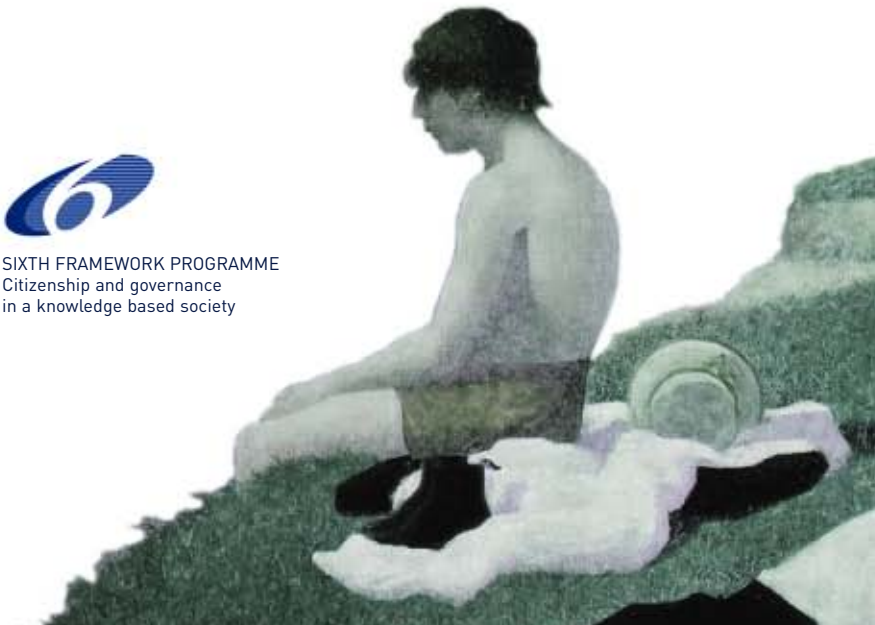
TECHNOLOGICAL RESPONSIBILITY

Socialising European Research

Highlights of the Handbook
on the socialisation of scientific
and technological research

Edited by
Wiebe E. Bijker and **Luciano d'Andrea**



SIXTH FRAMEWORK PROGRAMME
Citizenship and governance
in a knowledge based society

SOCIALISING EUROPEAN RESEARCH

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The *project* has received research funding from the *Community's* Sixth Framework Programme.

Printed in Rome (Italy), June 2009 by River Press Group srl
Graphic Design: Sectio sas

INTRODUCTION

The Handbook on the Socialisation on Scientific and Technological Research is the result of the three-year project "**Social Sciences and European Research Capacities**" **(SS-ERC)**, which was undertaken in order to address some emerging and policy-sensitive issues pertaining to the future of the European Union.

The project was intended as a contribution to the efforts made both at European and national levels to support research systems in coping with the transformation processes which are profoundly affecting them. These transformations are pushing to the forefront the relevance of the social dimension (in a broad sense) in the production of scientific and technological research and the growing complexity of science-society relationships. At the same time, they are showing the need for rendering science and technology more transparent and open to citizens.

This contributes to making research more dynamic, but, at the same time, more difficult to interpret and steer, since at a minimum level it requires a closer cooperation among a broad and diversified range of actors as well as an increased involvement of the social sciences in order to improve the capacities of the research systems in Europe to face these changes.

It is easy to understand how this changing scenario has much to do with the possibility for Europe to pursue the objectives established at the Lisbon European Council, held in March 2000, and to speed up the process of creating the European Research Area.

The **SS-ERC project** followed an approach which can be easily described as organised in **four** main steps.

The **first step** was that of **mapping the actual and potential contribution of social sciences** to a deeper understanding of science and technology. In this context, a **literature review** on the empirical and theoretical contributions of the social sciences was undertaken and **a database** of European social research institutions specialised in science and technology was developed.

The **second step** was to **generate new knowledge on the increasing weight of social dynamics** (in a broad sense, including political, economic, relational, cultural, and organisational dynamics) embedded in scientific and technological research and on the changing relations between science and society. For this purpose, **research** involving 5 European Member States (Denmark, Italy, Netherlands, Slovenia and Spain) was carried out.

The **third step** was aimed at producing further knowledge by **testing concrete forms of cooperation between social**

researchers and research actors (mainly research groups and universities) in order to improve the capacity of research actors to steer the social dynamics increasingly permeating scientific and technological research. To this end, **five experiments** (one in Denmark, Slovenia and Spain and two in Italy) were undertaken.

The **fourth and final step** was that of drawing out from the previous activities guidelines to devise strategies and develop policies aimed at enhancing the socialisation levels of science and technology, by increasing the capacity of European research systems to analyse, interpret and steer science-society relationships and the social dynamics embedded into the research process.

It is in this perspective that the Handbook has been conceived. The **document is addressed** to a wide range of actors: primarily, the **policy makers** involved, at different levels (European, national or local), in science, technology and innovation. Moreover, the **actors** who, directly or indirectly, are **engaged in research and innovation**, including scientists, universities, research institutions, science parks, high-tech incubators, technology districts and the like. Finally, the handbook could also be useful for the large number of actual and potential **stakeholders** (enterprises, civil society organisations, science communicators, etc.) concerned with science and technology.

The handbook is organised in **three parts**.

Part A, titled "**A new setting for dealing with science and technology**", is intended to provide a picture of the social and political context in which the transformations affecting science and technology are occurring, also in order to better understand what is at stake in the socialisation of scientific and technological research.

In **Part B**, titled "**Orientations for interpreting"**, the dynamics of science and technology socialisation are elaborated from different angles, starting from the current state of science and technology socialisation in Europe up to the proposal of developing specific socialisation policies. In this part, a reflection on "scientific citizenships" and the development of a widespread "technological responsibility" is elaborated.

Finally, **Part C**, titled "**Processes and policies in the six areas of socialisation of science and technology**", is aimed at providing the readers with useful orientations for devising strategies, tools and measures aimed at increasing the level of socialisation of scientific and technological research, in six different socialisation areas (scientific practices, scientific mediation, scientific communication, evaluation, governance, and innovation). Each area is to be understood as both an **analytical category** to identify trends, obstacles, constraints and opportunities, and a specific **domain for action** to develop new socialisation initiatives or reinforce existing ones.

The project has been carried out under the Sixth Framework Programme for Research and Technological Development by a network of six research institutions: Science Park Office of the Tor Vergata University of Rome (project coordinator); the Danish Centre for Studies in Research and Research Policy of the University of Aarhus (Denmark); University of Maastricht (Netherlands); Laboratorio di Scienze della Cittadinanza (Italy); Primorska University of Koper (Slovenia); General Foundation of the La Rioja University (Spain).

In this document, the contents of the hanbook are summarised.

PART A

A NEW SETTING FOR DEALING WITH SCIENCE AND TECHNOLOGY

In this part, some orientations for understanding what is "at stake" today with science and technology are provided. Changes affecting society, science and science-society relationships are presented and the concept of socialisation of scientific and technological research is introduced.

The contradictory condition of scientific and technological research

A scarce "social mobilisation" on science and technology

Changes in science-society relationships

Beyond the industrial society

Science and technology are affected by a **contradictory condition**. On the one side, they are more and more politically, socially and economically **significant and visible**. On the other side, there is an increasing **mistrust** and a widespread **indifference** towards science and technology. Therefore, scientific and technological research (S&T) risks to be perceived even by important parts of the social, cultural and political leaderships, as a **body foreign to social life**.

This **scarce "social mobilisation"** on scientific and technological research manifests itself in different ways: low appeal of scientific faculties for youth people and their families; decreasing social status of scientists (also in terms of salaries) in comparison with other professional groups; increasing obstacles to access and to careers on the part of young people; low investments on research, mainly by the private sector but, in some European countries, also by the State; a serious gap between science and culture, hindering that the often large implications of scientific research could be culturally developed; scarce attention devoted to research and innovation by large sectors of public administrations and political leaderships; the enduring forms of discrimination experienced by women in scientific careers; intensifying sense of fear and worry among people about science-related risks.

This situation reflects broader transformations affecting both **society** and **scientific and technological research**.

Actually, we are experiencing an overall shift – still in progress and, in some respects, just started – from **industrial society** to a **new type of society**, to which different names have been given: from risk to liquid society, from post-modern to knowledge society. This new kind of society appears to be more fragmented, network-shaped, globalised, more dynamic, uncertain and disordered. Social actors are more autonomous and freer to choose, think and act, being the social structure (social norms, behavioral models, social roles, values, etc.) increasingly weaker. All this entails a **crisis of the "institutions of modernity"** related to politics, religion, economy, trade-unions or public administrations.

[Box 1]
VIEWS OF THE PARADOX

Science is under attack. People are losing confidence in its powers. (...) And yet, opinion surveys regularly report large majorities in its favour. (...) Science has never been so popular or influential. (John Ziman, *Real Science*, 2000)

Today, science is no longer viewed unquestioningly as the harbinger of better times. Society's view of scientific inquiry has become more sophisticated and nuanced The gap between the scientific community and society at large has widened. (European Commission, *Science and Society Action Portfolio,* Brussels, 2005)

Public opinion, the sentiments of voters and the bias of the media debate largely determine the boundaries imposed on scientific practice at the beginning of the 21st century. And, as we have seen, these sentiments are unmistakably more skeptical and negative than in the past. (Peter Drenth, President of All European Academies, ALLEA, Bratislava, 2003)

Despite increasing communication there are indications of a disconnection between science and society. (...) Research is not seen as an attractive field for young people to pursue as a career. (...) Fewer researchers with less available time to bridge the gap between science and public perception would not alleviate the situation. (European Research Advisory Board, 2007)

The changing modes of S&T production

As other institutions of modernity, also science experienced a crisis, in terms of a decrease in authority, unity and autonomy. As a reaction to this crisis, S&T modes of production started changing rapidly. Different models have been developed to interpret these transformations, such as the "Mode1/Mode2" model, that of the "Post-academic science" or the "Triple Helix" model. Different trends of change can be identified: boundaries among disciplines are weakening; application fields are multiplying; research is asked to be more effective, fast, accountable, trans-disciplinary, result-oriented and able to generate benefits for people and firms. In this framework, science-society relationships necessarily are altering too. A strong intensification of science-society relationships is occurring, at multiple levels; an increasing number of actors and stakeholders are involved in research production; pervasiveness of technology is rendering users an active part in technological development; economic and social interests on S&T are growing on a global scale; new democratic and ethical issues emerge.

Socialising research

All that brings us to the question at the centre of the handbook: the **socialisation of science and technology.**

Used in its proper meaning, socialisation refers to the social and cultural process through which an individual – for example, a child or a foreigner – become a member of a given society or social environment, developing his/her own personal identity and finding his/her "place" within society.

Applying the idea of socialisation to scientific and technological research helps understanding which problems and hindrances scientific and technological research is matching. Actually, changes in science-society relationships made research socially less embedded into society than it was in the past. Its identity – that is, its capacity to manage and to steer the transformations which are affecting itself – seems to be weakened. Its degree of adaptation to a changing society is lowering; therefore, its "place" within society remains unstable and uncertain.

Often, these problems have been usually coped with as single questions (lack of scientific communication, difficult interactions between universities and enterprises, poor organisation of research institutions, etc.), as if they were unrelated each other. On the contra-

ry, they are to be analysed and faced as a whole as expressions of a unique overall profile of science-society relations.

A mainly European problem

Even though all advanced economies have to deal with problems related to the socialisation of science and technology, in Europe the question of socialisation is particularly worrying. Actually, Europe risks lagging behind other countries (United States, China, India, South-East Asia), not only because of the low level of expenditures on science and technology, but mainly for the lack of effective mechanisms for integrating research into society.

The "agents of socialisation"

Obviously, also in Europe relevant processes of science and technology socialisation are occurring. Actually, there are many actors (researchers, research groups, university administrators, civil society organisations, sometimes governments and local administrations) who – more or less consciously – are acting as "agents of socialisation", by creating new links between science and society or managing and driving the existing ones. Acting in this way, these actors allow research to socialise anyhow, contrasting inaction and disinterest of the other actors.

However, in Europe, more than elsewhere, the "agents of socialisation" are few; they often work in a hostile environment, where resistances and hindrances limit the "systemic" impact of their action; the degree of acknowledgment that they receive by public institutions varies country by country, but overall it appears to be very limited; they prevalently act in an "atomised" way or creating short and scarcely visible co-operation chains.

The risk of a "technological drift"

In the long run, low levels of S&T socialisation could result in a "technological drift", characterised by low quality research, decreasing economic competitiveness, and increasing dependence from technology produced elsewhere. Even the capacity of European societies to master themselves would strongly decrease, because of the shortage of scientific competences and technological skills.

PART B

ORIENTATIONS FOR INTERPRETING

This part of the handbook develops further insights useful for better interpreting the processes of S&T socialisation, providing a working definition of the concept and then analysing forms and areas of socialisation, presenting possible objectives and overall features of socialisation policies and introducing the issues related to technological responsibility and scientific citizenship.

The double meaning of socialisation

Descriptive sense

Prescriptive sense

Socialisation policies

Socialisation areas

Social and natural sciences

The concept of socialisation can be used as a **descriptive** and as a **prescriptive** term.

In its **descriptive sense**, socialisation describes the connectedness between science, technology, and society. Descriptive accounts of socialisation are mainly produced by social scientists analysing science and technology.

The **prescriptive** meaning refers to socialisation as an objective for science and technology by both strengthening the position of science and technology in society and promoting it, but also by taking on board the importance of social processes involved with S&T.

In this perspective, **specific socialisation policies** should be devised at national and European levels, in support of the current science and innovation policies and able to, on the one side, assessing S&T socialisation and, on the other side, developing co-ordinated measures for improving the average socialisation levels within the European Research Area, starting from coordinating and improving the existing policies.

Six main socialisation areas – that is, areas covering the most important interactions between science and society – can be identified. These areas (see box 2) represent a conventional scheme – even though theoretically based – to approach socialisation of science and technology as a whole. Actually, other schemes should be used and other socialisation areas should be also added to the scheme. There are many overlaps among the areas and anyhow each one is closely linked with the others at different levels.

Devising effective socialisation policies requires a stronger and more open **commitment of social sciences on scientific and technological research**. Actually, social sciences should use their analytic tools and approaches to make science and society better able to adapt to each other and to better managing an increasingly complex research process. In that sense, the descriptive and prescriptive role of social sciences can not entirely be separated. However, there are at least **two major problems** that need to be dealt with first.

[Box 2]
THE AREAS OF S&T SOCIALISATION

SCIENTIFIC PRACTICE – This area includes the social processes relevant to doing research, primarily those occurring within research groups as well as the surrounding factors affecting research practices.

SCIENTIFIC MEDIATION – The area refers to the – often informal and ad-hoc – functions linking science with the various social 'micro-environments' around it (cooperation with other groups within the same institution, research management, functions bridging university with companies, civil society organisations and agencies funding research).

SCIENTIFIC COMMUNICATION – This area is concerned with exchange of ideas and

information within science and between science and society (from disciplinary communication up to communication with the public at large).

Evaluation – This area includes the set of practices, programmes, or measures aiming to measure and evaluate all aspects directly linked to science and technology.

Innovation – This area explicitly addresses the novelty of the products of science and technology, asking both how this novelty affects social relations and processes, and how these relations and processes affect innovation.

Governance – This area is concerned with the steering of science and technology in society, at different levels, ranging from international organisations, supra-national bodies to national, regional, and even local government.

Lack of socialisation within social sciences

The first one could be described as the **lack of socialisation within social sciences**. Many social researchers are scarcely interested in science and technology or still do not consider science and technology a topic for investigation and analysis. Therefore, to make socialisation work, **an important step is also to socialise social scientists** to make them aware of the importance of science and technology, and engage them in solving problems that surround science and technology.

Lack of cooperation between social and natural scientists

The second major problem is the **lack of cooperation between social and natural scientists**. These are often described as living in different worlds, since there are considerable differences, broadly speaking, between their respective approaches. Nevertheless, for socialisation to work it is important to forge some sort of connection between social and natural scientists, for example concerning the different ways in which social sciences may contribute to socialisation.

Aspects of socialisation policies

Moreover, in order to develop effective socialisation policies some specific aspects are to be addressed.

- One of them is identifying and supporting the already existing socialisation **agents**. In principle, any social actor involved in activities that somehow contribute to the social embedding of science and technology can be seen as a socialisation agent. Hence the importance to steer and manage the diverse contribution they can give in order to make socialisation processes productive.

- Another aspect is understanding the **fields** where socialisation processes appear to be more visible or strategically developed (such as health, biotechnology, nanotechnology, sustainable development) and where they are not, and why (economic reasons, expected scale of impact, controversial nature of the issues involved).

- A third aspect is singling out the more socialisation-sensitive **themes**, that are more likely to arouse a public interest, such as the economic or social consequences of S&T, ethical issues or democratisation of policy making.

A high quality socialisation for Europe

It is also to take into account many **factors specifically challenging European research** on its path towards socialisation, such as:

- a widespread view of science as a sphere separate from the rest to society;
- the present fragmentation in approaching socialisation;
- the lack of a broad debate on science and technology;
- forms of outright rejection of science and its products largely present in Europe;
- tendencies toward a decrease in research funds in many European member states;
- an overall decrease in status of science and scientists.

To effectively cope these factors, European research is required, not to copy other socialisation models (such as working in United States or Asian countries) but to invest in a **peculiar 'high-quality' socialisation** of science and technology, which take into account values embedded in European culture such as sustainability, solidarity, fairness and democracy.

A frame for socialisation policies

In order to pursue this objective, a **frame for how to conceive socialisation policies** should be necessary, able to deal with issues such as who are the relevant **actors**, how to involve them, which role they are playing or should play, which are the **arenas** where socialisation issues can be discussed, how to ensure transparency, which **mechanisms** should be more effective to finding effective solutions.

This frame is necessary for keeping socialisation policies concrete, context-sensitive, in tune with national cultures and traditions, able to move on a case-by-case basis, rejecting any standardised and therefore ineffective recipe for socialisation. Socialisation policies, moreover, can work only by continuously creating new spaces for cooperation, building their action on existing strengths and improving the existing institutions, preserving at any moment a **holistic approach**.

Technological responsibility and scientific citizenship

Going beyond the present ad-hoc and fragmented approach to science-society relationship could be therefore a realistic and priority objective for Europe. Actually, current policies aimed at dealing with social dynamics involved in S&T are few, not explicit, unspecified, while the broader "landscape" is becoming more and more complex. It is therefore the time to develop a generalised approach to S&T socialisation allowing highly differentiated multi-level and context-tailored measures able to accomplish multiple **tasks**, such as preserving the quality of research, managing science-society relationships, improving how science is organised and performed, protecting the identity of science, enhancing the cultural role of science.

This cannot be done without the strengthening of a broad public attitude of **technological responsibility**, i.e. a diffused social and individual engagement, in support of science and technology, for guiding both how science affects society and how society affects science. Everyone, at different levels, is potentially concerned, from scientific professionals to the different sectors of the public, to fully exercise the rights and duties related to a **scientific citizenship**, which is not a simple condition that comes with the simple fact of being a scientist or citizen but a specific dimension of citizenship in contemporary society which requires action and opportunities for everyone to play their own role.

PART C

PROCESSES AND POLICIES IN THE SIX AREAS OF SOCIALISATION OF SCIENCE AND TECHNOLOGY

In this third part of the handbook, some strategic and practical orientations for devising policies, measures and projects aimed at socialising science and technology are provided.
The part includes six sections, each of them devoted to a specific socialisation area, i.e. scientific practices, scientific mediation, evaluation, scientific communication, innovation and governance.
Each section is organised on the basis of a common structure: overall presentation of the area, key issues and operational indications.

[1]

SECTION ONE
SCIENTIFIC PRACTICES

The area

The profound changes affecting S&T have significant effects on scientific practice. Actually, the "**profession of scientist**" – and therefore the concrete patterns through which the scientific method is interpreted and applied – is therefore rapidly changing, towards **different directions** (trans-disciplinarity, economic exploitation of research results, call for accountability and transparency, strengthening of the science-technology nexus, bureaucratisation of research procedures, etc.).

As showed by social sciences (sociology of science, knowledge management, psychology of science, etc.), these modifications, more than the individual researchers, seem to strikingly affect **research groups**, which appear more and more to be the "elementary bricks" which the entire building of research is based upon. Actually, in the new context, research groups are asked to perform a broadening range of functions and activities. However, research groups are **frail entities**. To emerge and survive, they need for a steady investment of "energy" by the group members, in terms of engagement, motivation, and social, political and administrative skills and capacities.

Therefore, socialisation policies, in this area, should be aimed at supporting research groups in coping with research processes and improving their relationships with the research institution they are part of.

Key issues

A set of key issues pertaining scientific practice can be emphasised.

Complexity

Research groups are becoming **complex entities**, a sort of "research micro-systems", performing a broad range of activities (related to e.g. innovation, communication, project promotion, management, public relations, and administration).

Groups' Quality

In this framework, **improving the quality** of the research groups is of pivotal importance, tackling all aspects of their life (leadership, inner organisation, inner cooperation, conflicts, etc.).

Quality of the research institutions

The quality of the research groups is in turn strongly influenced by the **quality of the research institutions** which they are part of. A group working in a low-quality context (e.g., poorly managed, providing scarce resources and support, etc.) has to divert time and resources from the research focus.

Training and preparation

Researchers' **preparation and training** appear to be scantly socialised to the modified ways of production of science and technology and to the new emerging science-society relation patterns.

Moreover, research groups are increasingly asked to be part of trans-national, trans-institutional and trans-disciplinary **research networks**, requiring time and specific capacities that they often are lacking of.

As it is easy to imagine, the quality and quantity of human, economic, technical and material **resources** are one of the elements particularly influencing research groups' life.

Research groups are also exposed to a **broad range of public policies** devised in sectors such as labor market, high-education, industrial development, urban development, innovation or public administration reform, the interactions and impacts of which are usually scarcely analysed.

Research groups are increasingly urged by enterprises, local authorities, governments, civil society organisations and, sometimes, by the public at large to direct their projects towards specific **application fields**. Often, the lack of specific institutional places and mechanisms makes this social and economic "**contextualisation processes**" difficult to manage.

Among the main operational indications, the following can be mentioned.

Research groups appear to be the primary organisational unit from which the research process originates. For this reason, they have to be adequately supported, by e.g. generating deeper and more systematic knowledge on the existing research groups; promoting the creation of new research groups; preventing and managing critical life-cycle events; feeding their inner cohesion.

Research institutions usually do not pay adequate attention to the needs of their research groups. Often, institutions represent a real unfavorable environment for them. Hence the need to create around research groups an "enabling environment" by e.g.: providing them with specialist advice; adjusting management and administrative procedures to their needs; assessing the quality of the institutional context; facilitating communication between research groups and other relevant units (such as the technology transfer office, the patenting office or the international relations unit).

The "profession of scientist" is rapidly changing, enriching with new contents and new functions. This entails developing measures which could support researchers in acquiring new skills and competences, by e.g.: reinforcing university curricula and researchers' education in domains such as innovation and technology transfer, team working, organisation and management of research networks, scientific communication and science-related ethical issues; promoting work stabilisation of young researchers; supporting researchers' mobility; contrasting gender discrimination; reinforcing the role of research groups as learning environment.

Research groups can attain high-quality research standards only through their strong integration within international scientific community. This requires growing efforts for e.g.: fostering trans-disciplinary research; facilitating scientific co-operation; creating new services in support to researchers; reinforcing welcoming structures within universities for foreign students and professors.

Relations with the scientific community

Resources

Impacts of public policies

Contextualisation

Operational indications

1. Supporting research groups

2. Creating an institutional "enabling environment" for research groups

3. Supporting researchers

4. Integrating research groups into scientific community

5. Managing the impacts of public policies

6. Opening up research groups and institutions to the social context

Scientific practices are influenced, not only by research policies, but by other kinds of policies, related to e.g. education, labor, welfare services, innovation, and international co-operation. Their impact could be properly managed through, mapping the public policies which directly and indirectly affect research activities as well as identifying and managing hindering factors and opportunities related to different public policies and their mutual interactions.

Research groups and often research institutions tend to be scarcely open up to the social context, notwithstanding the increasing pressure to link research activity to economic and societal needs. Often, these trends toward "social contextualisation" of research are more undergone than managed by research institutions, which often perceived them as a limitation rather than a propelling factor for research production. Some indications to be mentioned here can be: involving social actors in the research institutes' life; consolidating among research groups a habit of interacting with social actors as a daily practice; sustaining the inclusion of societal and economic impacts as one of the driving criteria in planning and managing the research activity

[2]

SCIENTIFIC MEDIATION

The area

Scientific mediation refers to all the activities "hooking" research to social environment through establishing stable cooperation relationships with the main actors that potentially provides researchers and research groups with key resources and opportunities. This need for higher level of cooperation is due to the very nature of knowledge as a **social construction** in which also social and institutional factors play a pivotal role. In this framework, scientists can be seen as **social producers of knowledge** - that is to say, social actors tied to several social worlds involved in a complex process of knowledge production.

Five main domains of mediation activities – often crosscutting other socialisation areas - can be identified:

- **governing** (management, administration, planning, etc. and involving actors such as university and department managers, technicians and administrative personnel);
- **teaching** (involving actors such as students, administration offices, Erasmus offices, secondary schools, high education institutions, local authorities, enterprises, professional networks);
- **networking** (with enterprises, civic society organisations, professional organisations, social services, local authorities, science centres, etc.);
- **designing and promoting** new projects (involving actors such as other research institutions, funding agencies, economic actors, professional organisations, local authorities);
- **managing knowledge** (publishing, exchanging knowledge, etc. and involving actors

such as webmasters, librarians, knowledge managers, communicators).

Mediation activities can obviously **occur spontaneously**, without any planning or specialisation. However, due to the rapid transformations of scientific and technological research, **planned professional mediation functions** provided by universities, research organisations and other concerned institutions are increasingly important. This is already occurring in some sectors (such as promoting innovation, first-job offers for students, incubators and university spin-offs). However, research institutions are required to strengthen their role in bridging researchers to the local and even global environment.

A set of key issues on scientific mediation deserves to be mentioned here.

One of the key question related to scientific mediation concerns, so to say, the "**optimal" dedication** (in terms of time, attention, motivation and personal resources) of researchers to different activities (research, teaching, management, designing new projects, etc), with special reference to those more valuable. Institutional mediation services could help them to find a balance among them.

Today research activities entail stronger links of cooperation and exchange between researchers and between them and other actors. This requires a profound **change in the mindset** of scientists, university administrators, technicians and any other actors concerned with research and innovation; change that not all of them are able or oriented to do.

There is a serious **shortage of specialised skills**, at both individual and institutional level, within research institutions in different fields of mediation, such as research management, project promotion, and social communication.

It seems not to be rare that scientists and non-professional mediators are influenced by biased **selective perception** mechanisms and phenomena of **cognitive dissonance**, distorting their view of social environment. Consequently, some spheres of the local environment are overrated while others are hidden.

There is the risk of interpreting scientific mediation only in a utilitarian **short-term perspective**, while multiplying the interactions between researchers and local public at large, without immediate returns for the former, is a necessary investment for the future.

Some main operational indications can be mentioned.

Performing the complex functions linked with research activities requires the mobilisation of a wide range of competences and skills (such as those pertaining public relations, innovation, lobbying, research management, networking, and so on).

Scientific mediation is overall aimed at involving relevant actors with scientific and technological research. This is possible only by developing effective participatory approaches where a strong and flexible link between analysis and action is ensured.

Key issues

Optimal dedication

Changing mindset

Skills shortage

Selective perception and cognitive dissonance

Local public

Operational indications

1. Adopting a trans-disciplinary and trans-professional perspective

2. Using a participatory action-research approach

3. Mapping social groups

In order to perform any scientific mediation service (e.g. project designing, governing or knowledge managing), there is the need for mapping all relevant actors, both institutional and non-institutional ones, such as fund providers and donors, professional organisations, committees and boards of experts, key policy-makers, potential research partners, NGOs and civic associations.

4. Strategically selecting mediation activities

Being resources limited, selective criteria are to be adopted to identify the actions to be promoted in the five domains of scientific mediation (governing, teaching, networking, designing and promoting, managing knowledge), following an open strategy of action which could take into consideration hindering factors, opportunities, needs and available skills.

5 Providing researchers with elementary management tools

Even though scientific mediation has to be increasingly performed by professional figures, researchers and research groups are to play anyhow a role in any mediation activity. Therefore, they should be helped to better organise their daily life by applying even elementary tools of management (organisation of space and times, use of documents, organisation and maintenance of administrative data, etc.).

6. Managing the components of scientific mediation initiatives

Even though different each other, any initiative in scientific mediation tends to show similar components, which it appears important to be manage properly. For each component some suggestions can be given such as:

- selecting the relevant actors to be involved in mediation activities (e.g. privileging actors already known on the basis of past experience or present contacts; choosing as much as possible neighboring entities; ascertaining their real interest in mediation activities, etc.);
- preparing and activating mediation activities (e.g. making explicit all the motivations underlying the collaboration and the minimum conditions for starting up; building up a shared and clear view about the expected results and benefits, etc.)
- managing and implementing mediation activities (e.g. promoting the transfer of practices, knowledge, know-hows and ideas among the actors involved; preventing any dispute about provision and management of the resources, etc.)
- making mediation initiatives visible and fully exploiting their results (e.g. activating a specific program aimed at promoting the visibility of the initiative, establishing rules of results emerging from the partnership, etc.).

[3]

SCIENTIFIC COMMUNICATION

Increasing complexity in S&T production and in science-society relations makes scientific communication a **pivotal element in socialising science and technology**. However, also the complexity of scientific communication increased significantly.

Each scientist meets up with the requirement of reporting on the results of his or her work; information from the environment in which their research is conducted forms the basis for evaluation of the degree of success of their research work; researchers also attempt to reach agreement with economic and social actors, central and local authorities and the public at large about the direction and objectives of their activities. All these communication processes impose on scientists the **added burden of managing communications networks** through which they are connected to all sub-systems of society.

In this perspective, **broadening the approach** to scientific communication is necessary, able to encompass both the communication between science and society and the communication involved with the research process.

A set of key issues concerning scientific communication can be stressed here.

There is a very **low awareness** about the new scenarios of scientific communication (e.g. on the high density of communication flows, the increasing number of actors involved or the strong impact of communication on S&T development).

In the new context of science and technology production, there are many **political issues** strongly concerned with scientific communication to deal with such as democratic participation to decision making, access to innovation, transparency in the use of scientific results, and control over risks related to S&T.

The higher weight of scientific communication entails an **increasing role of social sciences** and of communication sciences in particular, both in identifying the most burning problems and in experimenting more advanced solutions.

New context for knowledge and technology production demands **cooperation of various disciplines,** which is still difficult to promote because of the rigid hierarchical disciplinary-based communication structure of research institutions and the lack of common languages and channels.

The **clashing communication styles** of different actors (universities, private sectors, local authorities, political institutions, civic organisations, etc.) render often communication a time-consuming and scarcely effective process.

The area

Key issues

Low awareness

Political issues

The role of social sciences

Trans-disciplinary communication

Clashing styles

Scientists and scientific communication

In the "post-academic" framework, scientists should assume part of the responsibility for effectiveness in communication of science. However, many scientists lack the **skills** required for communication with the public and other stakeholders, are **uncooperative** or lack of **time** and **opportunities** to communicate.

Civic organisations

Role and relevance of civil society organisations in scientific communication is usually **underrated**, often by the same organisations. This results in their scarce involvement on S&T and in a very poor cooperation with universities, business and other research actors.

Scientific culture

The heightening of **scientific culture** and **scientific literacy** is a traditional objective of scientific communication. However, it should no longer be associated only with the need of raising a mere consensus on science and technology but with a more concrete and continuous **engagement** of people with science and technology.

Mass media and science reporting

Mass media are nowadays the entry points for a **public discussion of science**. However, media operate in the free market and they necessarily serve the interests of media owners and editorial policies, which are not necessarily overlapped with the public interest on S&T.

The scientific public sphere

Communication is a necessary tool for creating a "scientific" public sphere. However, unfair access to communication channels, bad functioning of communication mechanisms, scarce mobilisation of the public or the lack of effective participatory mechanisms could make this objective very difficult to achieve.

Operational indications

Some overall strategic orientations pertaining scientific communication can be mentioned.

1. Adopting a "situational approach"

Rather than designing prescriptive schemes of communication flows, it appears more appropriate mapping the existing "situations" in which science and technology are subject of communication, at the appropriate level (e.g. department, faculty, research institution, university, local level, etc.) and trying to improve them.

2. Overcoming the distinction between lay people and experts

Dividing communication participants into scientists/experts and lay public community is scarcely productive, being based on a science "literacy model" (assuming that knowledge boosts public acceptance of the scientific worldview) which already showed to be unreliable and practically ineffective.

3. Developing scientific culture

Any action in support of scientific communication has also to be aimed at developing (as a sort of by-product) a broader scientific culture, focused not only on history of science, scientific achievements or benefits of science, but also on the most problematic aspects of research (controversial issues, organisation of research systems, research policies, funding schemes, etc.).

4. Involving educational institutions

Any action in support of scientific communication should also aim, as far as possible, at involving educational institutions and science centres (including science museums) in socialisation initiatives.

Mono-directional models of scientific communication are ineffective for socialising scientific and technological research. Only a two-way communication process allows scientists to share insights from their work with the general public, stakeholders to contribute in determining the research policy agenda, and the public to cooperate with S&T.

Mapping the existing communication channels and trying to opening them up to other actors is often the best approach for rendering scientific communication more effective in a reasonable lapse of time.

A model of scientific communication is proposed, to be used at the appropriate level (departments, research institutions, universities, etc.) as a support scheme for e.g.: mapping existing communication flows; identifying obstacles and best practices; devising communication strategies; establishing assessment procedures; identifying professional figures and skills to be developed. The model operationally distinguishes seven different but interconnected components:

- **Intra-epistemic communication** (i.e. communication among researchers with their peers);
- **Trans-epistemic communication** (i.e. communication among researchers from different disciplinary fields);
- **Network communication** (i.e. communication involving actors such as research managers, technical and administrative personnel, suppliers and consultants, and other actors closely concerned with S&T production);
- **Social communication** (i.e. communication involving social groups, social parties, the business community, civil society organisations, and other stakeholders);
- **Political communication** (i.e. communication involving policy makers such as political institutions, public administrations, political organisations);
- **General communication** (i.e. communication addressed to the public at large);
- **Educational communication** (i.e. communication involving educational institutions, such as school, museums and science centres).

5. Promoting a two-way communication

6. Mapping and opening existing communication channels

Using an advanced model of scientific communication

[4]

EVALUATION

Evaluation of science and technology has gained importance and has become an instrument in policymaking at different levels and within varied contexts. Actually, evaluations are increasingly used to demonstrate the **societal relevance of public science and technology** and prove that policy implementation and investments are worthwhile pursuing.

Therefore, demands for evaluation are larger than ever, as knowledge production processes are nowadays negotiated among a growing number of stakeholders, each with their

The area

own interest. In this context, the issue of **socialisation of science and technology through evaluation is central**. As a matter of facts, in order to match these increasing demands of societal and technical assessment and guidance on science and technology, evaluation is increasingly performing multiple functions of different nature and is broadening its scope. Consequently, also evaluators are playing multiple roles.

However the **full potential of evaluations**, in terms of making them more effective and transparent, improving instrumentation, increasing participatory approaches and their role in valorising the results to attain better quality in decision making, **is still under-exploited**. Although the reservoir of evaluators is expanding, evaluation is under-developed in terms of capability to be part of the policy setting; traditional approaches are challenged; evaluators are rarely aware of their role as socialisation actors.

Key issues

A set of key issues pertaining evaluation can be underlined.

Challenges in socialising evaluation

There are different challenges in socialising evaluation of science and technology policy which are to be recognised and coped with. Among them, one can mention here: how to cope with higher **expectations** and growing **social pressures** on evaluations; how to use evaluation to improve research systems by strategic decision making; how to address expected and unexpected **impacts** of science and technology; how to manage the increasing number of old and new **stakeholders** and **dimensions** in evaluation.

Recent developments and their effects

Evaluation theory and methodology have apparently evolved together with science and technology expansion and policy attempts to control and manage developments. However, different questions remain open: to which extent existing evaluation practice and methodology are effective; how to manage a **broadening of the focus of evaluations**, shifted from a narrow economic and efficiency orientation to a more encompassing concept, with issues such as appropriateness of policy instrumentation and strategy development; how to cope with the tendency to use evaluation, not merely as a form of assessment, but as a social process of negotiation and learning between stakeholders.

Relationships between evaluator and policy maker

One implication of the different interests involved in an evaluation is the need for managing the relationship between evaluators and policymakers, also in order to control distorting factors such as the **conflicting expectations** that may influence the implementation process and delivery of results. **Bridging the gap between scientists and policy makers** could increase socialisation of evaluation and, consequently, improve the levels of socialisation of science and technology.

Challenges at national level

Despite more than 40 years efforts in science and technology evaluation, a **common evaluation ground is not yet seen in Europe.** Some European countries make systematic use of evaluations and have established **national evaluation centers** and **standards**. Other countries initiate evaluations and develop standards on an *ad hoc* basis.

Challenges at European level

There are, at European level, consolidated experiences in the evaluation of the FPs. However, the introduction of new research policies and instruments in the early ERA concept has had implications both for policy implementation and for evaluation in general.

Actually, the development of a European Research Area requires a corresponding development of a **'European Evaluation Area'** in which there is a common methodological and procedural understanding.

Among the main operational indications, the following can be mentioned.

Presently, evaluation results are not always implemented to support scientific and technological developments, nor have they always the expected impact. It becomes therefore necessary planning their application on policy making before starting an evaluation exercise.

Besides the evaluation's outcomes, also the implementation process in itself has a value, namely to clarify actors' viewpoints through exchange of information. Therefore, some requirements are to be ensured in order to make the process more credible, absorbable, steerable, and transparent. Also the credibility (reputation, independence and fairness) of the evaluators is to be guaranteed.

With the shaping of the ERA, the requirements for enhanced evaluation have grown to a level where rethinking of evaluation concepts and practices is called for, at least in two directions: creating synergies between different levels of evaluations and better linking evaluation and policy making.

It is time for establishing a more systematic approach to evaluate integrative science and technology activities at European level, drawing attention on, e.g., best practices, data comparability, and common data dissemination system.

In this same perspective, there is also the need for strengthening linkages between the different policy levels, using national expertise and experiences at the EU level and vice versa, establishing national evaluation agencies or units and promoting a networking action between relevant actors.

Ever at European level, mechanisms to make better use of the experiences and lessons already learned from evaluation practices are to be developed in order to mobilise and coordinate the competences and skills necessary for increased levels of socialisation.

For the future, initiatives for promoting a policy-evaluation co-development are to be promoted. This includes developing a European evaluation culture fully capable of addressing integration challenges.

In a differentiated context such as the European, it is of outmost importance creating a conceptual framework enabling European actors to perceive concepts, tools and standards in similar ways.

Evaluators and policy makers should take contextual factors into consideration such as the characteristics of national settings, institutions and research fields, in order to use experiences and adapt best practices to concrete frameworks.

Operational indications

1. Making actual use of evaluation results

2. Giving relevance both to the process and to the outcome of evaluation

3. Rethinking evaluation concepts and practices

4. Evaluating integrative activities for a European socialisation effort

5. Strengthening the linkages between different policy levels

6. Using better existing experiences and lessons learned

7. Promoting a co-development of policy and evaluation

8. Creating a common conceptual framework

9. Paying attention to the national contextual factors

10. Widening the scope of evaluations

11. Creating comprehensive instruments

12. Combining different approaches

13. Promoting a broader commitment to support evaluation

Another point is that of widening the scope of evaluation to adequate them to an environment with an increased number of stakeholders, a variety of new institutions and an expansion of research policy issues (and therefore variables to considered).

There is a need to use the instruments in more flexible ways that provide opportunities to exploit synergies in different areas and levels. This could be made both improving existing instruments and combining analytical and more process oriented tools.

Evaluation aiming to support policy and decision making, would be strengthen if it was combined with other tools in a broader system of data collection and analysis, in order to make evaluation and infrastructure "for strategic intelligence".

Finally, increased socialisation of evaluation is feasible only by promoting a broader commitment to support evaluation and its actors, in order to decrease the uncertainty in science policy and bridge the gap between science and society.

[5]

GOVERNANCE

The area

In relation to science and technology, **governance is a relatively new issue.** However, attention to the structures and processes for collective decision-making is rapidly increasing, as science and technology are becoming ever more pervasive, complex and embedded in social contexts throughout societies.

Over the last decades, **relations between science, technology and society have changed** in ways that could be characterised by commercialisation, integration and hybridisation. Borders between scientific disciplines have been crossed in the context of application. Modern technologies, such as IT, biotechnology, and nanotechnology are generic in scope, and breed on knowledge societies which are transdisciplinary and cross-sectorial. The various "systems of innovation", in which these technologies are being developed, produced, and marketed are based on collaboration between scientists and industrialists, and depend upon interactions with policy-makers. Moreover, **citizens** are increasingly being considered a relevant "**stakeholder**" of S&T, to be fully involved in decision making processes.

It is on the backdrop of these changes that the issue of governance is gaining an increasingly important place on national and international agendas.

Key issues

Some key issues on S&T governance can be mentioned here.

One of the main issues concerning governance is the relation between innovation and democracy. Actually, as already pointed out by the European Commission, "global economic imperatives to pursue **science-led innovation** as quickly and efficiently as possible, is in conflict with the **inevitable frictions and demands of democratic governance"** [1].

Innovation and democratic governance

Another emerging issue has to do with **commercialisation and privatisation of research.** Actually, there is a move from the public ownership and centralised control to privatised institutions and the encouragement of market competition. This aspect has extreme relevance for changing ownership of scientific results, since it is no longer primarily the state that funds scientific work. Hence the increasing recognition of **shareholders** as valid and legitimate actors in relation to the role of science in society. In contrast scientists are generally more hesitant to accept shareholder values.

Commercialisation and privatisation of research

While science has always spoken to society now society increasingly "speaks back", in many different forms involving stakeholders of all kinds and the public in all forms. This justifies the increasing interest in **civic deliberation** and **deliberative democracy** which emphasises public debate, collective reasoning, and reflection as imperative elements in a legitimate political community. In policies and activities concerned with public participation in science and technology, the normative ideals of deliberative democracy and of undistorted interaction have become highly influential.

Civic deliberation

There are numerous examples of **participatory exercises** on issues of science and technology based on principles adapted from theories of deliberative democracy, such as consensus conferences, deliberative polling, citizen juries, town meetings, and other public consultation programmes. However, there are many points of open discussion, such as if deliberative exercises are really compulsion-free and symmetrical, what is their real impact on S&T governance and decision making and which is the role of professional moderators, facilitators and brokers in deliberative initiatives.

Participatory exercises

Some operational indications on S&T governance can be provided.

Operational indications

It is particularly important understanding which are the main dimensions related to the governance of science and technology. In particular, it is to deepen who should decide on S&T and which are the criteria to be used. Actually, two pairs of alternatives can be given. In terms of who decides, the alternatives are direct deliberation vs. delegation; in terms of criteria, the alternatives are scientific evidence vs. moral and ethical issues. These two alternatives allow to develop a typology of governance structure which could helpful in analysing and assess a given system of S&T governance as well as to deepen issues such as the role of citizens, the distribution of responsibilities on science and technology and the best policy tools for promoting socialisation processes.

1.Understanding the dimensions of S&T governance

Any effort should be made for allowing citizens to be real decision-takers. This requires that citizens could be helped in understanding the societal and political complexities

2. Making citizens real decision-takers

[1] European Commission (2007), *Taking the European Knowledge Society.* Brussels: European Commission.

3. Improving citizens' chances to be heard at European level

4. Preparing citizens to be policy makers

5. Socialising all the actors (citizens, scientists, politicians) to be active "scientific citizens"

The area

nested in science and technology as a prerequisite for taking a stand, forming opinions, or expressing concerns.

In this same perspective, any effort should be made for increasing citizens' chances to interact with European institutions, e.g. through the creation of trans-European interest groups or enlarging the debate in the mass-media on S&T.

Citizens are not prepared to cope with new issues and challenges linked with scientific and technological development. For this reason, there is the need to create a new inclusive and integrative framework sustaining citizens in being involved in the decision making-process, by improving their capacities in coping with scientific knowledge, legally prescribed procedures and social values.

The socialisation of members of society to the role of active, scientific citizens has to be part of the ambition of modern educational system. Socialisation of scientists to take an active role beyond the confined academic circles in which they operate is also important. And finally, socialisation of politicians in order to achieve an awareness of and commitment to broader, more inclusive modes of science governance is vital. Out of these, the latter appears to be the most difficult but least discussed aspect. Hence the need for stimulating new attempts to explore and understand politicians' perceptions about science governance.

[6]

INNOVATION

Linking research with social and economic innovation is a well-established tendency. The overall tendency is that of passing from a sporadic innovation grounded on unpredictable individual discoveries to the construction of an "**innovation machine**", i.e. a "system of innovation" which, relying upon the co-operation and synergy of many public and private actors, could generate a regular stream of new discoveries and science-led technological applications.

Notwithstanding the efforts made and the past successful outputs, in Europe connecting research and innovation **remains highly problematic**.

In the **academic environment**, the orientation towards innovation seems to be still very weak. Moreover, research institutions displaying an orientation towards innovation tend to act on the basis of "**their own view**" of the existing demands for knowledge. This view is prevalently grounded on unspecific information and developed without meaningful interactions with enterprises or other key economic actors.

However, also **firms** and **civil society organisations** are scarcely aware about their own needs in terms of scientific knowledge (in Europe, enterprises engaged in innovation activities are estimated to be around 38/40% of the total number of firms[2]. Among them, only around 3.5% identify universities and high education institutions as highly important sources of information for their own innovation activities). Their information on what science can offer them is practically inexistent.

Therefore, a **double socialisation** processes is required: on the one side, research institutions are asked to be socialised to innovation; on the other side, enterprises and civil society organisations have to be socialised to research.

A set of key issues concerning innovation deserves to be mentioned here.

Key issues

Social dialogue

Social dialogue on S&T should be the basis for creating research-innovation links. However, **social dialogue** – to be meaningful - is not to be understood as a discontinuous and occasional activity, rather as a "**daily habit**" of interaction and exchange among the different actors involved, which is still very far to be diffused.

Social and academic recognition of innovation

In many research institutions, **innovation still has a low social and academic recognition**. Many researchers all over Europe see innovation as an activity which is out of their tasks while, In the context of scientific career, making publications is much more valuable than patenting or leading a project of technology transfer.

Pressures on research

There is an increasing **pressure on research institutions** by governments and enterprises to drive research activities towards the production of **economic outputs**. Sometimes, this pressure has **problematic** and even **counterproductive effects** (use of industrial management style, focus on short-run economically productive research objectives, marginalisation of fundamental research, etc.).

University-industry relationships

Relations between research institutions and enterprises usually meet many **difficulties due to different reasons.** Research organisations and enterprises operate at different paces and apply dissimilar organisational and operational models; they have different expectations and interests; often they distrust each other; their languages and communication habits are different and, sometimes, even clashing.

Skills and competences

Developing science-based innovation processes need the involvement of **a broad range of professional skills and competences** (related to e.g. marketing, communication, administration, law, management, and the like) which seem to be scarcely diffused among research institutions. They are often not embodied in formal professional figures or in well-defined professional corpuses of knowledge, nor included in standard university curricula of scientific faculties.

[1] Parvan S.V. (2007), Is Europe growing more innovative? Eurostat Community Innovation Statistics, *Statistics in Focus, Science and Technology,* 61.

University Third Mission

A positive change is the diffusion among universities and research institutions of policies and measures aimed at developing their so called **"third mission",** i.e. their direct engagement in support of economic and social development, to be added to their traditional missions of research and teaching. This provides now universities and research institutions with a "cultural place" and a strategic domain where concentrate and co-ordinate their own effort towards innovation and social engagement.

Scarce involvement of civil society organisations

Quite everywhere in Europe, a scarce involvement of **civil society organisations** and **Third sector enterprises** on research is to be noticed. This is to be understood as a problematic aspect, since experience, expertise and capacities of such organisations is of pivotal importance in building up the demand of knowledge for innovation.

Operational indications

Some operational indications on socialisation of innovation are listed below.

1. Strengthening the orientation towards innovation among research institutions

Creating organisational units specialised in technology transfer is not enough; it is equally important to shape and diffuse within the research institutions overall orientations towards innovation permeating its core strategies and structures. In this perspective, a set of actions should be promoted aimed at e.g. increasing the social and academic value of innovation, developing specific capacities on innovation among researchers, promoting the "innovation scouting" among research groups, adopting mechanisms and procedures allowing research institutions to evaluate their own capacity of innovation, and reinforcing the orientation of research institutions toward the "third mission".

2. Attracting private sector to scientific and technological research

A big effort should be made for attracting private sector (including Third sector) to scientific and technological research. In this perspective, it appears to be urgent to cope with the main – technical, cultural, relational, organisational, etc. - obstacles preventing many enterprises from taking research as an important source for innovating their products and processes, by e.g. generating new knowledge on enterprises' orientation towards research, promoting sensitisation activities, providing companies with advice and support and promoting specific actions for SMEs.

3. Improving the interaction between enterprises and research institutions

In Europe, interactions between enterprises (including Third sector enterprises) and research institutions have been the subject of strategies and practical guidelines. However this relation still appears to be usually weak and of low quality. Hence the need for developing measures such as opening up research institutions to enterprises (e.g. in teaching, research planning, placement-oriented activities, etc.), developing specific professional figures in the domain of university-enterprise relationships, mapping obstacles and success factors or feeding informal interactions among researchers and enterprise managers.

4. Supporting a research-based local development

The involvement of research institutions within local development initiatives appears to be still marginal. This fact is partly due to the enduring tendency of university to stay apart and partly it is the effect of the low awareness that industry and local authorities have about the potential added value of research for local development policies. Possible measures to be taken can be, as examples, promoting territorial coalitions pivoted on research, enhancing the capacity of local authorities in science-based innovation programmes, and

creating ad hoc information networks among local actors.

Social dialogue is a necessary step for creating the "social environment" allowing enterprises, stakeholders and research institutions to develop a "daily habit of interaction" which is presently lacking, by e.g. increasing the diffusion of technological forecasting exercises, promoting sensitisation initiatives on social dialogue, enlarging the use of ICTs in support to social dialogue, and promoting a broader involvement of civil society organisations within research institutions.

5. Broadening social dialogue on S&T