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FISTERA - Foresight on Information Society Technologies in the European Research Area 2020

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Purpose

FISTERA is a thematic network aiming to understand the key factors driving IST in a future Europe and to elaborate options on how to strengthen Europe's position in key IST areas. As such it serves as an input to the debates on strategies to reach the Lisbon objectives and on preparations for the IST Programme in FP 7.

A Multi-faceted Approach to Europe's Future in IST and IST Research

FISTERA has been launched in time to deliver thought-provoking results that should feed the debates about the Lisbon strategy, the future of IST research in Europe in general and the preparations for FP 7 in particular.

Set in this context the main objectives of the FISTERA project can be summarized as follows:

- Understand and capture the key technological, economic, social and political factors driving IST in a future Europe,
- Elaborate a vision of the future of IST in Europe and how IST is expected to contribute to improving quality of life,
- Identify the main strengths and weaknesses of IST research in Europe and potential opportunities and threats that might enhance or erode Europe's competitive position (SWOT)

- Suggest research areas that will be crucial for realizing the IST vision in the light of the SWOT analysis.

Within the framework of a SWOT-approach for international comparison, FISTERA analyzed different types of trends and trend-breaks likely to affect the future of IST research in Europe. Technological, economic, social as well as political factors were considered as potential driving forces. The internationally comparative approach was followed in order to identify candidate areas on which to focus future research activities and funding.

Different techniques were used to explore these driving forces: review of existing national, sectoral or corporate foresight exercises, systematic mapping of technological developments and market prospects, online-Delphi, patent analysis, workshops to explore cross-cutting issues like human resources, priority-setting, or industrial strategies.

Much emphasis was put on dissemination and discussion of findings, with more than 20 national workshops and a final conference being organized in the course of the project, and an online IST Futures Forum being created on the web.

Exploiting Technological Trajectories and Disruptions in Key Application Areas

FISTERA Scenarios - between Competitive Performance and Techno-economic Heterogeneity

In FISTERA, future developments in IST have been investigated from different perspectives. In order to capture different future socio-economic contexts for IST, four alternative future scenarios of the knowledge society were explored. These scenarios served as the backdrop against which to assess the importance of different application areas for the future of IST. The four scenarios were constructed along two main dimensions: European competitive performance, and European internal techno-economic heterogeneity to explore the implications of the project's findings. The stakeholder group will meet in autumn 2005 to assess progress against the Action Plan.
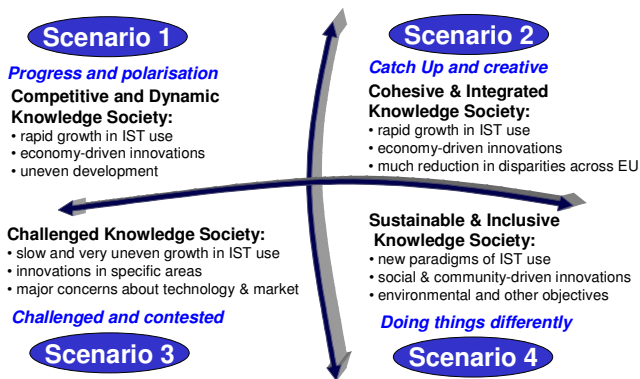

Figure 1: Overview of FISTERA scenarios

Education and Learning as a Top-priority

Within the different scenarios, eight different application areas were elaborated upon in terms of their future development and resulting requirements with respect to IST:

- Social and family relationships;
- Leisure and recreation;
- Ageing population;
- Health;
- Cultural diversity;
- Transport and mobility;
- Learning and education;
- Social welfare and public services;
- Government.

The scenario-building activity was complemented by a European online-Delphi process. Among other findings, it underlined the outstanding importance of *Education and Learning* as top priority area driving the future of IST from the application side, well ahead of *Government*, *Social Welfare and Public Services*, and *Cultural Diversity*.

Although there was not a strong consensus resulting from the Delphi process on these matters, the main impediments for the development of IST applications were seen in social inequalities with respect to access to IST, and the lack of adequate finance for innovations. Important contributions of research were seen in the areas of development of more user-friendly systems and in the enhancement of the security of transactions and personal information.

Technology Trajectories and Disruptions: Emerging Opportunities for Europe's IST Industries

As a complementary perspective on the future of IST, FISTERA has developed a four-layered approach to monitor current and future developments in clusters and applications of information society technologies, and implemented this

approach as a web-based tool. This approach distinguishes technologies and the functionalities they offer as the two 'bottom-up' layers of IST, and environments (like e.g. home, work, road) and IST-based services embedded in them as the two 'top-down' layers of IST. About 100 technologies and 120 functionalities have been identified, together with a multitude of linkages between them, as well as with the upper layers. For instance, the service of security assurance is required different environments like home, hospital, personal environment or malls/shopping, but always building on certain key functionalities like tagging, encryption or image recognition, which in turn may require a variety of individual technologies to be provided. Further detailed information can be retrieved on each entry at the four levels.

Based on this framework and expert judgments, technological trajectories up to the time horizon 2020 have been mapped, together with the interdependencies by which they are characterized across the four layers of the model. Not only technological trends have been investigated, but in particular also potential trend-breaks, i.e. disruptions in IST that can be anticipated on the basis of emerging developments in scientific research and expectations regarding the future evolution of performance parameters of current technologies.

Important disruptions are expected in the nine areas listed in Table 1. A particularly high relevance was assigned to the shift from products to services, the availability of unlimited bandwidth and intelligent terminals, the convergence of IST with other S&T areas like cognitive sciences, nanotechnology and biotechnology, and the disappearance of the computer in conjunction with the availability of embedded systems.

Disruptions	From Year
From Products to Services	Under way; main impact from 2010
Disappearance of the PC	2008-2010
Ubiquitous Seamless Connectivity	2008-2015
Changing Traffic Patters	Under way; main impact from 2010
Unlimited Bandwidth	2015
Disposable Products	2009
Autonomous Systems	2007
From Content to Packaging	2010
Virtual Infrastructures	2015

Table 1 - Possible disruptions in IST: Taken from the FISTERA Synthesis Report by Compano, R. et al. (2004):

'Attracting' the Paths of Future Developments

One of the objectives of this approach was to identify those information society technologies that will be instrumental in 'attracting' the future development path of other technologies. Six such 'attractors' could be identified out of the more then technologies and functionalities:

- Batteries;
- Embedded systems;
- Micro kernel/ad hoc protocols;
- Bandwidth;
- Storage;
- Information semantics;
- Radio propagation.

The data on these technology trajectories has been enriched by an analysis of the comparative strengths and weaknesses of European IST research using triadic patent statistics. The analysis shows that contrary to common beliefs, Europe seems to have improved significantly in several key areas of IST research like processing, and maintained its lead in well-known areas of strength like communications. To a significant extent, this development has been due to the strong performance of - in particular - some of the smaller and medium-sized Member States in Europe, notable the Nordic countries.

Apart from a great deal of interdependencies and knowledge flows between IST research in the US and Europe, the analysis also underlined the perseverance of historically built-up areas of comparative strength in research and technology.

Beware of Emerging Technological Opportunities and Bottlenecks in the Innovation System

FISTERA has highlighted that there are several new opportunities emerging in IST, either in areas of likely disruption or along the lines of established trajectories, which could be exploited if a forward-looking strategy for investment in R&D is pursued. Preference should be given to those areas, where Europe can build on its established scientific and technological strength, but investing early on in research on upcoming disruptive technologies offers the opportunity to take the lead in new areas.

Whether there will indeed be markets for these new ISTs will strongly depend on the future evolution of application areas. Beyond investment in ground-laying research, an R&D strategy that is oriented towards the user needs in these application areas thus seems to be necessary.

If Europe does not manage to be present in these emerging S&T and application areas, its IST industries are likely to face major difficulties of maintaining a competitive edge in the years to come. The uncertainties and impediments on the way towards the production and application of IST products and services in Europe are manifold.

The issue of human resources emerged as a cross-cutting concern in FISTERA. In order to maintain a competitive IST industry in Europe that is able to deliver the kinds of products and services needed to realize the solutions required in the main future application areas of IST, a highly qualified, but at

the same time flexible and socially competent human resource base for research must be available in Europe. Rather than with a shortage of skilled labour, Europe is facing the problem of a mismatch of the skills needed in industry and services on the one hand, and the skills available on the labour markets on the other. In this respect, closer collaboration between industry and universities in matters of training and education are needed, but also new and more interactive settings for application-oriented research where the insights from and experiences of users are brought to bear in earlier phases of the innovation process.

The scarcity of an appropriately trained human resource base is also one of the reasons behind the current trend towards outsourcing R&D, obviously in conjunction with other factors like costs and customization to the needs of emerging markets.

Other potential impediments need to be kept in focus as well. From the societal point of view social inequalities with respect to the access to IST are seen as crucial. In economic terms, the lack of adequate finance for innovation and the ability to integrate user needs early on in the innovation process have been highlighted. Finally, the uncertainties about the technological and cost performance of future technologies make R&D investment risky.

Priorities for Research in S&T as well as in Application Areas

In thematic terms, FISTERA highlights a number of areas where research investment should be intensified in Europe in the future. The priority areas suggested are not only motivated by developments in science and technology (e.g. in some of the aforementioned areas of disruptions and attractors), but on the contrary also strongly oriented towards socio-economic needs and application areas (e.g. health, learning and education, government). This double-pronged strategy seems to be well compatible with the suggestions for IST research in the 7th Framework Programme.

Different time horizons and research approaches are suggested for S&T-driven areas and for application-driven research respectively. Application-oriented research will need to build in the future on a much stronger involvement of users of IST in experimental settings in order to benefit from their experiences. However, longer-term research on key areas of S&T is also necessary in order to maintain a broad portfolio of options for future, but uncertain application opportunities.

In order to enhance the innovative performance of Europe in both application- and S&T-driven research, a number of generic issues with respect to research and technology development need to be addressed as well. Topics like the upgrading of the human resource base and the establishment of new types of settings for conducting leading-edge application-oriented research have been highlighted as decisive areas for enhancing Europe's attractiveness as a research location and where supportive policy action at regional, national and European level would be helpful.

The starting up and growth of new IST-based firms can be reinforced by conducive and stimulating economic framework conditions, and by the removal of unnecessary administrative burdens in a European Union that is still too fragmented.

Sources and References

http://fistera.jrc.es the main project website where all reports and other information on events are available

http://fistera.telecomitalialab.com where you can get access to the database of technology trajectories

http://les1.man.ac.uk/PREST/fistera/ist_forum.htm the link to FISTERA's IST Futures Forum