ERGEBNISSE VON TA-PROJEKTEN

FISTERA project publishes final report

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The thematic network project for DG-INFSO of the European Commission FISTERA (Foresight on Information Society Technologies in the European Research Area) has recently been completed with a final conference, a review and a series of publications. FISTERA has shown that tackling priority-setting requires interaction with and participation of actors and stakeholders, due to the often controversial nature of these issues and the recurrent lack of hard data. Participative approaches can support action more directly by informing and mobilising actors, and even contributing to the building of communities. Emphasis needs to be put on intensifying the level of direct interaction with and involvement of the key actors in charge of priority-setting.

1 The FISTERA project

The thematic network project for DG-INFSO of the European Commission FISTERA has recently been completed with a final conference, a final review and a series of publications. FISTERA was started in September 2003 and ran until end of November 2005. A final conference "IST at the Service of a Changing Europe by 2020: Learning from World Views" took place on 16 and 17 June 2005.

FISTERA was conceived as a thematic network consisting of 6 core partners:

- European Commission, Directorate-General Joint Research Centre, Institute for Prospective Technological Studies (IPTS), the project coordinator;
- Forschungszentrum Karlsruhe, Institute for Technology Assessment and Systems Analysis (ITAS), leader of work package 1;
- Telecom Italia Lab (TILAB), leader of work package 2;
- Austrian Research Centres, Systems Research (ARC/SR), leader of work package 3;
- Policy Research in Engineering, Science and Technology (PREST), Manchester Business School, University of Manchester, leader of work package 4;
- GOPA-Cartermill, Brussels, network administrator.

There were additionally a total of 20 network members, who were primarily responsible for dissemination of results and for input on aspects of particular interest to their own countries.

FISTERA sought to contribute to the overall goal of setting priorities for Information Society Technologies (IST) and IST-Research and Technological Development (IST-RTD) policy by advancing knowledge with regard to the four following aspects:

- Identification of candidate *thematic* priorities: FISTERA generated considerable material that can contribute to identify, justify and make transparent why some areas are more appropriate as priorities for Europe than others. It mirrors the distinction between basic scientific and technological areas on the one hand and areas that are geared towards delivering solutions for applications and ambients (application environments) on the other. It underlines also the importance of application areas where the public sector has a strong role to play (i.e. education & learning, government, health) for driving the future development of IST.
- Identification of *functional* requirements that need to be met in order to make these priorities a reality in the context of the European research area: FISTERA has highlighted *some* areas where RTD policy in IST needs to put emphasis on in order to enable the realisation of the thematic priorities. Certain areas were analysed more in depth (e.g. the situation with respect to human resources for IST research in Europe) than others.
- Design of *foresight methodology for IST*. Foresight tools cannot be picked from a shelf, but need to be designed specifically for the specific objective. FISTERA has contributed with regard to the highly dynamic field of information society technologies by adapting tools and generating new ones.

- Identification of *building blocks for consistent priority-setting*. Priority-setting needs to be built on clear and transparent arguments, especially when there is a need to justify and legitimise public policy intervention.

2 Findings from the FISTERA Delphi

FISTERA carried out a Europe-wide Delphi exercise in which close to 600 persons participated online. An important objective was to analyse to what extent Information and communication technology applications (ICT applications) can contribute to the so-called Lisbon goal of making Europe the most creative knowledge-based society worldwide. Participants were asked to select those application areas that they believed would have the greatest positive contribution to the achievement of each of the six EU goals (job creation, wealth creation, competitiveness, social cohesion, social inclusion, and environmental quality) in the period up to 2010 and beyond.

A basic result is that all ICT application areas are considered to be relevant and important to meet the Lisbon objectives. This underlines the systemic nature of the information and communication technologies. An outstanding result of the survey is the strong endorsement of "Education and Learning". This repeatedly emerges as an application area for IST that contributes to numerous EU social and economic goals and is central to the construction of a European knowledge society. Even so, the participants in the Delphi survey only considered European capabilities and preparedness in this area as average and moderate.

There was no strong consensus on the major factors impeding development of IST applications. The main problems were seen as those concerning social inequalities in access to IST, and lack of adequate finance for innovations. The two issues mentioned most frequently as challenges for RTD in European Union (EU) Information Society Technologies were establishing more user-friendly systems, and enhancing the security of transactions and personal information.

Of policy relevance is the result that the majority of respondents see national governments and firms in IST as the two 'key players' to improve the development and deployment of IST applications in nearly all areas. With respect to the European institutions it is believed that they could contribute particularly to the improvement of applications for (1) social welfare and public services, (2) cultural diversity, and (3) transport and work organisation. A fairly strong pattern of emphasis emerged when it came to actions that the EU would need to undertake, with the two topics Social and institutional innovations, and Reducing the "digital divide" coming ahead of many others – including such familiar ones as Improving the communications infrastructure, Developing new and improved IST applications, and achieving Better IST training and awareness programmes.

3 The FISTERA database as an instrument of foresight

FISTERA developed a novel database methodology to track technology trends and foresight for ICT, called technology trajectories. The project analysed relationships in the database to explore particular technologies with very high potential for the future. Some technologies exhibit a so-called "attractor" pattern. "Attractors" are those technologies that have a potential to become instrumental in "attracting" or influencing the future development path of other technologies. Consequently their evolution is likely to affect deeply other technologies, generating a multiplying effect on the entities it attracts. Amongst about 200 technologies of the FISTERA database, only few showed a pronounced unequivocal attractor pattern, namely batteries, embedded systems, micro-kernels and ad-hoc protocols, as well as those technologies enabling more bandwidth, more storage, information semantics, and radio propagation.

Technological evolution, the availability of novel (or just significantly enhanced) functionalities and the widespread adoption of new services over a long time span is likely to create new ways of living and novel perception of values driving to the evolution of the culture. A blend of technology, production, distribution and adoption may disrupt some market segments as we know them today. This opens new opportunities to new players and may change the competitive position of whole countries. It is almost impossible to predict when and what will cause a disruption, but the necessary (but not

sufficient) conditions can be investigated. For this purpose FISTERA evaluated the set of technological trajectories to understand the phenomena that would, if met, enable a disruption.

In FISTERA's view, the following possible technology-enhanced topics are worthwhile monitoring as potential disruption candidates:

1. The shift from *products to services* is already happening and may gain momentum, gaining impact from 2010 onwards.
2. The *disappearance of the PC* will become pronounced from 2008-2010 onwards.
3. The drive towards *ubiquitous seamless connectivity* may emerge between 2008 and 2015.
4. Communication patterns are already changing and the impact from the *changing traffic patterns* will start to impact in the next decade.
5. At the same time we will be observing an *increase of disposable products* which will impact the way they are produced and how users deal with them.
6. In the near future (2008), *autonomous systems* will become more reliable. The more trust in their performance will raise, the more they will impact.
7. From 2015 onwards bandwidth will no longer be a limiting factor. The availability of this *unlimited bandwidth* will also favour the emergence of virtual infrastructures.

These findings should not be treated as predictions but as much as a stimulus for discussion.

4 Analysis of previous foresight studies

There were two distinct phases of work on the findings of other foresight studies on IST in work package 1 of FISTERA. In the first phase, three major issues emerged: *Firstly*, national foresight reports contain little on emerging key technologies or technology trajectories. *Secondly*, most of the studies limit themselves to identifying subjects worthy of support at the national level only. *Thirdly*, the scenarios resulting from the process are often not particularly technology-specific, but do provide justification for the support of projects contributing to progress in key areas of technology, such as artificial intelligence. To sum up, national foresight exercises do not generally cover the whole chain from technology assessment to assessment of technology's impact on society and offer limited value for conclusions on the EU as a whole.

During the second phase, FISTERA reviewed additional foresight exercises completed within or outside the EU after 2001 with the objective of identifying commonalities and differences with regard to older studies. The idea was to examine possible changes due to certain events like the bursting of the "new economy" bubble or the terrorist attacks, and novel emerging trends. Generally speaking, the visions for IST and their drivers appear to be very similar before and after 2001 with some notable exceptions.

Similarly, FISTERA could hardly detect any significant differences in visions between new and older Member States of the EU. This means that the enlarged Europe basically shares the same visions for the future for IST. Notable differences, however, do exist in the perception of the IST capacity and deployment in the mid and long term as well on the order of challenges and their priorities. The general vision on the role and future of IST seems to be a common pattern beyond the EU – the national priorities for their implementation can have major differences. This consensus seems to indicate that no radical changes in vision is in sight, while the weight of the impact of different IST application fields may change.

Fear or *"Angst"* receives express mention as a factor driving the development of technology in foresight exercises performed after September 11, 2001. Consequently ICT for security ramps up in the priority list of foresight studies established after 2001. The other two application areas receiving more attention are ICT for health and for governmental applications. The increase of importance of the former (health) is justified by the challenges arising from the ageing demographics and the consideration that ICT can contribute in two ways: first to decreasing costs in the health case sector and secondly to the convergence of ICT and biotechnology that is supposed to lead to promising health applications. In the case of governmental applications, the motivation is founded on the strategic role of the governments to contribute to the knowledge society.

For the majority of the areas, the perceived importance between the two periods

before and after 2001 has hardly changed, with exception of security, health and governmental applications.

From a comparison of the Delphi ranking with regard to the updated priorities of the national foresight studies, FISTERA concludes that the *importance of ICT for health, government and education is increasing*, while the mismatch in the case of security may indicate that the technology experts are *probably overestimating the impact of ICT for security*.

Outside perceptions of Europe vary a great deal: some non-European studies virtually ignore the existence of the European Union as an entity, focusing instead on individual member states, while others see the EU as a potential partner (e.g. Canada) or competitor (Korea). While Japan frequently appears to dismiss Europe altogether as having fallen behind in any technological race, US perceptions are more favourable, locating Europe between itself, the leader, and Japan. In one US scenario for the future, the EU has political and economic power rivalling that of China.

5 Where Europe stands in IST

In terms of the share of IST in overall patent activity, Europe has gained momentum in the 1990s but still lags behind the US and Japan. The catching up was to a significant extent due to a favourable position in communication technologies – a growing technology area. Less known is that Europe reduced significantly the gap in processing technologies. This is a positive message because it can be attributed at least partly to an active role of certain member states (particularly Germany and France) and EU policies adopted few years before. Specialisation in visualisation, storage, sensors, and other technologies, however, is still low.

At the level of countries, Europes' catching-up was mainly due to the *small and medium-sized countries* in the European Union, particularly the Nordic countries, the Netherlands or Belgium. The number of IST patents in the big countries (France, Germany and the UK) grew at a slower rate than in the medium sized countries. Germany is still the largest single applicant country.

Moreover, FISTERA results also indicate a high degree of international interrelatedness in IST. Leading European companies invent between 30 and 70 % of their IST patents outside their home countries, i.e. although the patent may be applied for by the parent company, the actual inventor is based either in other European countries or in the US. On the other hand, the number of patent inventions by European actors is higher than the number of patent applications, which indicates a strong presence of RTD by US firms in Europe. One can estimate that there is a constant flow of knowledge from Europe to the US which accounts roughly for about 25 % of all European patent applications.

Whilst there is clear evidence of internationalisation of the science base, too much IST policy research seems to focus on European, national or regional/local issues. It is important to avoid thinking of Europe in isolation and to consider the implications of globalisation. In particular, research should address the implications of recent trends in standard-setting, the ways in which major commercial organisations, such as Sony, are able to establish global standards, the implications of and scope for intervention in this process. Timely establishment of standards in Europe could be instrumental for underpinning the competitive advantage of Europe as a lead market for application-oriented research and innovation. Whilst attention to trends and opportunities in Europe should thus not be abandoned, a focus on global collaborations and the activities and performances of competing global blocs would be of use.

Cultural diversity is both a challenge and an opportunity for Europe. If Europe will not become successful in maintaining social cohesion, diversity could lead to problems and social unrest. If Europe develops concepts for integration which it can successfully implement, this diversity can prove to be a strength in the development of applications of technology. Certainly, a major challenge will be the ageing of European society. Europe's position in research and development is regarded as likely to be challenged by regions such as China and India.

Building IT skills, including social innovation and IT literacy was detected in the workshops and the Delphi study amongst the top constraints affecting the future integration of ISTs in European society. Education emerges as an area that is important across a range of six EU goals. It is seen outstandingly

as contributing the most to job creation, wealth creation and competitiveness in the EU.

FISTERA also addressed the economic dimension of IST and analysed the impact of ICT on jobs and the organisation of work. Among the direct effects of ICT are impacts on skill requirements and the skill acquisition process, which are of vital importance for the competitiveness and efficiency of organisations. Modern working conditions will require further mixes of generalised and more advanced skills and competencies. In a fast changing work environment there is an increasing need for individuals and the society to take responsibility for their own work and skills development.

6 A bottom-up approach

It is increasingly recognised that a great many of the most exciting developments in IST – and indeed in other areas of technological and social innovation – comes from communities of what are typically labelled as "users" or "consumers". FISTERA results point towards the essential need of adopting a user-oriented approach to future IST technologies - i.e. placing the people in the centre. Users should become more involved in the process of identifying potential prospects, problems and solutions and thus fostering a greater and deeper bottom-up innovation in IST. This is a priority not least because of the nature of areas of rapid growth in IST application, such as e-government and e-health, which are by definition user-oriented. This is important not only for the development of user-friendly and useful technologies, but also for reducing the risk of market failures (i.e. user-relevance).

The big question is how such "bottom-up" innovative energy can be facilitated. Attempts to build and support European communities of end users that can define (and possibly meet) their own needs with respect to ISTs need to be explored. If users can become 'agents of change', then 'top down' governance and producer-dominated technology and applications development can be challenged. As a pre-condition, it will be necessary to identify and create the (user) entities that have the potential to cause and implement change. Such agents could be engaged in creating visions. A participatory approach to innovation in IST is crucial to help identify and adapt to factors that enable or constrain the diffusion and adoption of certain IST developments, particularly in areas like education or ageing. The result may be more economically and socially viable products that stem from complex social and individual needs reflecting, and capitalising on, a wealth of European diversity and idiosyncrasies.

7 Lessons from FISTERA

FISTERA made a considerable effort to share experiences of lessons learned on foresight in IST. Many contributions have been offered to the research community in terms of reports and studies. FISTERA methodology influenced foresight exercises in several countries including Romania, Hungary, Austria, Poland and Colombia.

With few exceptions, foresight activities in Europe have targeted themselves at the national level or at the lower regional levels (states, autonomous regions or urban areas). This usually implies a strong focus on the interests of the geographical area covered by the study. The European dimension normally plays a minor role in such foresight considerations. An aggregation of the findings from national research and foresights reveals differences within Europe rather than common interests. Thus there is a genuine need for regular pan-European monitoring and foresight studies: to provide a basis to help overcome this apparent fragmentation and draw attention to the potential of European cooperation and collaboration in IST related endeavours, and to overcome challenges usually exceeding the capacities of the individual member states.

FISTERA's experience is that tackling priority-setting requires interaction with and participation of actors and stakeholders, due to the often controversial nature of these issues and the recurrent lack of hard data. Participative approaches can support action more directly by informing and mobilising actors, and even contributing to the building of communities, to realise the priorities identified. In this sense, the experience of FISTERA is instructive in that emphasis needs to be put on itensifying the level of direct interaction with and involvement of the key actors in charge of priority-setting.

Further information

FISTERA's web site at http://fistera.jrc.es (last recall on March 29, 2006) provides the latest news on a series of books emerging from the project, including the final book by the project team:

R. Compano; C. Pascu; M. Weber (eds.), 2005: Challenges and Opportunities for IST Research and Applications. Bucharest: Publishing House of Romanian Academy of Sciences, ISBN 973-27-1289-9

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