created an urgent need to define widely agreed-upon methods and vocabularies for describing its contents in a consistent manner. One approach to meeting this need is the use of Metadata Schemas. In achieving this aim in relation to the vocational education and training (VET) sector, several initiatives have emerged at the European and international level, but there is a need to integrate core skills and competencies issues into the metadata solutions that have arisen in the framework of those initiatives.

Relevance: Linking Metadata Initiatives in the Educational and Training sector with skills-related concepts can facilitate policy making in the Education and Training area, aimed at enhancing workers' employability.

Introduction

Anyone who has ever tried to find information online using a web search engine will no doubt have experienced the frustration of retrieving a large number of "hits" but then finding themselves unable to narrow the search down more precisely. To tackle this problem, the widespread adoption of descriptive standards for the content of electronic resources will improve retrieval of relevant resources on the Internet.

As a part of this process, over the last few years a number of metadata initiatives have arisen which have developed metadata schemas and specifications to describe all kind of information sources. Metadata is a broad term that covers many types of **"structured data about data"**. It can be applied to any kind of information resource, ranging from traditional resources such as library catalogues, subject indexes, book reviews and abstracts, to new forms of technical and descriptive data for Web resources including anything from digitised map co-ordinates to online mail-order catalogues. Therefore metadata is used to describe an information resource, but Metadata can serve a variety of purposes, not only helping identify a resource that meets a particular information need, but also evaluating the suitability of resources for use or tracking their characteristics over time.

In order to allow a common platform for applying metadata schemas[1] ensuring interoperability between all information resources, it is

The growth of the Internet means that more widespread use of descriptive standards for the content of electronic resources will be necessary to improve the efficiency of information searches

Metadata is a broad term that covers many types of "structured data about data". A number of global standards for metadata schemas are now beginning to appear in several areas important to get consensus among all related initiatives. This process is culminating in the emergence of world-wide standards on metadata schemas, and in the development of global specifications to be used freely by any person, company or institution. One area where metadata have been successfully agreed-upon is VET (vocational education and training).

In the field of education and training there are currently four main metadata initiative. These are being promoted by the IEEE, the Dublin core community, CEN and ISO

Metadata in the framework of VET

According to one of the Metadata Watch Reports[2] delivered by the SCHEMAS Project, there are four important metadata initiatives in the education and training domain.

The first of these initiatives is that of the IEEE LTSC LOM[3]: The IEEE (The Institute of Electrical and Electronics Engineers) LTSC (Learning Technology Standardization Committee) includes a number of working groups that deal with issues ranging from a Learning Technology Architecture to work on a Learner Model. Metadata activities are grouped together in the Learning Object Metadata group (LOM). IEEE LTSC LOM is a metadata schema with a hierarchical structure, in which data elements are grouped under categories (general, lifecycle, meta-metadata, technical, educational, rights, relation, annotation and classification). The latest version has 9 categories and a total of 47 data elements.

The CEN initiative places the emphasis on specific recommendations for EU-wide standardization. The ISO's approach is to give world-wide recognition to the metadata schemas that emerge from standardization efforts

The second initiative is DCMI[4] (Dublin Core Metadata Initiative). The Dublin Core community has been investigating metadata on VET, and as a result they have delivered the Dublin Core Metadata Set for description of educational materials. The DCMI Metadata Set is composed of 15 elements and it is more generic than the LOM Schema.

These are the two main proposals under development regarding metadata standards for VET. Both of them, the IEEE LTSC-LOM working group and the DCMI announced on 6 December 2000 their joint commitment to developing interoperable metadata for learning, education and training.

The third initiative is by CEN (European Committee for Standardization) ISSS (Information Society Standardization System) LTWS (Learning Technology Workshops). CEN/ISSS LTWS[5] focuses more on delivering specific recommendations in relation to formal standardization with an EU scope, than on generating new metadata standards. CEN/ISSS has set up a workshop on learning technologies in order to deliver concrete recommendations that include promotion of standards; taxonomies and vocabularies; profiling of LOM for specific communities; internationalization of LOM and bindings of LOM to RDF and XML. They have also promoted the translation of IEEE LTSC LOM to some other European languages such as French, German, Spanish, Italian, Greek, Dutch and Catalan.

The fourth initiative is the ISO (International Standards Organization) IEC JTC1 (Joint Technical Committee) SC36 (Sub-Committee number 36). The SC36 working group was set up under the umbrella of ISO/IEC JTC1[6]. As far as formal standardization goes, this body represents the top of the hierarchy, and its main role is to give world-wide recognition to the metadata schemas that are emerging.

These are the main metadata initiatives in the VET sector world-wide. All of the initiatives mentioned above include many specific projects, but most of them are related to the development of specifications based on the standards which are being developed by the cited initiatives.

How can metadata technology be used to promote lifelong learning?

First of all, we need to start by looking at the concept of **Lifelong Learning (LLL)**. This term describes a goal set by most developed countries, whereby all citizens would participate in learning activities over the full course of their lives - from cradle to grave - as a matter of routine. This includes structured learning ranging from initial formal education to job-related training courses provided by employers, public labour-market training schemes, and adult-education programmes. But it also includes the informal learning which takes place in all varieties of life-situations, outside educational institutions and structured learning activities, such as early childhood learning, learning-by-doing, self-motivated study and learning, learning via social interaction, learning from the mass-media, and so on. In this sense, the term **Life-Wide Learning** is sometimes used to describe the breadth and variety of formal and informal learning that takes place in each life phase, and includes an implicit message that the informal aspects be left less to chance than before.

Therefore, lifelong learning includes not only formal learning, but also informal learning. In both cases, core skills are desirable goals guiding the learning process and therefore, an effort should be made to raise awareness of the definition, categorization and development over time of related skills concepts, in order to get international accreditation, validation and recognition of not only formally obtained qualifications but also of skill levels[7].

Metadata in the framework of Core Skills

After having analysed the main metadata initiatives in the VET field, and although most of them are supposed to be aware of the new paradigms of education and training, i.e. lifelong learning as well as life-wide learning, the fact is that there is no real reflection of some of the concepts involved (e.g. those relating to skills and competencies) in the current approved versions of metadata schemas. The apparent gap in this field could be due to the fact that core skills and competencies tend often to be considered as additions to existing curricula. Although this may be entirely appropriate in initial education and training, in lifelong learning core skills may be the 'driver' for learning rather than a 'passenger' of some other learning activity.

A brief introduction to core skills related concepts could help clarify the extreme importance of including skills and competency[8] issues in the current metadata schemas and, as a consequence, in the current world-wide efforts to classify and describe information resources.

There are a lot of definitions of the term "Core Skills", because "the conceptualisation of core skills is problematic for several reasons." The first difficulty is the fact that "the term has several synonyms, including personal transferable, key, generic, common, and work or employment related skills". Another fundamental issue is the discourse about their "transferability ... making an interesting distinction between transferable and transferring skills". This being the case, for the purposes of this study we shall follow Neville Bennett's definition[9], "the term of core skills is but one of several related terms, each of which have been used to label sets of skills or attributes deemed important by employers and government. These sets contain different numbers and combinations of skills, and are based on differing purposes, definitions and interpretations".

There are many ways of classifying these skills. According to a Delphi study carried out by Prognos A.G. on behalf of the German Federal Ministry for Research and Education (BMBF) between 1996 and 1998[10] to characterise the knowledge society between 2005 to 2020, the study identified four important categories of knowledge which educational systems will have to deliver, and which could be used as an alternative classification of competencies.

Life-long learning is now a goal of most developed countries, and the aim is to involve citizens in formal and informal learning activities throughout the course of their lives

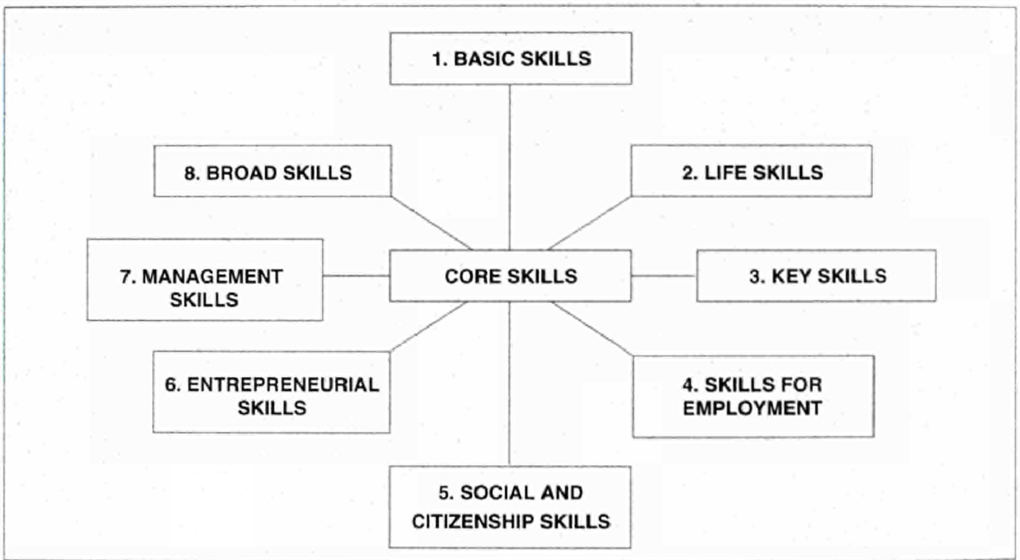
In the case of both formal and informal learning, core skills are the goals guiding the learning process. This makes it essential to define, categorize and track the development of these skills

1. Instrumental competencies, which include foreign languages and information technology skills.
2. Personal competencies, such as self-confidence, ability to handle feelings and emotional stress, knowledge-handling ability, curiosity, critical argumentation and analytic ability.
3. Social competencies, such as articulacy, team-work, sense of responsibility, solidarity.
4. General knowledge, including current affairs and everyday knowledge such as economics, religion, literature, politics or biology.

Another possible classification[11] uses descriptions of core skills developed in the last fifteen to twenty years to slot them into eight main categories: basic skills, life skills, key skills, skills for employment, social and citizenship skills, entrepreneurial skills, management skills, broad skills. Those skills go from skills for learning and developing competence to skills for looking for opportunities to start or improve businesses and, generally speaking, skills for developing effective performance across a wide range of settings at work and also in social and economic life. (See fig.1).

One categorization of core skills subdivides them into instrumental competencies, personal competencies, social competencies, and general knowledge

Figure 1. The eight-category classification of core skills



Source: Tomás de la Barra

An alternative categorization of core skills subdivides them into basic skills, life skills, key skills, skills for employment, social and citizenship skills, entrepreneurial skills, management skills, broad skills

Having given this brief introduction to the "core skills" concept and some examples of possible skills categorizations, we can move on to look at some of the reasons justifying the importance of the skills discourse for the VET framework. Some of them are listed below.

- There seems in fact to be a consensus that core skills are an essential component of a modern VET system. Not only do they enable individuals to reach their potential, but they also provide a rich seam of learning opportunities throughout education and training.

- Core skills can be used as an instrument for curriculum development in themselves, especially in education, by acting as a linking element between education and training concepts. They are one of the means by which innovative teaching and learning practices are implemented in educational institutions, leading to a greater emphasis on learning by doing.

- It is not only occupationally specific (or subject specific) skills, which are directly connected with the labour market, that are worth being considered. Core skills are primarily to do with the application of a broad set of skills, knowledge and understanding to real life situations. Whatever the balance or mix of core skills that individuals may use at any one time, they use core skills as a way of understanding their situation and acting on it.

- Core skills are the means by which influences from work and the labour market are propagated to young people. Labour market analysis can reveal the precise need for core skills, and should form one of the bases on which curricula are developed. Those responsible for making policy on core skills should be led jointly by an analysis of labour market needs and by existing good practice on integrating core skills.

Advantages of considering core skills in relation to metadata initiatives

The economic and social imperative for urgent action to promote continuous education and training is driven by the mismatch between the slow 'natural' rate of skills renewal of the (active) population, and the high rate of new knowledge and skills requirements (and therefore also of skills and knowledge obsolescence) in the work place and life in general. The former is due to the highly inertial one-off/front-end approach to education and training during youth, while the latter is driven mainly by rapid technological change.

As a consequence of the relatively short half-life of workplace skills, there is a disparity between the supply and demand for skills on the labour market. This implies that an enormous effort is constantly required to keep the workforce skills-level up-to-date. Today's changing circumstances would seem to suggest that lifelong learning is not only the new paradigm of education and training, but that it also represents the only scenario where these problems can be solved, making it a prerequisite for sustainable economic development.

As was explained earlier, skills are the "drivers" for formal and especially informal learning in the framework of LLL. In this sense, and in relation to metadata initiatives, it is true that there are some national approaches to producing taxonomies of competencies (National Vocational Qualifications, NVQs) but there seems to be little concern, if any, with trying to introduce all these important concepts into the metadata schemas which will be used to describe information resources on VET.

Moreover, the ideal goal would be to be able to specify skills with the same terminology used in the labour market in relation, for example, to the profile of the employees who are already working or for whom there is demand in the workplace. Therefore, including skills information as a part of the metadata structure could improve the process of searching for information using the terms used by the labour market.

Core skills can guide the development of new up-to-date curricula. To include skills information in metadata schemas would serve to give a tool to different targeted user groups (teachers, learners) to be able to choose learning materials (for example, a course) using as search criteria the type of skills the user group wants to acquire, and not only focusing the search on details of the learning material content. This is particularly relevant to informal learning, where skills are the "drivers" for learning activities.

Integrating the skills and competencies discourse with metadata initiatives would provide a new

The economic and social imperative for urgent action to promote continuous education and training is driven by the mismatch between the slow 'natural' rate of skills renewal and the high rate of new knowledge and skills requirements

Lifelong learning seems not only to have become the new paradigm of education and training, but also a prerequisite for sustainable economic development

Including skills information as part of the metadata structure could improve the process of searching for information using the terms used by the labour market

Resistance to PRT systems may arise from existing bodies with responsibility for public transport, and in the case of RUF the overlap between road and rail may also generate conflict between the authorities responsible for each

ULTra is likely to be able to attract passengers as it will offer an improved service at similar costs to present systems, given that the infrastructure is relatively cheap

RUF would need to convince people of the benefits of owning their own short-range battery powered vehicle for use on and off the guide-way system

The vehicle industry is a critical stakeholder given that it may view any system which could compete with traditional modes of transport as a threat However, this industry is today facing increasingly tough legislation, especially on emissions and safety, which may increase its interest in concepts which could overcome these barriers to continued growth. It must be assumed that the RUF concept is more appealing as it includes a privately owned vehicle, which is where the vehicle industry has its main expertise. In the ULTra system one must assume that fewer vehicles would be needed as the vehicles are being used extensively throughout the day by a number of different users. An issue of particular importance to the vehicle industry would be the development and acceptance of standards to secure interoperability on the rail of vehicles from different manufacturers, while providing ample room for product diversification.

The infrastructure owners and operators are, to a large extent, public organizations, though some competition with private railways can also be anticipated. These organizations have a long tradition of construction and operation of infrastructure. Additionally they have experience in the difficult fields of infrastructure planning, right-of-way acquisition, contracting complex projects in an urban environment, etc. Thus PRT systems may potentially allow them to extend their traditional role. However, road and rail infrastructure owners and operators are usually divided into two separate entities. The potential conflict between these two groups would need to be resolved. In the case of ULTra, the conflict is somewhat limited, as this concept might logically be allocated in the rail sector, but even so there may be resistance to it. The RUF concept, on the other hand, bridges the gap between road and rail and therefore might present a more difficult problem in this respect.

Public transport operators may potentially be affected considerably by PRT. In case of ULTra, the system runs automatically, leading to reduced staffing needs compared with traditional public transport operations. The ten-passenger MaxiRUF vehicle, which can make local pick-up and drop-off journeys throughout the city, would serve users without a vehicle (similar to bus operated feeder lines to train stations or shared taxies). Additionally such a service would guarantee traffic on the rails during early system implementation. Finally it would require staff to operate the vehicles as long as they are not on the rail, thus provide jobs for displaced transit workers

Passengers are critical to the success of any system, and they will only use a given system if they perceive positive benefits or if they have no other choice. In the case of ULTra, users will enjoy an improved service in the area of coverage. As investment costs are expected to be lower than for a traditional rail system, it seems fair to expect prices to be similar to normal transit prices. Thus, replacing inner city buses with ULTra is likely to be perceived as a positive change for regular transit users. Additionally the system has the potential to attract more passengers as it avoids transfers, and may provide faster transport in congested areas. Traffic calming measures or access control in inner city areas could further boost the market share obtained.

The RUF system needs to attract passengers in a slightly different way, as users, to a large extent, need to buy their own vehicle. This will only happen on a significant scale if users perceive benefits sufficient to outweigh the disadvantages.

The typical commuter wastes a considerable amount of time queuing. As the RUF user will spend most of that time on the rail (presumably not in a queue) the user will enjoy significant time savings. Additionally the time spent on the rail can be used productively, as the vehicle is under automatic control. Mobile internet access, already available, would allow the user to get a head start on the day by reading e-mail, etc. while commuting.

Keywords

metadata, ICT, employability, curriculum, vocational education and training, VET, core skills, competency, national vocational qualifications, NVQ, lifelong learning, LLL

Notes/References

1. A schema is a set of metadata elements representing the attributes of a resource. Each element will have a name and associated semantics **http://www.schemas-forum.org/related/glossary.htm**
2. Document Number: SCHEMAS-PwC-WP2-D22-Final-20000602. The Schemas Project is funded as part of the IST Programme, a theme of the EU 5th Framework Programme. Further information can be found in **http://www.schemas-forum.org/**
3. Further information on IEEE LTSC Initiative can be found at: **http://ltsc.ieee.org/**
4. Further information on the Dublin Core Metadata Initiative (DCMI) can be found at: **http://purl.org/DC/**
5. Further information on the CEN/ISSS LTWS Initiative can be found at: **http://www.cenorm.be/isss/**
6. Further information on the ISO/IEC JTC1 SC36 can be found at: **http://jtc1sc36.org/**
7. The IPTS Futures Project Report Series N. 14: "Knowledge and Learning: Towards a Learning Europe".
8. For the purposes of this study, the terms skills and competencies will be considered to be equivalent.
9. Bennett N., Dunne E., Carré C., (1999), "Patterns of Core and Generic Skill Provision in Higher Education", Higher Education 37.
10. Source: BMBF Prospect 3/98.
11. Taken from Report on "Development of Core Skills Training in the Partner Countries", June 1998, European Training Foundation (ETF). For further information on the skills commonly listed in each of the eight categories, please download the original document in: **http://www.etf.eu.int/etfweb.nsf/pages/downloadtheme1**
12. In particular, the author would welcome any comments about this proposal and try to give further information on this field, which is the subject of the Ph.D. thesis on which she is working while at the IPTS.

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Internalizing Transport Externalities

Panayotis Christidis, Peder Jensen and Laura Lonza Ricci, *IPTS*

Issue: The true cost of transport externalities and the extent to which they can in practice be internalized is still an open research question. Although a lot of progress has been made on the technologies that would enable the introduction of efficient transport pricing systems, the development of suitable pricing frameworks is still lagging behind.

Relevance: Striking a balance between the environmental impacts of transport, economic growth and social equity is a matter of political decision-making as well as scientific analysis and requires that the trade-offs associated with the introduction of fuel taxes or road-pricing measures be taken into account.

Research tends to suggest that the external impacts of transport (environmental and health impacts in particular) are not adequately represented in the current package of fiscal measures

Most research results suggest that the external impacts of transport (environmental and health impacts in particular) are not adequately represented in the current package of fiscal measures levied on transport. It is also becoming more obvious that the internalization of external costs is a necessary measure in order to minimize transport externalities. According to the 'polluter pays' principle, the price that the user pays should reflect the full cost of transport activities, including the costs of transport externalities. Nonetheless, there are no conclusive research results leading to an indication of what a "fair" pricing level for transport and fuels might be. Indeed, no unique 'fair' price exists: results differ depending on the assumptions on which they rely and the contexts they refer to regarding data availability, identification of cause and effect relationships, etc.

The calculation of the total costs of, for instance, global warming from CO_2, health problems from ultra-fine particles, depletion of natural resources, delays due to congestion, or fatalities in accidents, depends on the values placed by society on a large number of attributes such as safety, air quality, etc. Moreover, the perceived value of these resources depends on the socio-economic context, and ethical and political priorities. In addition, even if a generally accepted value of the costs of transport externalities could be calculated, attributing the proper share to each type of transport activity in every geographical, temporal or socio-economic context would be difficult (since it goes beyond simply calculating usage shares of each transport mode and involves considerations such as peak vs. off-peak and urban vs. non-urban usage).

Transport is an important means of satisfying economic and social needs and therefore any measures that could lead to an increase in the cost for users tend to meet with strong resistance. What complicates the matter further is the need for transport policies to minimize environmental impacts without undermining growth. De-coupling growth from environmental impacts is a main policy priority, but enabling policy-makers to pursue this goal pro-actively is far from easy (Christidis, September 2000). Social equity is also an issue that needs to be analysed carefully. Increased transport costs are expected to reduce the mobility of people on lower incomes. Fuel taxes tend to be regressive, i.e. they constitute a larger proportion of income for the lower income levels of the population than they do for the higher levels. Road-pricing and vehicle taxes, whether one-off or annual, also have impacts on car ownership, fleet characteristics and transport intensity that may differ according to the user's income level. (Note that this applies to private as well as public transport, as price elasticities regarding public transport may be higher for low income groups). Hence, there is a need to understand better the socio-economic and environmental impacts of variations in transport costs.

The issue of internalizing the external costs of transport and agreeing on the extent to which they are actually internalized is a matter for political decision-makers. There are trade-offs that have to be considered in both the short- and the long-term when identifying the 'fair' price for transport. In the short-term, political decisions have to find a balance between attempting to improve environmental conditions and the pressure that the new measures will put on economic activity and equity. In the long term, the issue of inter-generational sustainability is also important. The extent to which externalities are internalized today will affect the resources and the quality of life of future generations. If the price that we pay today for the depletion of natural resources or for global warming is low, future generations will have to tolerate a lower quality of life or will be burdened with higher abatement costs.

Fiscal measures

The mitigation of the negative impacts of transport requires a combination of technological, legislative, fiscal, planning and other transport demand management measures. Each approach has its own potential benefits, implementation costs, side effects and time horizon; consequently, a different policy mix is suitable for each specific case, depending on the local environmental, and economic and social characteristics.

Fiscal measures directly affect users' choices and travel behaviour. Transport users will select more efficient alternatives (generally speaking) if they have to pay the full cost of their mobility patterns. Not obliging users to pay the full cost of the negative impacts they cause is, from an economic point of view, tantamount to sustaining an inefficient market. As demonstrated by the results of the European Commission's AUTOOIL 1 & 2 programmes, fiscal measures tend to increase the success and lower the costs of technical measures.

The range of fiscal measures applicable to transport policy include toll schemes for certain infrastructure (e.g. motorways) or areas (e.g. parking fees and urban road- pricing) but have a limited scope of application, and are mainly used as measures to reduce congestion. Fuel taxes serve transport policies by affecting the overall level of transport and they are very important revenue generators. The same holds true for one-off purchase taxes and annual flat-rate fees, which are mainly aimed at raising revenue from the transport sector and are only partially related to the externalities generated by it.

Across the EU there is a lack of a common approach to pricing the road transport system. The policies of individual Member States in relation to tolls, one-off and annual vehicle taxes and fuel taxes vary significantly according to individual states' preferences and priorities. In most cases the

Even if a generally accepted value of the costs of transport externalities could be calculated, attributing the proper share to each type of transport activity in every geographical, temporal or socio-economic context would be difficult

Inter-generational sustainability is an important issue. The extent to which externalities are internalized today will affect the resources and the quality of life of future generations

Fiscal measures directly affect users' choices and travel behaviour and can make the market reflect full costs more effectively income from such tolls and taxes is used to cover budget deficits or to finance the construction or maintenance of road infrastructure. Environmental taxes do not exist as such in most cases, although part of overall taxation on transport is meant to serve such purposes as well (e.g. part of tax on fuel). The main problem with most vehicle and fuel taxes is that they treat all types of usage in the same way; e.g. they burden rural and urban, peak and off-peak transport activities in a similar way. This raises distributive issues whose resolution depends on the underlying political context.

There is no EU-wide approach to transport pricing, with the situation in Member States varying g reatly according to their preferences and priorities

It is widely accepted that the mitigation of transport-related negative impacts entails the adoption of policy mixes that include fiscal measures as the main instruments with which to implement fair and efficient pricing. However, a pricing framework should be flexible enough to consider the context of the specific transport activities. For example, such a framework should be able to differentiate between a user of an un-congested rural road from one of a congested urban street during the rush hour. Pricing frameworks should also take into account the existence of alternatives for the users. Applying new or higher user charges should not result in parts of society or the economy being deprived of an acceptable level of mobility. In any case, it is certain that the marginal costs of transport will grow even more rapidly than its marginal benefits when the system gets close to its saturation level. Indeed, the distribution of negative externalities in the transport network includes impacts (e.g. the cost of traffic accidents) that are unrelated to energy consumption, and so cannot be covered adequately by simply imposing a fuel tax.

Internalizing the external costs of transport would not aim to increase the cost of transport for all users. Its goal should be to get users to pay for their fair share (often higher, but occasionally lower)

The internalization of the external costs of transport would not aim to increase the cost of transport for all users. Its goal should be to get users to pay for their fair share (often higher but occasionally lower, e.g. the case of zero-emission vehicles, off-peak transport). A new road-pricing framework, in the form of general taxes (e.g. vehicle or fuel taxes), use charges (e.g. tolls and road-pricing) or their combination, would mainly affect the structure of charges on road transport. The charges for polluting transport activities (e.g. in congested urban areas) would be raised, while the charges for transport activities that today have to pay a price that exceeds the level necessary to cover their external impacts could be lowered. An efficient pricing structure would therefore rationalize both the charges transport activities are burdened with and the transport choices that users make.

The revenues raised via the various fiscal measures affecting transport could be used to enhance further the success of transport policies. In theory, the fact that users will have to pay for the cost of their actions should make these actions reflect priorities more accurately. The way government authorities allocate the extra revenue generated (e.g. to cover budget deficits, to construct new infrastructure or to repair environmental damage) is not in principle relevant to the measures themselves. However, the acceptability and the success of fiscal measures could be enhanced if this revenue is primarily used in order to provide alternatives that would ensure an acceptable level of mobility for all users (e.g. public transport). From a long-term perspective, these funds may be used to stimulate research and development of new technologies that could provide more environmentally friendly solutions (e.g. zero-emission vehicles) which might otherwise be under-funded by private finance, given the high costs, uncertainty and the fact that the benefits accruing to society far outweigh those for the individual investor (and cannot easily be captured by the latter).

Road-pricing

The use of road pricing as a means of financing infrastructure has been with us for many years.

Road pricing as a demand management tool on the other hand is relatively new. Thus there is relatively little experience with the use of road pricing as a tool to control traffic levels.

In the communications from the Commission on fair and efficient pricing in transport, road pricing is presented as a solution to significant problems in the transport sector. By charging the appropriate price we can obtain the appropriate traffic level. For example, pricing can be used to reduce congestion, since higher prices will reduce demand and balance it with limited available supply (in the short term at least) of transport infrastructure. The Commission's position on a suitable pricing framework, work programme and graduated implementation for pricing reform is outlined in the 1998 White Paper "Fair Payment for Infrastructure Use".

However, the application of these principles in practice is not simple, primarily due to the problems of determining the full cost of environmental and safety impacts, etc. Additionally, the question of equity emerges immediately when economic measures are suggested as a means of regulating consumption. More importantly, a major obstacle to the application of road-pricing measures is the user reaction, especially in the case of urban road pricing. User awareness of the reasons, the objectives and the benefits of road pricing needs to be raised in order for the public to accept it.

Thus road pricing will, if implemented on a large scale, be partly based on economic analysis, partly on political reality. The need for further research on the political implications of road pricing should therefore be considered a priority.

Pricing is currently being studied by a number of European projects and networks (A1, AFFORD, CAPRI, CONCERT-P, CUPID, FISCUS, LEDA, PATS, PETS, PROGRESS, TRENEN, UNITE, etc.) but all projects cover limited angles of the whole picture leaving a number of policy questions still to be discussed.

Success factors for fair and efficient pricing in transport

A fair pricing framework for transport would be beneficial for society as a whole. However, given the trade-offs involved, four principles should be followed in order to ensure that the measures lead in the right direction:

1. Broad consensus across all stakeholder groups should be sought before the implementation of new measures. Users, local authorities, governments, industries, environmentalists and all other actors involved should work towards a consensus on what the costs and benefits are. In this context, agreement on the estimates of the real cost of transport and fuels is required. It is also necessary for the actors to agree on the parameters to be included and, possibly, the range of levels within which they can oscillate.

2. The extra revenues generated by internalizing transport externalities should be used, insofar as is possible, to help reduce the negative externalities of transport, e.g. alternative transport modes or research into less polluting/ more fuel-efficient technologies. Although the use of tax revenue may not alter demand for transport services, the long-term impacts on the environment would be better. Moreover, the public's acceptance of the measures could be increased in this way, since the link between the pricing measures and the improvement of transport or environmental conditions would be more apparent.

3. The provision of economically attractive and equitable baseline transport alternatives for all users is essential. Since equity issues can prove

The acceptability and the success of fiscal measures could be enhanced if this income is primarily used in order to provide alternatives that would ensure an acceptable level of mobility for all users

User awareness of the reasons, the objectives and the benefits of road pricing needs to be raised in order for the public to accept it

The success of pricing mechanisms will depend on consensus between all stakeholders, use of revenues raised to tackle the impacts that justify these pricing mechanisms, and the provision of economically attractive and equitable transport alternatives

West Midlands) started a two-year foresight exercise in late 1999. The exercise aims to support regional industrial competitiveness through the use of foresight, the exchange of best practice, and the utilization of a sound strategy for research, technology development and innovation. The exercise is tailored mainly for SMEs. It is designed as a mini-foresight exercise emulating the sector panel and steering group approach of the national foresight.

North-East England (UK): Foresight North East is a programme which was set up in 1996 and run since 1998 by RTC North. While serving as a contact point for national foresight, the programme has run several successful regional foresight activities using a variety of methods. Scenario workshops have proved very popular, both in relation to the offshore sector and vocational education. Opportunity mapping has occurred in Energy and Environment sectors. High tech seminars have been organized in IT, communications, chemical sensors, nanotechnology and other specialist areas. The choice of method is generally a matter for the committee or panel concerned.

The Basque region (Spain): Foresight activities linked to the Science and Technology Plan for the Basque Country promoted by the Basque Government are carried out periodically. The Plan is organized around eight industrial clusters (Aeronautics, Automotive, Energy, Environment, Telecommunications, Electrical appliances, Knowledge & Machine tools). The clusters are responsible for analysing future trends in technology, with the aim of feeding into three types of S&T support programmes. In addition, a Technology Analysis Working Group analyses future trends in order to detect the main technological trends that will exert influence on the region, and these inform the core of the plan.

The OECD's Territorial Development Service has recently begun an exploratory activity on regional foresight and prospective studies[4]. In February 2000, the European Commission's STRATA action under the fifth EU RTD Framework Programme, launched a two-year long network project (FOREN[5] - Foresight for Regional Development - see box 3 for more details) to explore ways of integrating foresight processes into regional development policy activities, and ultimately to deliver a "rough guide" to regional foresight[6].

Box 3. FOREN - Foresight for Regional Development

FOREN was set up as a network project under the STRATA action of the Fifth EC RTD Framework Programme, to run from February 2000 to January 2001. The objective of FOREN is to promote the integration of foresight processes into regional development policy and strategic planning. It aims to produce a regional foresight user guide for policy-makers and potential foresight promoters from a wide range of regional contexts. The work undertaken involves an analysis of different region types and of the associated mix of issues and priorities for each type, combined with a testing of the potential of foresight methods to help achieve more effective and future-proof regional development policies and strategies.

FOREN is composed of two types of experts - foresight practitioners and regional development policy-makers from universities, research centres and other foresight centres of excellence, as well as regional development agencies, regional and local authorities.

The Network consists of four coordinating partners and 22 paired network members:

Core Partners:

- CM International CMI Paris, France
- Institute for Prospective Technological Studies IPTS Seville, Spain
- PREST University of Manchester, United Kingdom
- Sviluppo Italia SI Rome, Italy

Paired Members:

- Instituto de Desarollo Regional + Parque Tecnológico de Andalucia (E)

Keywords

Transport, pricing, externalities, policy implications

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Earth Observation as a tool for Improving Climate Quality in Cities

Giulia Abbate, *ENEA*

Issue: Any land-cover change, even where it affects only small areas, has immediate consequences for the quality of the climate and air, and consequently on the well-being of the population, particularly in densely populated urban areas. Policy decisions regarding land-cover could promote integrated solutions for many problems, including climate change at local level, air quality, energy efficiency and transport planning. Earth observation techniques can provide support for decisions in this area.

Relevance: Many city planners and managers already recognize that future planning strategies and building methods will have to integrate climate knowledge, for a variety of reasons, including the health and well-being of population and judicious use of natural and human resources. Specific climatic standards and criteria – based on detailed scientific understanding of the phenomena – will have to be worked out. These may be applied, for instance, in multi-annual urban development plans and district regeneration projects.

When considering setting up measures for the sustainable development of our cities, climate has to be regarded as a high-value natural resource. It has a clear effect on human health and comfort, while at the same time being affected by human activities

Integrating climate knowledge into sound urban planning and management

About two thirds of the world's current population lives in urban areas and the trend towards the increasing concentration of people and human activities in towns and cities still continues apace. In Europe there are 365 cities of more than 100,000 inhabitants and about 80% of Europeans live in agglomerations of more than 10,000 people. Their large populations, heavy industries, intensive energy use, demand for scarce freshwater and land, make urban and peri-urban areas among the most vulnerable on the planet (WMO, 1997). Yet cities continue to attract more and more people. They are perceived as offering more opportunities, not just in terms of survival but also of satisfaction and fulfilment.

It is thus clear that the real wealth of urban areas is their people, with their enormous patrimony of personal and collective progress obtained through the effort, work and creativity of generations. The people's wellbeing therefore has to be regarded as a resource, and improving it has to be accepted as a challenge for the future.

When considering setting up measures for the sustainable development of our cities, climate has to be regarded as a high-value natural resource (Bitan, 1992). Its influence on health and most human activities is more than evident, while the influence of human activities on climate begins on a local level and extends to larger and larger scales. In order to alleviate the impact of human activity on the environment before experiencing some unforeseen non-linearity in the climate system, remedial action will have to be considered in the processes that surround our everyday life.

Weather conditions are a matter of considerable interest to the public. Day-to-day experience builds-up to a personal perception of climate, accompanied by feelings of comfort or discomfort. Daily weather forecasts on TV and in the newspapers have made us familiar with some concepts of meteorological science and with images from weather satellites.

As a result, there is considerable public awareness of meteorology and climatology and an in-depth scientific knowledge and technical experience available –even if mostly acquired working at a different scale– for future work to improve the quality of life in urban areas starting out from weather and climate aspects.

The influence of urban areas on atmospheric phenomena

Through drastic modifications to the natural land-cover, urban activities impose localized changes on the Earth's energy budget, which lead to complex atmospheric phenomena. Cities act as sources of heat and pollution. A large part of their area comprises dry, waterproof surfaces which store incoming radiation and convert it to sensible heat more readily than natural areas (Oke, 1982; Goldreich, 1985). Thus, the atmospheric surface layer in cities is generally warmer than in the surrounding countryside. This effect is exacerbated by heat losses from buildings, air-conditioning systems, direct releases of heat to the atmosphere and the like. A wide variety of associated phenomena have been observed, including modifications in synoptic (i.e. generalized conditions in a region) and local air circulation patterns, abundance and distribution of rainfall within and around cities, frequency of thunderstorms, etc. (Stull, 1991).

A very large set of variables and effects interact to lead to highly specific climates at the level of each town or district, or even at that of smaller areas. Scales of phenomena range from modifications of synoptic weather conditions due to the presence of a city (a heat and roughness island) to local variations due to a single building, tree, road, etc. (Abbate, 1997). A full analytical description of the phenomena involved in the city-climate interaction reveals itself to be very complex.

The simplified cause-effect diagram shown in Fig. 1, based on Hertig gives and insight into the complexity of the interactions and may suggest proper counteracting actions to planners and managers (Hertig, 1995).

From the main causes of climate change in urban areas (left column), to changes in physical parameters, processes and budgets (second and third columns), the diagram reaches the main meteorological phenomena observed in urban areas (fourth column).

The economic costs of these effects can be high. For instance, McPherson (1992) reports that in U.S. cities about 3–8% of demand for electricity to run cooling systems is used just to compensate for heat island effects with an increase of about 3-4% for every increase of 1°C in ambient temperature (McPherson, 1992). Apart from being inefficient, this is also socially divisive in a situation where not everyone can afford the cost of air conditioning.

Phenomena like urban heat islands, city-induced airflows, local airflows in complex terrain (i.e. various patterns of buildings, trees,

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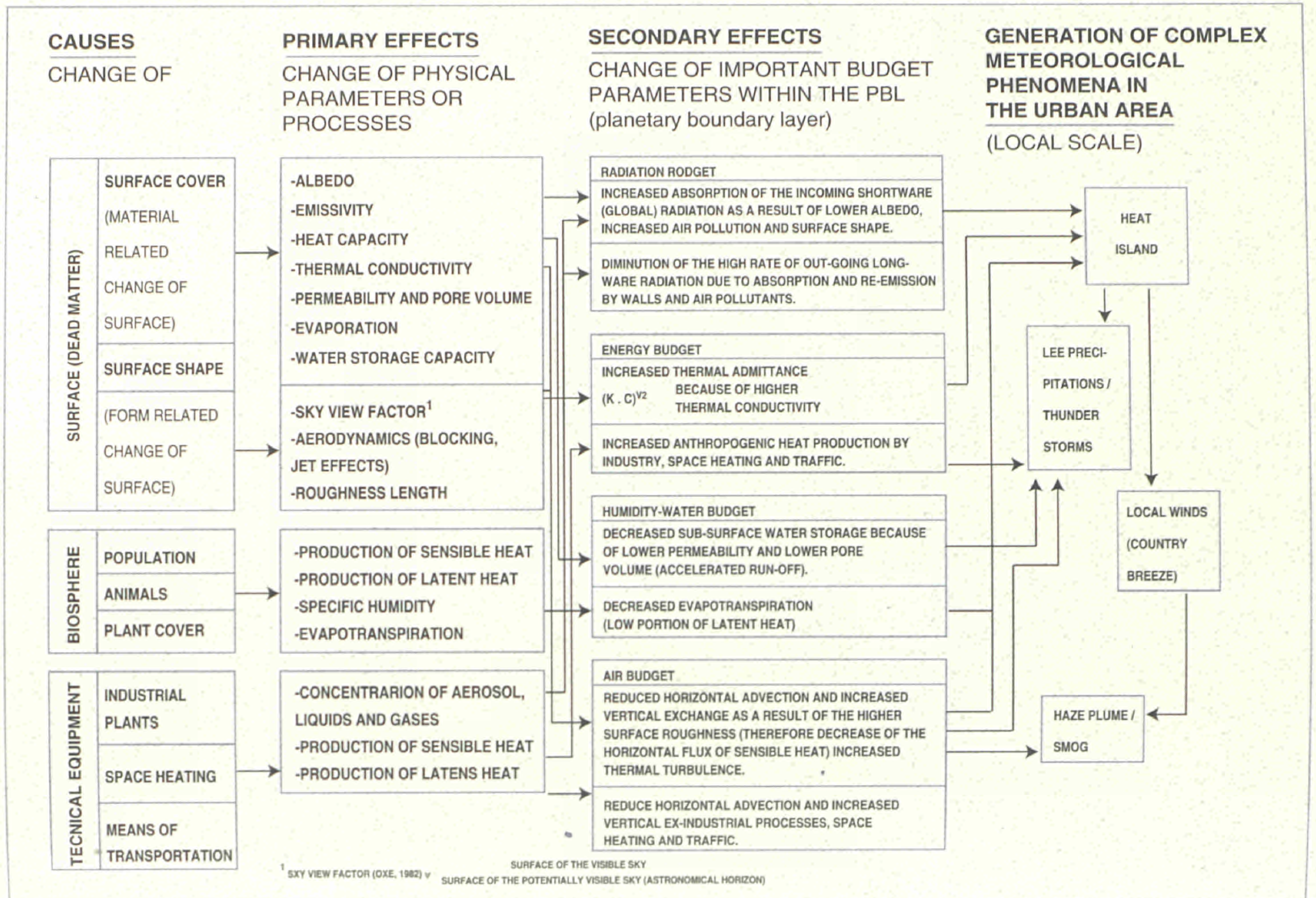
Phenomena like urban heat islands, city-induced airflows, local airflows in complex terrain (i.e. various patterns of buildings, trees, roads, etc.), the influence of synoptic winds on boundary layer airflows, etc. have to be fully understood for each specific urban area



Source: Hertig, 1995.

Figure 1. Causes and effects in local climate patterns

roads, etc.), the influence of synoptic winds on boundary layer airflows, etc. have to be fully understood for each specific urban area.

It has been observed that there are big differences in climatic parameters (i.e. temperature, solar radiation, relative humidity and wind) and pollutant concentrations can occur short distances from one another within the same city (Abbate, 1997, 1998, 1999; Parlow, 1997; Wald, 1999). High air pollution rates may be reached even in the presence of little traffic as a result of air stagnation. The relationship between photochemical pollutants and microclimatic parameters (and thus land-cover) needs to be investigated in depth, as land-cover and climatic parameters not only influence dispersion and deposition but also the formation of smog.

This means, for instance, that reducing air pollution in a city could be achieved by painting dark roofs white, as well as by switching to electric vehicles, and at much lower cost. Of course, the ideal approach would be to do as much as possible of both (Bitan, 1992; Abbate, 1999).

The central role of data and information for sustainable planning and management of urban areas

Rather than continuing to disregard the laws of nature and/or overexploit natural resources, we can regain harmony with natural cycles and phenomena by integrating knowledge into "considerate" planning and management (Hailey, 1998).

Central to any attempt to realize this is an innovative information system design (Citiesnet, 1998).

New technologies - like GIS (Geographic Information Systems), Earth Observation (EO), GPS (Global Positioning System) and the Internet, together with enormous advances in computer technologies in terms of their ability to store, manipulate and access data and information – have widened the limits of our possibilities much more than we could have hoped for just a decade ago (Nichol, 1994).

But we must be careful not to lose our way. Working to "adapt" present information systems to new technologies will perhaps leads to a more efficient use of existing data, but we risk making technology our goal rather than our tool. While using computers as "toys" we may forget the importance of the problems to be solved.

To be really helpful in supporting the right decisions, data and information have to be collected specifically for the purpose for which they are intended (Lavalle, 1999). The data set has to be accurate, objective, reliable, comprehensive, and always up-to-date. Of equal importance is that the data set is seen to be such and that the collection method is transparent, as quality of life is a collective interest.

Special parameters can be monitored to assess whether decisions and measures taken are leading towards the target. Uniform and consistent data should be acquired at regular time intervals. Time intervals between measurements have to be correctly related to the temporal scales of the natural cycles and phenomena under study.

This system-approach and fine-tuning method applied to an urban area - and to the microclimatic conditions in it - may well improve the present situation. The structure and user-interfaces offered by information systems should facilitate this type of approach.

Earth observation as a source of climate-related data to support sustainability

Earth observation can provide detailed climate-related data and information to support decisions aimed at achieving resource sustaina-

The way in which microclimatic parameters affect photochemical smog mean, for instance, that painting dark roofs white could reduce air pollution by lowering air temperatures

To be really helpful in supporting the right decisions, data and information have to be collected specifically for the purpose for which they are intended. The data set has to be accurate, objective, reliable, comprehensive, and always up-to-date

In some regions, more traditional regional planning activities which do not contain some of the key foresight elements have been repackaged under the "foresight" label. In other instances, foresight is perceived to be of little value in that it is associated with rather distant and abstract considerations of relevance only to national and global concerns. So in making the case for regional foresight the challenge is to demonstrate how it complements rather than displaces established planning processes, adding new dimensions and value, enhancing what regional based actors already do, providing ways and means for broadening their horizons, as well as the legitimacy and effectiveness of regionally-based strategies.

Conclusion

Given the rising importance both of regions as a reference level for business and socio-economic development and of regional politics in Europe, the situation is ripe for a deployment of regional foresight. However, if it is to be encouraged and facilitated by EU-level policies and instruments[13], clear ideas of what regional foresight entails, how it can be implemented and what added value it can bring, need to be developed and disseminated. The recently adopted guidelines for innovative actions to be funded by the European Regional Development Fund in 2000-2006 (EC, 2000a) with a budget of 400 M. places an emphasis on *"experimental tools in future-oriented fields"* and opens the door to proposals from 154 European regions. Similarly, the European Commission's proposals for the next RTD Framework Programme (EC, 2000b) contain a strong foresight emphasis. However, the success of these instruments in bringing foresight to bear on sustainable regional development also strongly depends on a well articulated bottom up recognition of the need and opportunity on the part of regional actors. The appearance of some spontaneous regional foresight initiatives is promising but needs to be carefully examined in order to distinguish good practices and the regional specificities, and the results widely disseminated and debated.

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Keywords
Foresight, regional development, regional typology, forward planning

Notes

1. In this paper we use the term "region" in a loose way to accommodate the many meanings which can be given to the term in different parts of Europe - large political autonomies, city regions, counties, historical regions, etc. However, we recognise that policy initiatives have to be taken with respect to clearly defined jurisdictions or in co-operation between different regional authorities.
2. For example, foresight can be a powerful instrument to enable, inform, and give direction to technology coordination (e.g. in user-supplier networks), which is in increasing demand at regional levels and between regional and higher territorial levels.
3. See the forthcoming September 2001 issue of the journal Foresight.
4. Ian Miles, PREST - private communication, April, 2001.
5. **http://foren.jrc.es**
6. Two relevant publications to signal in this regard include The Futures Toolkit, published by the UK's Local Government Association (**http://www.lga.gov.uk/lga/toolkit/index.htm**); and a guide (in French)

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Adoption of Knowledge Management in Europe: the Challenge for Research & Technological Development

Marcelino Cabrera, *IPTS*

Issue: In many respects Europe seems to be leading the Knowledge Management field. Although Europeans may be likely to work in collaboration both internally and externally in the private sector, the same does not necessarily apply for Research & Technological Development organizations.

Relevance: Knowledge is the natural asset in RTD organizations. The current process of defining the European Research Area (ERA) has created an opportunity to develop and adopt KM in European Research across networks of excellence so as to exploit synergies in research efforts. However there remain some difficult barriers to knowledge sharing that need to be overcome.

The networking of existing centres of excellence in Europe and the creation of virtual centres through the use of new interactive communication tools will be one of the main aspects of the European Research Area

Introduction

It is widely assumed that we have entered a knowledge-based society where economic and social development will depend essentially on various forms of knowledge and on the creation, acquisition, use and re-use of knowledge.

Knowledge Management (KM) is a strategic discipline for organizations in the knowledge-based economy. The application of its methods and techniques has proven successful in an increasing number of firms in European Industry.

According to a number of reports there is an outstandingly high level of KM adoption in European Industry. Europe is reported to lead the world in the use of KM in business (KMPG, 2000).

The challenge is now how to use KM efficiently in the Research context, and more particularly in the synergistic constellation of the European networks of excellence[1] aimed at within the ERA framework.

The European Union is engaged in the process of defining the European Research Area (ERA)[2], with a view to strengthening the common European Research policy, concomitant with the enlargement process. The networking of existing centres of excellence in Europe and the creation of virtual centres through the use of new interactive communication tools will be one of the main aspects of ERA[3]. By fostering a common policy the full potential may be obtained from the opportunity of exploiting synergies in Research efforts.

likely to put even greater pressure on governments to demonstrate that their decisions take scientific advice fully into account.

Directly relevant in this respect is therefore the issue of **good scientific practice**. Each scientific discipline has its own specific characteristics, and traditions and practices vary between institutions and countries. Drawing clear lines between misconduct in research and scientific fraud is not always simple, but it is up to the scientific community to draw up proper codes of conduct and rules of procedure to prevent malpractice. In all disciplines, good scientific practice must be based on conscientious and accurate performance of research and presentation of results, appropriate acknowledgement of previous work and achievements of others, including accurate and adequate documentation of data. The responsibility for the prevention of misconduct and fraud in science primarily falls to researchers themselves and it is the duty of directors of research groups and research institutions to ensure that the rules and codes of practice are followed.

Scientific Evaluation: a matter of trust

The scientific research enterprise, like many other human activities, is built on a foundation of trust. Scientists trust that the results reported by others are valid. Society trusts that the results of research reflect an honest attempt by scientists to describe the world accurately and without bias. The level of trust that has characterized science and its relationship with society has contributed to a period of unparalleled scientific productivity. But this trust will endure only if the scientific community devotes itself to exemplifying and transmitting the values associated with ethical scientific conduct. In the past, young scientists learned the ethics of research largely through informal means—by working with senior scientists and watching how they dealt with ethical questions. That tradition is still vitally important. But science has become so complex and so closely intertwined with society's needs that a more formal introduction to research ethics and the **responsibilities** that these commitments imply is also needed[1].

Scientific Evaluation: a matter of responsibility

The scope of technical and scientific progress raises questions as to what responsibility must be taken by science and society whenever new options for intervening in human life and nature present themselves. The crucial question is: what responsibility must be taken for the protection of the environment, the protection of human dignity and the safeguarding of fundamental liberties and rights as they are laid down in our countries' constitutions and the conventions of the European Council?

It is commonly assumed that, when based upon the best available scientific evidence, safety standards are universalizable. However, the recent debate on genetic issues casts doubt on this assumption - ethical norms are even less susceptible of generalization. It is suggested that different conceptions of life, death, health, nature, freedom and public welfare are connected to or based on values; It is further suggested that we are confronted with a plurality of different and changing values; What concept of value are we dealing with? What constitutes its inherent ambiguity? What distinction is to be made between values and their interpretation? The basic presupposition seems to be that the existence of pluralism and of differences in this domain (the moral domain, the domain of values) poses a problem; therefore it is asked whether this plurality should be balanced by universal values or **norms**, i.e. by a common ethical approach. The central concept in these presuppositions is the concept of "plurality" and "diversity", a concept that is directly related to the on-going process of the integration and unification of Europe.

Misconduct in science, improper use of science advice and a lack of transparent procedures for reaching government decisions can cost both government and society dearly. The involvement of the courts in cases based on scientific issues is putting greater pressure on governments to demonstrate they take scientific advice fully into account

Trust will endure only if the scientific community devotes itself to exemplifying and transmitting the values associated with ethical scientific conduct. More formal approaches to inculcating these values are needed today than were necessary in the past

It is commonly assumed that, when based upon the best available scientific evidence, safety standards are universalizable. However, the recent debate on genetic issues casts doubt on this assumption

Various international guidelines and principles on scientific advice in government decision-making have been developed. These principles are receiving increasing acceptance and are being adopted in countries such as the U.K., the U.S. and New Zealand

Scientific Evaluation: a matter for norms, standards or principles?

Advances in science and technology over the past few decades have given rise to unprecedented ethical questions. To address these questions, the issue of a legal framework for scientific practices has arisen, but is as yet unresolved. How should the EU establish guidelines for the sciences without impairing the freedom of scientific creation, which is itself recognized as being akin to a constitutional right?

The approach taken by the European Union seeks to be essentially concrete and operational. Although the European Community does not have any direct legislative authority in matters of ethics, it develops directives and regulations for activities in many fields as a means of defining the (ethical) values and rules that must be respected in this field. The governments of the EU have to tackle issues that are increasingly complex and require decisions that have both widespread and profound impacts. Many of these decisions involve risk assessments that arouse public concern. Recent examples in France and Japan indicate a tremendous loss of public confidence over the safety and management of their public blood supplies (as a result of HIV contamination); Scotland and Japan have faced public concern regarding the ability of their expert advisory systems to deal with the E. coli bacteria; and, the U.K. has grappled with the economic and public confidence fall-out resulting from its handling of BSE (Mad Cow Disease). This gives rise to the following immediate questions: Is it possible to define fundamental ethical principles common to Europe while at the same time respecting the cultural diversity and national identities of the countries which make up the European Union? How does one choose between a total ban and a demand for a better or alternative technology? How is "precaution" to be managed in the most reasonable manner? How can science fix a scale with which to assess different levels of risk? Is it possible **to standardize the use of science and develop a coherent, consistent and robust set of guidelines or procedures?**

Various international guidelines and principles on scientific advice in government decision-making have been developed. These principles are receiving increasing acceptance and are being adopted in countries such as the U.K., the U.S. and New Zealand. In many instances, expert panels and advisory bodies provide the means of securing scientific advice and bringing it to bear on issues and problems of public concern.

Within the European Community the distinctive science decision making systems that have evolved at national level remain. The pressures to generate guidelines for the use of science within the Community are no different from those elsewhere. They are designed to protect decision makers and the public alike. Their degree of success will be seen in the courts and this will put increasing pressure on all nations to evaluate the quality of their science for decision making against legal standards.

The pressure for such standards or guidelines is acknowledged to come from the demands of the public for decision makers to accommodate their perceptions and fears and adopt preventive measures to eliminate risk or limit it to a manageable level. In particular, they address the need for decisions which must be taken before all the necessary scientific data are available, and which therefore often adopt an approach based on the "precautionary principle".

Scientific Evaluation: a matter for the European Union

The European Commission understands the dialogue between science and ethics as a part of future European S&T policy issues. In June 1999 the European Commission ran a conference entitled

"Ethics and Science – The Social, Juridical and Philosophical Debate". The objective of this conference was to highlight the philosophical, social, legal, economic, cultural and political aspects of the ethical questions relating to science and technology in Europe. Prior to this Conference, in a Council Resolution of 13 April 1999, the Commission was asked to develop clear and effective guidelines for the application of this principle, which is to be invoked when the potentially dangerous effects of a phenomenon, product or process have been identified by scientific and objective evaluation, and this evaluation does not allow the risk to be determined with sufficient certainty.

According to this interpretation of the precautionary principle[2], scientific/ethical evaluation of R&D should not conflict with the requirement for scientifically based decisions. It should cover uncertainties, the lack of data and knowledge, and it should offer protection of man and the environment within the framework of sustainable development.

With these guidelines, the European Commission attempts to cover cases where scientific evidence is insufficient, inconclusive or uncertain and preliminary scientific evaluation indicates that there are reasonable grounds for concern that the potentially dangerous effects may be inconsistent with the high level of protection opted for by the EU.

The guidelines established in the aforementioned communication will provide a useful tool in the future for taking political decisions in this regard and will contribute to legitimate decisions taken when science is unable to assess fully the risk rather than allow such decisions to be based on irrational fears or perceptions. Thus, one of the objectives of the Communication is to clearly describe the situations in which the precautionary principle could be applied and to determine the scope of measures taken in this respect. It will therefore help ensure the proper functioning of the Internal Market as well as a high level of protection and predictability for consumers and economic operators located in the EU and elsewhere.

Conclusion

Scientific and technological advice are key knowledge inputs for credible and effective policy and regulatory decisions in many areas. EU policy makers are constantly asked to examine a range of questions. A number of recent events have undermined the confidence of public opinion and consumers because decisions or their absence were not supported by full scientific evidence and the legitimacy of such decisions was questionable.

It is the Commission's policy to take decisions aiming to achieve a high level of protection on a sound and adequate scientific basis. Potential measures must be based on an examination of the potential benefits and costs of action or inaction and subject to review in the light of new scientific data. They should thus be maintained as long as the scientific data remain incomplete, imprecise or inconclusive and as long as the risk is considered too high to be imposed on society. Finally, they may assign responsibility or the burden of proof for producing the scientific evidence necessary for a comprehensive risk assessment.

However, this issue of how and when to use the precautionary principle, both within the European Union and internationally, has given rise to much debate, and to mixed, and sometimes contradictory views. Where there are reasonable grounds for concern that there is a lack of detailed scientific evaluation, the precautionary principle should be applied, starting with a scientific evaluation that is as complete as possible, so as to identify the degree of scientific uncertainty at each stage, where possible. Decision-makers, however, need to be aware of the degree of

Scientific/ethical evaluation of R&D should not conflict with the requirement for scientifically based decisions. It should cover uncertainties, incomplete knowledge and offer protection for man and the environment uncertainty attached to the results of the evaluation of the available scientific information.

The precautionary principle should provide a basis for action when science is unable to give a clear answer. But even though it should be neither a politicization of science, nor the acceptance of a zero-risk criterion, the judgement of what is an "acceptable" level of risk for society is an eminently political responsibility rather than a matter for scientific assessment.

In view of this, the political arena is given the task of promoting science and research, while scientists and researchers are given the task of helping to find solutions for societal problems. They must therefore bolster structures within the scientific system which enable them to identify what kinds of responsibility science will have to take upon itself and help them deal with these responsibilities. It may therefore become important to broaden the scope of the debate on the application of the precautionary principle towards best practice in a number of areas. These areas could include process review, including internal and external peer review; the function of the media and journalism; the choice of material (sources) and methods employed in research; the use of science in balanced evidence-based decision-making (risk assessment); the transparency of scientific and legislative processes; the communication of results; the foreseeable consequences of scientific and technological output.

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Matthias Braun trained as a biologist and holds a PhD in biochemistry from the University of Düsseldorf. He has worked at the VDI-Technology Center, Future Technologies Division since 1996 and manages foresight activities. His main fields of interest are the design and methodology of foresight processes.

Keywords

Science and ethics, R&D policy, risk assessment, scientific evaluation, precautionary principle

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

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

The Institutes are:

- The Institute for Reference Materials and Measurements (IRMM)
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- The Institute for Prospective Technological Studies (IPTS)

Further information can be found on the JRC web site:
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ABOUT THE IPTS

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

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

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

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

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

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

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

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

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 EURO per year in four languages: English, French, German and Spanish.

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- CEST - Centre for Exploitation of Science and Technology - UK
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