TECHNOLOGICAL RESPONSIBILITY

Handbook on the Socialisation of Scientific and Technological Research

Social Sciences
and European Research Capacities
(SS-ERC) Project

Edited by
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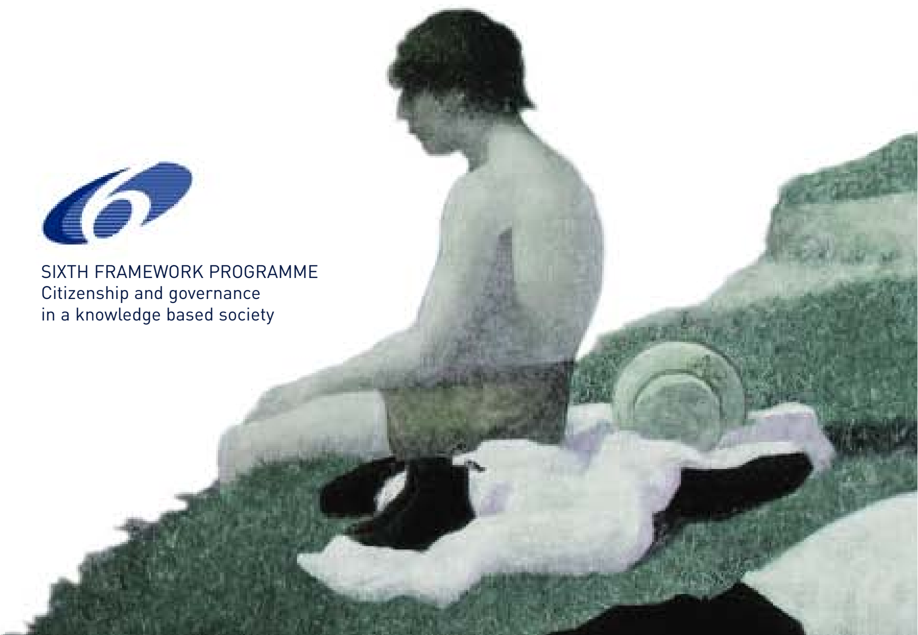
SIXTH FRAMEWORK PROGRAMME
Citizenship and governance
in a knowledge based society



TECHNOLOGICAL RESPONSIBILITY

HANDBOOK ON THE SOCIALISATION OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH

A tool for promoting science and technology socialisation policies addressed to policy makers, research and innovation actors and stakeholders

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FOREWORD

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Scientific and technological research is rapidly changing: the ways in which research is produced are changing; science-society relationships are becoming more complex and multifaceted; an expanding and more diversified set of actors and stakeholders is involved in the research process or is able to influence it; increasing emphasis is put on research by governments and national communities to support economic development in their own countries.

These transformations are occurring in an uneven and non linear way and their future trajectories are uncertain. What is certain is that scientific and technological research, in the "knowledge society", is and will be increasingly different – in terms of structures, functioning, meanings, social and political significance, governance, and involved actors – from the so called "Big Science"[1] which contributed to the post-war economic growth of industrial societies.

If the "Big Science" made research similar to an "industrial enterprise", current trends are making research similar to a "social undertaking", in which elements previously underrated now play an important role. We can mention, as examples, the orientation, willingness and capacity of the actors involved in science production to synchronise with each other, the degree of cooperation between scientists belonging to distinct disciplinary communities (often very different from each other as regards contents, interests, languages and culture) or the emergence and consolidation of new professions connected in one way or another with the research process.

The stakes are high. As a matter of fact, these issues are strongly related to the efforts of the European Union to make our continent a dynamic science-based economy. Also to be interpreted in this perspective is the great investment the EU is making to establish a single European Research Area, which should allow Europe to fully express its research and innovation potential.

However, as stressed by the European institutions, it is not enough to increase research funds, support research networks or reinforce research infrastructure in order to implement this strategy. More concrete policies and measures are required, capable of addressing areas which are usually neglected by policy action, such as widespread behavioural models, personal orientations, organisational dynamics, social relationships or professional practices.

1 de Solla Price, D. J. (1963), *Little Science, Big Science*. New York: Columbia University Press

This Handbook moves in this direction. It is focused on the risk which can derive from poor socialisation of scientific and technological research, understood as an inadequate or even decreasing capacity of science and innovation systems to adapt to a changing society and to manage and steer the transformations affecting them. With time, poorly socialised research is likely to progressively lose productivity, economic significance, social impact and, eventually, also quality. Therefore, it is difficult to conceive first-class research which is not highly socialised.

Therefore, this Handbook can be viewed as an attempt to prevent and contrast these risks, by bringing together in a unitary perspective questions pertaining to innovation, organisation of research institutes, research practices, scientific communication, access to research funds or evaluation, which are still regularly undervalued (sometimes by the scientists themselves) in their overall impact on research and almost always treated separately by different groups of policy makers or experts.

By proposing socialisation as an analytical and policy key, the Handbook provides policy makers, research actors, research institutions and stakeholders with orientations and tools which will support them in quickly recognising the changes occurring, in mapping critical factors and opportunities as well as in devising suitable strategies and taking appropriate decisions. At the same time, the Handbook also aims to raise awareness and to promote a more widespread sense of responsibility about the future of scientific and technological research in Europe, also directed at actors and social sectors that feel they are not involved in science and technology.

To a certain extent, the Handbook represents the final output of an experimental process. The approach adopted in the project has been experimental in nature, characterised by a mix of research and pilot initiatives, which have seen social researchers, natural scientists and engineers work together. Also experimental is the proposed analytical framework, which is therefore flexible and open to both theoretical and empirical contributions.

The hope is that the work carried out, notwithstanding its inevitable limits, could be helpful in acknowledging and enhancing the many experiences in science and technology socialisation already made in Europe and in sustaining new and more effective policies and measures able to ensure a greater degree of embeddedness of research in European society.

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INTRODUCTION

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 this 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); University of Primorska, Science and Research Centre of Koper (Slovenia); General Foundation of the La Rioja University (Spain).

The handbook has been edited by Wiebe E.Bijker (University of Maastricht) and Luciano d'Andrea (SS-ERC scientific coordinator), with the assistance of Erik Aarden (University of Maastricht). Special thanks are to be addressed to Sally Wyatt (Virtual Knowledge Studio for the Humanities and Social Sciences, KNAW) for her careful review of the text and valuable suggestions for its improvement.

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[A]

Part

PART A

A NEW SETTING FOR DEALING WITH SCIENCE AND TECHNOLOGY

[A]

CHAPTER ONE

THE SOCIALISATION OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH

[1]

THE CONTRADICTORY CONDITION OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH

Science and technology are affected by a **contradictory condition**.

Research is increasingly significant and visible

On the one hand, they are more and more politically, socially and economically **significant and visible**. Science-based innovation is increasingly acknowledged as a pivotal factor of competitiveness in the global market; science and technology are viewed as key elements for successfully coping with global problems (such as sustainable energy, growing mobility needs, food shortage, environmental protection); power and pervasiveness of technologies have increased to the point that they profoundly affect social life and even individuals' biographies.

Science and technology are therefore asked to be increasingly effective, accountable, result-oriented and able to generate benefits for people and firms.

On the other hand, in large sectors of society and political leaderships, there is an increasing **mistrust** towards science and technology and a widespread **indifference** with respect, not so much to scientific discoveries and technological innovations (which arouse interest and curiosity of the public at large), as to the **destiny of the scientific and technological research** and the **problems met by scientists and research institutions**.

A scarce "social mobilisation" around science

This **scarce "social mobilisation"** on scientific and technological research manifests itself in different ways: low appeal of scientific faculties to young people and their families; decreasing social status of scientists (also in terms of salaries) in comparison with other professional groups; increasing obstacles met by young people in accessing scientific careers; 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; diffused, even if not dominant, sense of worry about science-related risks.

In sum, science and technology risk to be more and more socially marginalised and to appear as a "**foreign body**" to the social system, in the very moment in which they are taking a **driving role** for the economic and social development and are establishing closer and multifarious connections with society (box 1.1.).

[Box 1.1]
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)

[2]

SCIENCE-SOCIETY RELATIONSHIPS

Which **factors** are at the basis of this paradox? And which **effects** does it produce?

In order to deepen these issues, it is necessary to dwell a little upon the **processes of change** that are occurring in the last decades.

Societies are changing

Primarily, **societies themselves have been profoundly changed**; and this process is still at its first steps. We left behind an **industrial society** – with its strong structures and rules, hierarchical relationships, State's centrality, well-defined boundaries between sectors, groups, disciplines and competences – to enter a more fragmented, network-shaped, globalised, more dynamic and disordered "**knowledge society**", where ideas, knowledge, information and therefore science and technology are acquiring a social and economic weight they never had before.

Science and technology are changing

Also, science and technology are radically changing: boundaries among disciplines are weakening, while application fields are rapidly expanding and fragmenting into thousands of research strands; the focus is increasingly put on economic and social results of research programs; organisational ways to produce research are changing. Science appears less and less a unitary, ordered and consistent entity.

Science-society relationships are changing

Consequently, **science-society relationships are changing too**. At least up to the end of the 60s, science, although important, was not perceived as pivotal for development, as we believe today. Moreover, science was relatively separate from, but at the same time fairly integrated into, society. A limited set of actors (universities, some state agencies, some large companies) was actually involved.

Presently, a **strong intensification** of science-society relationships is occurring, at multiple levels; there are no longer "authorities" or "traffic lights" able to regulate the flows. An increasing number of actors and stakeholders are potentially involved in research production, while the pervasiveness of technology is, to a certain extent, rendering users an active part in technological development. Economic and social interests on scientific and technological research are growing and developing on a global scale. So, science and society are "compelled" to live together under the same roof and to share the same food.

An intricate puzzle

Thus, if in the past, science-society relationships were a puzzle made up of a low number of pieces, relatively easy to combine together, now **the puzzle to be completed is much more intricate**, being made up of an increasing number of pieces which are more difficult to fit together.

Perhaps, the paradox of a **research** playing a central role for development, but also exposed to be socially marginalised can be understood taking into account this complex setting. As a matter of fact, this paradox is not to be seen as a phenomenon in itself, but rather as a **symptom** of broader contradictions characterising present science-society relationships.

[3]

SOCIALISATION AS AN INTERPRETATIVE PERSPECTIVE

The notion of socialisation

All that brings us to the **question at the centre of this handbook**, i.e. the **socialisation of science and technology**. Used in its proper meaning, socialisation refers to the **embeddedness of an individual** – for example, a child or a foreigner – into a given society or a given social environment. Through socialisation, the new member acquires culture, social rules and meanings of society and learns to recognise and assess the expectations that the other members have about him. In this way, the individual develops his/her **personal identity** and learns to find his/her "**place**" within society.

The **application** of the concept of socialisation, not to an individual, but to the set of social institutions and human activities that we call "**scientific and technological research**" is based on this same **idea of embeddedness**.

A difficult embeddedness

As a matter of fact, most of the problems and hindrances met by scientific and technological research can be due to the fact that research is **less embedded** into society than it was in the past. Its **identity** – that is, the capacity of research systems to manage themselves and to steer the transformations which are presently affecting them – seems to be weakened and disarticulated. At the same time, its **degree of adaptation** to a changing society is low and, therefore, its "**place**" within society remains unstable and uncertain[1].

An overall profile of science-society relations

A perspective turning around the idea of socialisation offers the possibility to **overcome the great fragmentation** characterising analysis and management of science-society relationships. Actually, policy makers and social scientists (with some remarkable exceptions) tend to identify and to focus the attention on the **single questions** (the problems in scientific communication, the difficult interactions between universities and enterprises, the poor organisation of research institutions, etc.), as if they were unrelated to each other. On the contrary, the perspective of socialisation helps in understanding that we have to deal with a **single system of relations and transformations** and, consequently, allows us to reassemble an **overall profile of science-society relations**, at least in a given social or institutional context.

Operationally, in order to strengthen and make more visible this **unitary approach to science-society relationships**, socialisation has been organised in **six "socialisation areas"**, that is six large domains where it is easier to identify ongoing socialisation processes as well as those factors which could hinder, foster or drive them. These areas are: scientific practices, scientific mediation, scientific communication, evaluation, governance and innovation.

[4]

THE WEAK SOCIALISATION OF RESEARCH IN EUROPE

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 particular-**

[1] See Castells, M. (2000) *The Rise of the Network Society: The Information Age: Economy, Society and Culture*, Volume I (2nd revised edition). Oxford: Blackwell.

ly worrying (see box. 1.2). As we will see below, 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**.

[Box 1.2]
VOICES OF RESEARCHERS: THE CONTRADICTORY CONDITION OF SCIENCE AND TECHNOLOGY IN EUROPE

On the one hand researchers and scientific findings are treated with **high esteem**, almost as the carriers of truth and unquestionable knowledge, but on the other hand they are considered to be working far away from the reality of policy and practice and thus **often not taken seriously**. (…) Over-estimation seems to lead to underestimation (Netherlands)

Everybody lives surrounded by technology, [especially] young generations since they live with technology in a very easy way. Reality imposes that you are **using technology more and more frequently**… On the other hand, I think that **social consideration is very low, very insufficient**… (Spain)

I notice this gap: researchers and their institutions, knowledge and technology are generally considered to be **crucial** and **important for society**, but at the same time **researchers' salaries are much lower than that of policy officers of the same level**. In my view, this is an awkward situation (Netherlands)

Perhaps a distinction should be made between science and technology. People are **more open to science**, but **fear technology**, even though they use it extensively. The present trend in science and technology is that of no longer to distinguish between science and technology.(Italy)

(passages drawn from the interviews made in the framework of the SS-ERC project)

The weakness of the "agents of socialisation"

Obviously, also in Europe **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 advance anyhow, contrasting inaction, disinterest and resistance of other researchers, research groups, social groups and sometimes of their own government. The point is that in Europe, the "agents of socialisation" seem to be **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 from public institutions varies country by country, but overall it appears to be **limited**; they prevalently act in an "**atomised" way,** or create short and scarcely visible co-operation chains.

Hence the urgent need for European governments and research institutions to develop **specific socialisation policies** – subject of this handbook – in support of traditional research policies, in order to sustain the agents of socialisation, to increase their number and to remove as much as possible the constraints limiting them.

[K]

CHAPTER'S KEY ISSUES

- 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,** but, at the same time, they appear to be **relatively marginalised**.

- To understand this paradox, it is necessary to dwell a little upon the **change processes** that are occurring in the last decades: the overall shift from **industrial society** to **knowledge society**; the deep transformations affecting the ways in which **science and technology are produced**; the change occurring in **science-society relationships**.

- These transformations have taken place in a very **short time span** and in a **chaotic** and **contradictory** way, producing **considerable displacement** between changes and suitable "machineries" (social, cultural, political, organisational and so on) for handling them.

- The handbook deals with this set of questions, focusing the attention on the **socialisation** of scientific and technological research, that is its degree of **embeddedness** in society, providing an overall profile of science-society relationships.

- Many authoritative sources and the same European Commission stress how in Europe socialisation processes are particularly **weak** and the actors working in support of research socialisation - the "**agents of socialisation**" – are few, they often work in a hostile environment, where resistances and hindrances limit the "systemic" impact of their action.

- Hence the urgent need for European governments and research institutions to develop **specific socialisation policies** – subject of this handbook – in support of traditional research policies, in order to support the agents of socialisation, to increase their number and to remove as much as possible the constraints limiting them.

CHAPTER TWO

THE SOCIETAL PERSPECTIVE

[1]

BEYOND THE INDUSTRIAL SOCIETY

The growing importance of science and technology is not an isolated fact. Rather, it reflects **broader transformations** that are affecting all contemporary societies. This has mainly started in the 60s of the last century but its pace accelerated in the following decades.

Almost all scholars agree in recognising these transformations as the signs of an overall shift – still in progress and, in some respects, just started – from **industrial society** to a **new type of society**, of which it is difficult to define the present profile and even more tricky to assess future developments.

The interpretations

Different interpretations of this shift (sociological, but also economic and philosophical ones) have been developed (box 2.1.). One follows from the other, they often overlap, but remain well distinguished from each other.

[Box 2.1]
BEYOND THE INDUSTRIAL SOCIETY: DIFFERENT INTERPRETATIONS

Post-industrial society. Developed, among others, by sociologist Daniel Bell[1], this notion refers to the shift in advanced societies from an economy and a social structure built on industrial production to an economy and a social structure turning around services, based on information production and management.

Information society. The expression "information society" has been mainly used to refer to the effects deriving from the technological revolution in the field of the ICTs[2] on economy and social structure (development of networks, impacts on daily life, effects on personal experience, changes in human relations and power distribution, etc[3]).

Knowledge society. The concept of "knowledge society" mainly refers, not to knowledge in itself, but to all the components (social processes, actors, learning processes,

[1] Bell, D. (1974) *The Coming of Post-Industrial Society.* New York: Harper Colophon Books.
[2] Lash, S. (2002) *Critique of Information*. London: Sage Publications.
[3] Castells, M. (2000) *The Rise of the Network Society: The Information Age: Economy, Society and Culture*, Volume I (2nd revised edition). Oxford: Blackwell.

cognitive elements such as values, languages or social representations, etc.) involved with its production, storage, manipulation and diffusion.

Risk society. Coined by the German sociologist Ulrich Beck[4], the expression "risk society" put at the forefront the diminishing capacity of contemporary societies to control technological, physical and social dangers, the great majority of which are produced by the same legal, social and organisational mechanisms put in place for controlling risks. These dynamics have profound effects on social structures and individual lives (social fragmentation, uncertainty, etc.).

Reflexive modernity. The concept of "reflexive modernity" (mainly developed by sociologist Anthony Giddens[5]) focuses on the current, further phase of "social individualisation" started with modernity. This process is increasingly weakening traditional social bonds. Hence the need for both individuals and institutions to reinforce their capacity to keep a "reflexive control" over their own choices and over the consequences of their actions, being disappearing any authorities able to provide them with guidance and protection.

Liquid society. Proposed by German sociologist Zygmunt Baumann[6], this notion mainly refers to the process of "liquefaction" of those social structures (social classes, marriage, the state, etc.) which had driven modern societies up to few decades ago. This process has strong effects (instability, uncertainty, weakening of social protection mechanisms, existential precariousness, etc.), faced by individuals and institutions through devising different more or less effective coping strategies.

Post-modern society. The concept of "post-modern society" emerged in the 70s, in the framework of a large and composite philosophical movement, originated in France[7]. The core idea is that modernity, understood as a social organisation and a form of thought pivoted upon both rationality and the unitary explanations of the World (such as those offered by religions, political ideologies or science), failed its objectives. Therefore, we live now in an increasingly fragmented World, in which the authority of political, scientific and religious institutions is decreasing and the boundaries between social spheres, disciplines, categories and worldviews are increasingly blurring.

The processes of change

Although being different, the interpretations given to this overall shift seem to converge in identifying a common **set of change processes**.

The most relevant is probably that of the **modified relationships between social actors** (individuals or groups) **and "social structures"** (which manifest themselves, for

4 Beck, U. (1992) *Risk Society: Towards a New Modernity*. London: Sage Publications.

5 Giddens, A. (1991) *Modernity and Self-Identity: Self and Society in the Late Modern Age.* Stanford: Stanford University Press.

6 Baumann, Z. (2000) *Liquid Society*. Cambridge: Polity Press.

7 Lyotard, J-F. (1984) *The Postmodern Condition*. Manchester: Manchester University Press.

example, through social norms, behavioural models, social roles, values, etc.).

In the industrial society, social structures tended to have a relatively strong control over individuals and social groups. In contemporary societies, however, individuals and groups are endowed with a **stronger subjectivity and a higher strength**. Therefore, they tend to be more autonomous, to enjoy a broader range of socially accepted options and to escape as far as possible from the control of social structures and even, under certain conditions, to modify them.

Linked to this process, there are other **no less important changes** to be mentioned.

Crisis of the institutions of modernity

- **Transformations and crisis of the "institutions of modernity".** The weakening of social structures also entails a crisis of the "institutions of modernity" related to politics, religion, economy, trade-unions or public administrations. All these institutions have lost authority, power and autonomy; they are asked to be more transparent and accountable; in order to be functioning, they are more in need of the support of users and citizens; to manage themselves, they can less and less rely upon hierarchical relationships. Some institutions prove not to be able to stand the impact of the growing and growingly fragmented demands of the public.

Uncertainty and instability

- **Growth of uncertainty and instability**. Instability increases in all sectors of social life (labour, emotional ties, social protection, etc.), because of the weakening of social structures, which, while producing a control over the individuals, also provides the same individuals with social, psychological and physical protection. Therefore, the sense of uncertainty appears to be a dominant character both in the social life and in the biographical dimension.

Social and cultural diversification

- **Social and cultural diversification**. The modified balance between actors and structures produced a strong social and cultural diversification within society. It is more and more difficult to identify homogeneous social groups or dominant behavioural patterns. Even individuals' identity is more unstable, fragmented and inconsistent. At the same time, diversification feeds a multiplication of ideas, initiatives, behaviours and forms of knowledge, accelerating social changes.

Weakening of social boundaries

- **Weakening of social boundaries**. All the "inner" boundaries within society are weakening: between social spheres, between institutions, between social groups and between cultures. New forms of social and cultural hybridisation and *metissage* constantly arise from within society.

Globalisation and localisation

- **Globalisation and localisation**. Globalisation processes are speeding up and enlarging their scope, affecting all sectors of social life. At the same time, also localisation processes (i.e. a strengthening of the local dimension in economic, social and cultural domains) are also rapidly emerging. Some authors introduced the term "glocalisation"[8], exactly for stressing the co-presence of these two apparently opposite trends.

8 Robertson R. (1995) Glocalization: Time-Space and Homogeneity-Heterogeneity. In Featherstone, M., Lash, S., Robertson, R. (eds), *Global Modernities*. London: Sage Publications.

Increasing importance of the affective-cognitive dimension

- **Increased importance of the affective-cognitive dimension**. The "affective-cognitive dimension" (feelings, expectations, worldviews, knowledge, etc.) of the social actors is getting a prominent role in all spheres of social life (politics, consumption, economy, public administration, social relations, etc.), also thanks to the huge developments in mass communication and ICTs.

The causal factors

There are many **causal factors** that contributed to producing this overall shift in contemporary society. In a sketchy and not exhaustive way, five main factors can be mentioned here.

Demographic factors

- **Demographic factors**. The impetuous population growth that occurred in the 20th century created a "critical mass" of population which produced a social pressure on state structures, administrations and services, progressively weakening them.

Education

- **Education.** Mass education greatly contributed to multiplying individuals' capacity in coping with complex problems, in developing their own interpretations of reality, in interacting with public institutions, in choosing and taking decisions autonomously and in shaping and implementing their own personal orientations.

Access to rights

- **Broadening access to rights**. The increasing recognition of individuals as bearers of rights (civic rights, political rights and, after the Second World War, social rights) previously limited to few social groups allowed all citizens to access "public arenas", public services and provisions which were previously denied to them. This reinforced the identity-building processes of people and increased the presence of citizens in organised forms within the public sphere.

Technology

- **Technology**. The escalating diffusion of powerful technologies at affordable costs hugely improved the capacity of individuals to influence and handle social and physical reality surrounding them. Moreover, technology increased the physical mobility of persons and goods as well as the opportunities to access communication and information. All these elements dramatically enhanced the range of choices and actions potentially available for individuals and groups.

Mass consumption

- **Increase in mass consumption**. The explosion of mass consumption, despite its distortive effects and risks of manipulation, strongly supported the rising of subjectivity of social actors. Actually, consumptions allowed people to concretely practice their own lifestyles and to facilitate the construction of their self-identity.

[2]

HOW SCIENCE AND TECHNOLOGY ARE CHANGING

Like all institutions of modernity, **science and technology are profoundly changing**, moving in the same direction as the social system as a whole. Consequently, **science-society relationships** are changing too.

Processes of change

Different models have been developed to **interpret** these transformations, such as the "Mode1/Mode2" model[9], that of post-academic science[10] or the "Triple Helix" model[11].

While they are very different from each other, these models together allow us to shed light on the main trends of change.

Collectivisation

- **Diffusion of cooperative practices in scientific production.** Research is increasingly a collective enterprise involving ever-enlarging spirals of scientists. Actually, it is claimed to match more complex research demands requiring, to be coped with, costly and sophisticated equipments which cannot be provided by single research institutions. Interaction among research institutions is practically unconstrained, thanks to ICTs.

Contextualisation

- **Contextualisation**. Research is increasingly "context-driven", i.e. "is carried out in a context of application, arising from the very work of problem solving and not governed by the paradigms of traditional disciplines of knowledge"[12]. Consequently, research is more and more "problem-focused": it is no longer initiated by the interest of the scientist, but is aimed at coping with specific problems or exploiting a given opportunity.

Socially-diffused research

- **Socially-diffused research**. There is a much greater diversity of the sites at which knowledge is produced as well as of the types of knowledge produced. University is no longer the unique environment for research production

9 Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S, Scott, P., Trow, M. (1994) *The new production of knowledge: the dynamics of science and research in contemporary societies*. London: Sage Publications; Nowotny, H., Scott, P., Gibbons, M. (2001) Re-*thinking Science: Knowledge and the Public in and Age of Uncertainty*, Cambridge: Polity Press; Nowotny, H., Scott, P., Gibbons, M. (2003) 'Mode 2 Revisited': The New Production of Knowledge. *Minerva*, 41.

10 Ziman, J. (2000) *Real Science. What it is, and what it means*. Cambridge: Cambridge University Press,

11 Etzkowitz, H., Leydesdorff, L. (1998) The Endless Transition: A 'Triple Helix' of University - Industry – Government Relations. *Minerva*, 36; Etzkowitz, H., Leydesdorff, L. (2000) The dynamics of innovation: From National Systems and 'Mode 2' to a triple helix of university–industry–government relations. *Research Policy,* 29.

12 Limoges, C. (1996), *L'université à la croisée des chemins: une mission à affirmer, une gestion à réformer*. Quebec: Actes du colloque ACFAS.CSE.CST, Gouvernement du Québec Ministère de l'Éducation.

- **Trans-disciplinarity**. Research is ever more trans-disciplinary in nature, while in the past it was narrowly carried out in specific disciplinary domains.

Trans-disciplinarity

- **Quality control enlargement**. Quality control systems are changing, involving other actors beyond peers (knowledge brokers, final users, etc.) and applying multiple assessment criteria.

Quality control enlargement

- **Accountability**. There is an increasing need for making science accountable towards a wide range of actors, with effects such as the proliferation of evaluation exercises and modification of research procedures (for example, disaggregation of trans-disciplinary research in order to allow disciplinary-based evaluation).

Accountability

- **Utilitarianism**. Research results are expected to have economic impacts. This does not mean only applied research is done, but rather that economic utility is applied as a parameter for any kind of research program. Therefore, a discovery is assessed for its commercial value, even before it is assessed for its scientific value.

Utilitarianism

- **Political steering**. Policy makers show an increasing desire to lead the research process and to steer research priorities, both at the European (through the framework programs) and the national levels.

Political steering

- **Competitive access to resources**. Access to public funds is increasingly based on competitive procedures, grounded on multiple criteria.

Competitive access to resources

- **Bureaucratisation.** Research is growingly submitted to bureaucratic and administrative regulations and standardised procedures (related to, for example, work security, application for funds, evaluation and assessment, fraud control, management, etc.)

Bureaucratisation

- **Hybridisation**. Relationships between universities, governments and industries are increasingly closer and co-ordinated. This results in the creation of "hybrid" structures and institutions (such as academic spin-off, high-tech incubators, science and technology parks, etc.).

Hybridisation

Overall, these tendencies result in a **closer and complex interaction between science and society.** A pivotal contribution, in this regard, has been given by the so-called **"social-constructionist" approach**, which decisively contributed **to overcoming any deterministic view** of science-society relationships: both the one, largely dominant in the past, understanding science as an autonomous and separate entity able to deterministically inducing changes in the society; and the reverse one, undoubtedly less diffused, understanding science as fully controlled by social processes, forces and actors. Rather, this approach allowed to highlight how science and society are involved in a sort of **"co-construction" process**, since the evolution of the one is increasingly influenced by that of the other, even if not without tensions, conflicts and contradictions.

Co-construction of science and society

On the basis of the interpretations presented so far, some points deserving particular attention can be singled out.

Emerging trends

The deepness of transformations

"Techno-sciences"

Firstly, all interpretations show that transformations presently affecting science and technology are not partial or marginal, but **deep** and "**systemic**" in nature, radically altering the way in which research is done and modifying the same social meaning of science.

One of the most significant effects of these transformations is that, in the new context, science and technology have become inextricably intermingled or hybridised in some sense, giving birth to a unique "**techno-scientific" system**. Science is increasingly aimed at the technological product, while technology is increasingly based on scientific procedures and technology plays an increasing role in doing research. The shift from science to technology is no longer the output of a linear process proceeding from basic research to industrial development, allowing to mark the boundary where science ends and technology starts.

Science-society co-evolution

At the same time, these transformations have made **science-society relationships much more intense and complex**. While, in the context of industrial society, science and society had few relations, being limited by social and institutional mechanisms (it is not by chance that university were viewed as an "ivory tower"), today, in the context of post-industrial society, they continuously interact at different levels, producing widespread phenomena of **overlapping** and **hybridisation**, but also **conflicts** and **mutual rejection**. Pursuing a harmonious **science-society co-evolution**, therefore, becomes particularly **difficult**, even though increasingly **necessary**, since science more and more needs society and society, to develop, more and more needs science.

Scientisation of society

This enlarged and intensified interaction between science and society is reflected in the augmenting presence of science and technology in all sectors of society. It seems that a "**scientisation of society**"[13] is occurring, that is a massive diffusion within society of ever more powerful and low-cost technological products as well as a large penetration in the daily life of the universal principles and logics on which science is based. However, this process is also occurring in a contradictory way, producing conflicts, resistances and unbalances which heavily influence the way in which science and technology are socially managed.

Research as social enterprise

This large array of processes makes research a matter which no longer involves only scientists or public agencies. Actually, scientific and technological research is becoming a complex **social enterprise** requiring to a greater extent **close cooperation** and **free-flowing communication** among many different social actors (researchers, decision-makers, financing institutions, research technicians, evaluators, research managers, enterprises, local administrations, scientific communicators, civil society bodies, ordinary citizens), each of them bearing specific interests, culture and representations of reality.

13 Schofer, E. (1999) The Rationalization of Science and the Scientization of Society: International Science Organizations, 1870-1995. In Boli, J., Thomas, G. (Eds.), *Constructing World Culture: International Nongovernmental Organizations Since 1875.* Stanford: Stanford University Press.

[K] CHAPTER'S KEY ISSUES

- The growing importance of research reflects **broader transformations** which, mainly since the 60s of the last century but with accelerating pace in the following decades, are affecting all contemporary societies.

- Almost all the scholars agree in recognising weight and size of these transformations, even though it is **still open the debate** on whether they are the signs of an overall **overcoming of the industrial society** towards a **new type of society**. About this shift, **different interpretations** have been developed (post-industrial society, information society, knowledge society, risk society, reflexive modernity, liquid society, post-modern society).

- Notwithstanding the strong differences among them, these interpretations allow identifying a **set of change processes**, relatively unequivocal and well-defined in their core features. The most relevant of them is probably that of the **modified relationships between social actors** (individuals or groups) **and "social structures"** (which they manifest themselves, for example, through social norms, behavioural models, social roles, values, etc.), producing a weakening and crisis of the "**institutions of modernity**"

- Like all institutions of modernity, **science is profoundly changing**, moving in the same direction as the social system as a whole. Consequently, **science-society relationships** are changing too.

- To account for these transformations, different **interpretative models** have been developed, allowing to single out **some overall trends** of change within science and in science-society relations.

- These models show how **deep and systemic these transformations are**. They are leading to new ways of scientific production, an increasing co-penetration between science and technology (techno-sciences), a profound modification of the social meanings attributed to scientific and technological research and more intense and often problematic relationships between science and society.

- This large array of processes increasingly makes scientific and technological research a complex **social enterprise** requiring to a greater extent close cooperation and free-flowing communication among many different social actors.

CHAPTER THREE

TOWARDS A NEW AWARENESS OF RISKS INVOLVING SCIENCE

As we already stressed, current transformations can put scientific and technological research at risk. In this chapter, this aspect is elaborated, focusing the attention on the **risks** that could derive from **a poor or wrong management of these changes**; risks that could affect both science and society.

Two main critical areas can be identified here:

- the **first** area is that of the "**identity"** of the scientific and technological research, that is the way in which research system controls and steers itself;
- the **second** area is that of the **adaptation** of science to society.

[1]

THE IDENTITY OF RESEARCH

The **first critical area** is that of **identity**. This concept is used here to refer to the capacity of research, so to say, to get a control over the transformations which modify it from inside and to steer them towards specific desirable aims.

As shown above, while traditional structures of research (its specific culture, operational procedures, social position, sources of authority, etc.) are weakening and even disappearing, the new ones find it hard to emerge.

Therefore, **steering the research processes** appears even more difficult, at all levels (from the management of the smallest research groups up to the development of long-term European research policies). There are several factors that come into play.

Patchy changes

First of all, transformations affecting science and technology are **not occurring everywhere** nor with the **same intensity**, they are not producing the **same effects** and their final **outputs are not really predictable.**

For this reason, **research less and less seems to be a unitary social institution**, characterised by a high level of uniformity and, therefore, by a consistent identity. On the contrary, it appears to be a multifaceted entity, where diverging rules and social practices can coexist. Scientists, too, are no longer a relatively homogeneous social group as they were in the past and the ways in which they fulfil and view their role is now extremely variable. This means that pre-defined recipes for successful support of scientific and technological research do not exist; therefore, intervening in it requires to continuously combine action and analysis.

National differentiations

In **Europe**, this picture is further complicated by the presence of **strong differences** among **member states** in the ways these transformations are interpreted and managed, even though, thanks to European institutions, important convergences are arising. These differences – which are, at the same time, a richness but also a risk for European research - are due to different factors, such as diverging scientific traditions, different structures of national research systems, diverse attitudes of people towards innovation, varied features of national economies and specific research policies devised at national or local levels.

Poor awareness by the actors of research and policy makers

It should also be remarked that the **actors involved in the research processes** (research institutions, scientists, research managers, etc.) **are usually not fully aware** of the changes affecting science and technology and of their short-term and long-term implications. Moreover, actors' reactions to change are diverging (ignoring it, resisting it, accepting it selectively, etc.). The same can be said about **policy makers.** Most of them ignore the current evolutionary trends of research; their attitudes and strategies are often diverging and not so rarely inconsistent. This appears to be particularly serious since – as already highlighted – policy makers increasingly show a desire to directly steer the research process.

Expert knowledge and post-normal science

Another factor influencing the "identity" of research is the **growing pressure on research institutions** (primarily enacted by governments and international institutions, but also by important sectors of the public and of civil society) to **address complex high-impact problems** (related to health, environment, energy, and the like) and to be **more committed to policy making processes**. Consequently, increasing attention is devoted to the nature and role of "**expert knowledge**" in social life and in policy making, with special reference to its actual use in the different sectors and its relationships with "ordinary knowledge". In this same framework the large debate on so-called "**post-normal science**" can be understood as well. This is on the epistemological ground, procedures and rules characterising research in cases where "facts are uncertain, values in dispute, stakes high and decisions urgent"[1].

Beyond these overall considerations, there are **some specific risks** deserving particular attention[2].

Mis-steering

The main risk is that of "**mis-steering**", i.e. the scarce capacity of decision makers (be they scientists or not) to adequately lead the research sector (box 3.1.). This is due to, e.g. an inadequate knowledge of research dynamics and mechanisms, wrong choices among conflicting priorities, under- or over-estimation of given research sectors in terms of economic potential, lack of scientific culture or failures in identifying or mobilising key actors.

Shortage of adequate skills and expertise

This kind of risk is worsened by the shortage and bad use of professional figures increasingly necessary in the research process. In the European research base, for example, there are problems with the presence and effective use of professionals with **skills and**

1 Funtowicz, S., Ravetz, J.R., Post-normal Science. *The Encyclopedia of Earth*, (www.eoearth.org/article/Post-Normal_ Science)

2 See SS-ERC Project (2007) *Final Research Report*, (http://www.techresp.eu)

expertise on, e.g. research management, university-enterprise relationships, European funding process, scientific communication, management of large research networks, high-tech incubators, technology screening or academic spin-off. In this way, on the one side, scientists risk to be damaged in their research activities (since they have to take an overload of work) and, on the other side, there is an increase in research costs as well as waste of time and resources.

[Box 3.1] VOICES OF RESEARCHERS: MIS-STEEERING

Many people here are stressing the extreme power of politics on research. I do not see it. Rather, I see **the weakness of politics**. There is a **gap in the policy makers' capacity** in guiding the research sector, in assessing the weight and potentials of the research projects, in embedding research within policy programs (Italy)

It's a problem that the government doesn't know the inside of research problems, so **they aren't capable of asking the right questions** and they can only stick to their (different) perspective (Netherlands)

(Policymakers) still think in **linear models and input-output models**. Policymakers have expectations that are often unrealistic, in particular to some fields of science (Denmark)

Other risks are **wrong prioritisation of research areas** and **waste of resources** – narrow prioritisation that may have consequences for future research, or funding allocated only to areas which are "in" (example: nano-technology). (Denmark).

Because of a lack of goals, (at the European level) there are no choices made. They are trying to satisfy all parties and not society in general. **There's a lack of decisions and learning from mistakes**. Too many countries and inadequate skills prevent learning and advancement (Netherlands)

Political leaders are unprepared. They still continue "to think analogically"; therefore, they cannot imagine the future in a "digital way" (Italy)

(passages drawn from the interviews conducted in the framework of the SS-ERC project)

Over-steering

Another risk is the tendency by policy makers to **over-steer research**. This could result in different kinds of negative effects such as conflicts, forms of subordination of researchers to policy makers, useless and/or uncoordinated evaluation exercises, psychological stress among researchers. This phenomena have been already recorded in different national contexts (e.g., Denmark, the Netherlands), also with reference to the European research policies.

There is also the risk that policy makers could use the increasing significance of science as a **symbolic tool** to be used in the political arena and in public debate. There is a "rhetoric" about the centrality of science and innovation which sometimes generates a "**rhetorical steering**" of research, that is an action aimed at increasing the political control on research but not interested in supporting research or in pursuing specific objectives. This often results in measures and programs carried out without following precise strategies and even without investing the necessary resources.

Rhetorical steering

[Box 3.2]
VOICES OF RESEARCHERS: OVER-STEERING AND RHETORICAL STEERING

Another central risk is the **growing wish/need among politicians to manage and control research**. Of course there is a legitimate demand for knowledge - the return of the investment from the taxpayers, but there is a need to understand that research and new findings - to a certain extent - cannot be planned and orchestrated top-down (Denmark)

Thus, there is quite a wide **gap** between the **bureaucrats** who have **to 'score' short-term**, and the **scientists** who are more driven by the **progress of science** and try to adept just enough to qualify for the funding (Netherlands)

A central risk is that related to mercerisation of the research – because it represents a threat to the creativity and independency of the research communities and **in the long run could produce less fruitful results** (in spite of the growing investments and societal interest in research) (Denmark)

The problem which we encounter in practice arises from the fact that in everyday life **the need for science is mainly declarative**: more science is needed, more information is needed and this is what will make Slovenia more competitive. In practice, concretely, i.e. in the operative sense, it is much harder (Slovenia)

There is the danger of **over steering of research in both industry and academic settings** (…) One should not depart from the principle of trust: one should trust the intelligence of science and the ability of scientists to think reasonably, to not push them and make them obey politicians and bureaucrats (Netherlands)

In this context (of political centralisation of research), the researchers are asked only to implement **what is required by the economic intelligence** (Italy)

European laws and regulations in any area are too much. Too many rules, too much red tape, and this hinders innovation. The huge amount of bureaucracy takes time and also decreases creativity. (Netherlands)

While we are debating on the centrality of the research, **we are cutting the public investments on research** (Italy)

(passages drawn from the interviews conducted in the framework of the SS-ERC project)

Free-riding by private firms

Also the **orientations of the private sector** could carry some risks (box 3.3.). The most relevant of them is that enterprises, especially small and medium-size ones, although the context may be favourable to them, still face great difficulties in investing in research and in linking up with the research sector. This sometimes generates a real tendency to **free-riding**: companies try not to take the risks linked to scientific research (necessarily high) waiting or actively acting for transferring these risks on the shoulders of public actors (through public incentives to innovation, public funded initiatives to facilitate university-industry relations, forms of knowledge spill-overs from public research institutions, etc.).

[Box 3.3]
VOICES OF RESEARCHERS:
ENTERPRISES AND RESEARCH

Smaller companies do not realise the benefits good knowledge management brings. The **absorptive capacity of companies is limited** but they do not think this is a real problem (Netherlands).

The **interest of enterprises is only utilitarian** (…). They are not involved with research but mainly with the technological development in the short run (Italy)

(There are) few initiatives of private companies to increase R&D.(Spain)

There is a poor sharing of **responsibility**, mostly on the part of the **private sector**. Companies in the Netherlands do not keep up with their R&D expenditure (Netherlands)

I do not see enterprises which are particularly mobilised on research issues. This is mainly a problem of the lack of scientific culture (Italy).

(passages drawn from the interviews conducted in the framework of the SS-ERC project)

Therefore, as far as this first critical area is concerned, the overall question to be coped with is that of **endowing scientific and technological research with adequate tools to "control itself"**. Scientific and technological research needs qualified human resources, knowledge, procedures and means allowing those who are involved in the research process to timely recognise and interpret change processes and to drive them towards desired objectives, by supporting or, when necessary, countervailing them.

Increasing the capacity of scientific and technological research to control itself

[2] THE ADAPTATION OF RESEARCH TO SOCIETY

The **second critical area** is that of **science-society relationships**.

As already underlined, these relationships are **increasingly intense and complex**. Because of the weakening of the traditional structures of modernity, which tended to keep science relatively isolated from other social spheres, and as a consequence of the diversification of science and technology production sites, today science constantly interacts with society at different levels, in many ways and through multiple channels. There are no longer gatekeepers or recognised authorities able to regulate this intense traffic of exchanges.

Intensifying science-society relationships

Reaching a state of equilibrium, even though a dynamic one, between science and society appears to be more difficult and the **risks** that could arise are of different nature.

The closest and perhaps the most serious risks are those of a progressive **delegitimation** and **social marginalisation** of research (box 3.4.).

This is a **contradictory phenomenon**. According to Eurobarometer pools, 9 Europeans out of 10 think that scientists are giving a great contribution to the development of society; science museums and science centres are increasingly popular and attractive; popular magazines specialised in science and technology are increasing in number and diffusion. And yet, according to many sources (including various European institutions[3]), relationships between scientific and technological research and the different social spheres remain problematic. For example: the social status of European scientists seems to be declining; young people remain scarcely interested in scientific careers; research institutions in Europe are poorly attractive for young talents; people's distrust and indifference

Delegitimation and social marginalisation of science and technology

3 See, for example: EURAB (2007), *Research and Societal Engagement*. Brussels; Grablowitz, A., Delicado, A., Laget, P. (2007) *Business R&D in Europe; Trends in Expenditures, Researcher Numbers and Related Policies*. JRC/IPT/Erawatch, Brussels; European Commission (2007) *Towards a European Research Area. Science, Technology and Innovation. Key Figures 2007*. Brussels; European Commission (2008) *Reports of the ERA Expert Groups. Executive sommaries.* Brussels.

in science and technology is diffused, even though there are broad social areas where they are accepted and supported; very few civil society organisations and universities are engaged in working together; the interest of enterprises towards research is still limited.

[Box 3.4]
VOICES OF RESEARCHERS: RISKS OF SOCIAL MARGINALISATION OF SCIENCE AND TECHNOLOGY

When there is **insufficient communication**, the distance between scientists and citizens increases, which relates to the perceived legitimacy of science (Netherlands)

Local communities are not really interested in "rocket science", but rather in using research results in practice in order to help the development of their own community (Slovenia)

What is in danger is the legitimacy of technology: In the example Nanotechnology and GMOs you see that these technologies are in danger of losing their legitimacy because the public **does not trust the organisations [companies] working with these technologies** (Netherlands)

The risk of a **delegitimation of research in Italy is a real danger**. Result? We will be a country of technological consumers but not of technological producers, even though we will continue to generate new ideas that others will exploit (Italy)

(There is the need for) **mechanisms of social legitimisation** (…). In a, so to say, "technified" or "technocratic" society, I believe that places for a social debate and evaluation of the impact of science and technology are lacking (Spain)

People got to a point when they said "this (the science) is going very, very fast, **I can't understand it** and **I am afraid** that something will happen which I cannot control anymore." Saying that, they saw they couldn't stop the process. (Netherlands)

(passages drawn from the interviews conducted in the framework of the SS-ERC project)

Self-isolation

On the opposite side, there is also the risk of a progressive **self-isolation of research actors towards society**. Many scientists and research institutions are still working nearly as if nothing were changed in science-society relationships and within scientific and technological research. Other researchers and institutions see the claims for accountability and the criticisms moved toward science and technology by different sectors of society as unacceptable forms of interference. Initiatives for scientific communication and social dialogue on science and technology remain few, scattered, occasional and sometimes of a pure symbolic value. All in all, there is a sort of "**viscosity**" or a **resistance** by research actors to modify their own procedures, orientations and attitudes, even though they are increasingly under pressure to dialogue with society. In this way, the main risk is that changes occur through a chain of unintended and poorly managed "landslides".

A responsibility gap

The combination of these two trends – social marginalisation of science and self-isolation of the research actors – may result in a third risk, that of the emerging of a **responsibility gap** in research (box 3.5.). This gap, or, better, a lack of diffused "**technological responsibility**"[4], is generated both by the lack of involvement of many social actors and the public at large with science and technology and by the poor commitment of many research actors in driving transformation processes affecting science and technology. Hence, the risk that narrow and even isolated groups of experts could have a large influence the research as a whole.

Scientific communication

This responsibility gap is facilitated by the poor development of **scientific communication** focused not only upon "*science in the book"* (e.g., on past discoveries, on great scientists, etc.), but also on "*science in action*" (e.g., on the activities of research institutions, on the research strategies they are devising, on the obstacles they are dealing with, etc). The risk is that people know everything about Newton or Galileo, but nothing about the research programs carried out by their city's university and research centres.

Citizens' participation

At the same time, the limited diffusion of effective participatory mechanisms keeps citizens out of decision making processes on science and technology. In this way, a responsibility gap may result in a real **democracy gap**, at least about the steering processes of research and innovation.

[Box 3.5]
VOICES OF RESEARCHERS: THE RESPONSIBILITY GAP

Responsibility for S&T is increasingly being institutionalised or 'professionalised', and to a certain extent, Denmark witnesses a **concentration of power on the hands of professional administrators**. This also means that the social distribution of responsibility is narrowing down (Denmark).

In Spain **we are really very underdeveloped** [in the issue of citizen participation in S&T]. (...) Citizens are exposed to different news and signals from the scientific system, but they never can give an opinion about what to investigate (...) There are no channels for the citizens, communities, local governments, neighbourhood associations, consumers' associations, workers' unions and organisations of businesspeople, to express their demands of research and to discuss priorities and to influence policies (Spain).

4 Quaranta, G., (2007) Knowledge, responsibility and culture: food for thought on science communication. *JCOM. Journal of Science Communication*, 6 (4).

The question of citizens' involvement is a **tricky one**. How do you imagine citizens to participate fully? They can never participate on an equal ground. However it is important to involve citizens in an early stage of development, and not just economically before the endstage (Netherlands).

Many participatory exercises are really just 'tokenism' at worst or 'consultation' at best but not sufficiently connected to decision-making to be considered real participation. (Denmark)

People are interested in science, but it is difficult (for them) to **obtain information** that someone with a general education could process (Slovenia)

When a problem arises, there is an overdose in communication which makes the problem scaling up towards a given direction. People start worrying and mobilising, without understanding what is really happening. (…) This situation is to be prevented, through a practice of **permanent communication, making consultation with citizens possible** (Italy)

(passages drawn from the interviews made in the framework of the SS-ERC project)

Increasing the capacity of research to adjust to society

Therefore, the key problem in this **second critical area** is that of increasing the capacity of scientific and technological research **to adjust** to a more complex, contradictory, demanding and sometimes hostile society. This means both developing more effective tools of dialogue and bringing science and technology to come into terms with the **big trends** affecting contemporary societies (multi-culturalism, social fragmentation, gender dynamics, high speed communication, etc.) which, in different ways, influence research and its social and economic impact.

[3]

TECHNOLOGICAL DRIFT

As already underlined, the elements presented so far seem to show that, at least in Europe, science and technology are **in danger**.

We are not discussing about the success and positive impacts of science and technology, which are clearly visible. The pivotal question is that, despite its undisputed success,

scientific and technological research increasingly risks to be socially undervalued, and this may lead research to produce low quality results, from the scientific perspective, and poor impacts in term of innovation.

If **research is in danger**, **society is in danger as well**.

In 2005, the European Research Advisory Board (EURAB) - an expert commission supporting the European Union in the field of research policies - tried to assess the possible consequences of a crisis of the European research systems. In particular, EURAB identified **six great challenges** (box. 3.6.) requiring high-quality and high-impact research. These challenges are putting into question the future wellbeing of European citizens and the possibility for Europe to safeguard the core elements of its own identity.

Six challenges for Europe

[Box 3.6]
SIX CHALLENGES FOR THE RESEARCH IN EUROPE

"**The economic challenge -** The most important priority of Europe must be growth as the sine qua non condition for the sustainability of the social model, the success of enlargement, and the cohesion and the stability of Europe. The basis for growth is investment in research & development, education and infrastructure.

The global challenge - Today's challenges are global and not restricted to the national level. Problems related to climate, energy and environment cross national borders (…) and threats to health and life quality cannot any longer be seen from a purely national perspective. (…) The creation of new knowledge to address the global challenges will require a multi-facetted expertise and competence not often found in one single institution or country.

The demographic challenge - Europe has a problematic demographic profile in which a decreasing working generation has to sustain an increasing ageing population. (…) As a consequence, European innovation and efficiency needs to be at a higher level than those in other parts of the world, including the USA, to maintain economic competitiveness and to meet the demands of the health care system. Thus, Europe should not only aspire to reach the level of US research funding, but even try to exceed it.

The health challenge - With an aging population comes also an increased demand for extended medical care. With the completion of the Human Genome Project, medicine is about to enter a new era of earlier diagnosis, more individual treatment, better prevention of diseases and maybe new types of treatment.

The European cohesion challenge - A condition for increasing the European competitiveness is a stronger cohesion between countries, regions, and also within our societies. In particular with the expansion of the EU, an upgrading will be necessary of national knowledge and levels of research infrastructure for newly accessed member states in synergy with the structural funds to enhance growth and employment and to guarantee the European cohesion.

The European culture challenge - The concept of European Cultural Heritage in the context of the enlarged European Union could also be a key focus for a new research effort to explore its meaning in Europe's growing and diversified multi-ethnic societies.(…) Understanding culture, language and society is a key factor for more security and to solve religious, cultural and social conflicts."

(Excerpt from EURAB (2005) *The Financial Perspective for Framework Programme 7 and Criteria for the Selection of Topics for the Work Programmes.* Brussels)

Technological drift

Moreover, the limited capacity of scientific and technological research system to control itself and to adjust to a changing society could trigger widespread and serious process of "**technological drift**", which could lead into an overall deterioration of the social and economic system.

We can speak about a "drift", since science should be produced anyway, but in the absence of any effective social and political orientation and public interest. Consequently, research could become ever less important in both economic and social terms.

Scarce or bad connections between research and society at different levels could produce **different effects**.

Researchers' and research institutions' motivations, strategic orientations and aims would progressively weaken and even fade, up to the point of losing the capacity to collect and mobilise "**human agency**" and resources needed for carrying out high quality research.

Science and technology would keep a pivotal role in the social life. However, national and local communities would be increasingly dependent from technology produced elsewhere, no longer being able to manage, adapt, modify, develop and use it. Forms of "**technological dependentism**" could arise, exposing European countries or some of them to economic subordination, brain drain and cultural colonisation from abroad.

The "**drift effect**" could be further worsened by the **shortage of high quality researchers and experts** and the lack of good **research infrastructures.** This could reduce the capacity of European societies to govern themselves and to cope with the complex economic, social, environmental and technological problems challenging them. They would be less capable to master themselves; they would increasingly develop by imitating and applying external models; finally, they would no longer have the cultural tools and the "social force" needed to build up their own future.

[K]

CHAPTER'S KEY ISSUES

- **Two main critical areas** for research could be identified.

- The **first area** is that of the **"identity" of scientific and technological research**, which is the capacity of research, so to say, to get a control over the transformations which modify it from inside and to steer them towards specific desirable aims.

- The **second critical area** is that of **science-society relationships.** These relationships are **increasingly intense and complex:** science and technology constantly interact with society at different levels, in many ways, and through multiple channels. There are no longer gatekeepers or recognised authorities able to regulate this intense traffic of exchanges.

- These two critical areas required to be coped with reinforcing the capacity of European research systems both to **steer themselves** and **to adjust** to a more complex, multifold, contradictory, demanding and sometimes hostile society.

- The elements presented so far seem to show that, at least in Europe, research is **in danger**. Despite their undisputed success, **research increasingly** risks to be socially marginalised, to lose in weight and visibility, to be addressed toward wrong goals, to be far from the needs of society. In the middle run, this may lead research to produce low quality results, from the scientific perspective, and poor impacts in term of innovation.

- In this framework, the capacity of Europe to cope with the **big challenges** putting into question its future would be reduced. In particular, widespread processes of "**technological drift**" could arise, leading to an overall deterioration of the social and economic system and an increasing dependence from technology produced elsewhere.

CHAPTER FOUR

THE POLICY GAP

This first part of the handbook has been aimed at outlining **the main themes** revolving around science and technology in contemporary societies.

Even though in a sketchy way, the main changes affecting societies as a whole and in particular those involving scientific and technological research have been examined. This allowed us to highlight how profoundly are the transformations that have been occurring in the last decades in the ways of production of science and technology as well as in science-society relationships.

As we saw above, these changes encouraged **positive tendencies** towards a more productive, accountable, open and problem-oriented research. However, many **problems** are arising in the way in which these transformations are perceived, welcomed, interpreted, managed, supported and driven by the many actors today concerned in science and technology production, by the stakeholders and by the public at large.

To complete the picture of the main themes connected with science, technology and society, one aspect remains to address, i.e. which policies have been devised to deal with these changes, which are their objectives and what are their results so far. Therefore, in the next secton, a short presentation of the policies developed by the European Union to cope with the transformations involving science and technology in the context of the "knowledge society" will be offered.

[1] EUROPE AND ITS COMPETITORS

The Lisbon Strategy

In Europe, in the last decades, a new vision of science and technology has been progressively emerged. This vision sees science and technology as the **structural backbone** of and the **fuel** for a broader transformation radically affecting contemporary societies as a whole, to be strategically driven.

This vision found its utmost expression in the so-called "**Lisbon Strategy**" (box 4.1.). Established in 2000, the Strategy is aimed at favouring the convergence between research and other key-sectors for the European economic and social development. Therefore, the Lisbon Strategy can be understood as the European "**global strategy**" for the beginning of this century.

[Box 4.1]
THE LISBON STRATEGY AT A GLANCE

The Lisbon strategy is aimed at achieving results in three domains: economy, social protection and environment.

As for the **economy**, the strategy was intended to enhance ICTs, to promote a strong co-ordination of research at the European level, by creating a common European Area of Research and Innovation (ERA), to promote a more friendly environment for business (and mainly for SMEs) and to improve the circulation of goods, persons, services and capital within Europe.

As far as **social protection** is concerned, the Strategy is based on the assumption that creating a knowledge economy requires the enhancement of the working and living conditions, promoting a more flexible social protection system. This requires reorganising the education system, enlarging the presence of women in the labour market, the adoption of an active employment policy and the adoption of new measures against poverty and social exclusion.

Finally, as for the **environment**, the objective is that of promoting an environmentally sustainable economic growth, starting from some priority sectors (climate change, viable ecological transport, health security, sustainable use of natural resources, clean technology, greenhouse effect).

Since its establishment, the Lisbon Strategy **met many obstacles in its implementation** to the point that a complex process of revision and re-launch was started.

The Revised Lisbon Strategy

On the basis of the results of a specific commission – led by the Dutch former prime minister Wim Kok – in charge of assessing the implementation of the Strategy, in 2005 the so called "**revised Lisbon Strategy**" was established, introducing both substantive changes (narrow focus on the economic dimension, with respect to environmental issues and social protection) and methodological ones (definition of new "integrated guidelines for the Strategy implementation"; reform of governance and monitoring mechanisms, by establishing two 3-year cycles of implementation; production of an annual report on the Strategy implementation stage by each Member State).

The European Research Area

Although its overall results are still disappointing, the Lisbon Strategy made a deep transformation of the European research policies possible, mainly by establishing, as their common objective, the creation of the so-called **European Research Area (ERA)** (box 4.2.).

[Box 4.2] THE EUROPEAN RESEARCH AREA: ESSENTIAL FACTS

In 2000, in the framework of the Lisbon Strategy, the EU decided to create the European Research Area (ERA), that is a unified research area all across Europe based on **six main principles**:

[a] An adequate flow of competent researchers – The ERA could enable researchers to move and interact seamlessly within Europe, by creating a single labour market with attractive working conditions for both men and women.

[b] World-class research infrastructures – The ERA could allow the building of research infrastructures which should be integrated, networked and accessed through the concomitant development of new generations of electronic communication infrastructures, both in Europe and globally.

[c] Excellent research institutions – The ERA could progressively structure itself along the lines of a powerful web of research and innovation clusters, mostly interdisciplinary, able to interact routinely with the world of business as well as to engage in durable public/private partnerships.

[d] Effective knowledge sharing – The ERA could make possible: an open and easy access to the public knowledge base; a simple and harmonised regime for Intellectual Property Rights, including a cost-efficient patenting system and shared principles for knowledge transfer and cooperation between public research and industry; innovative communication channels to give the public at large access to scientific knowledge, the means to discuss research agendas and the curiosity to learn more about science.

[e] Well-coordinated research programs and priorities - The ERA could allow the identification of research priorities for Europe through joint foresight, involving the scientific community, society and industry, and jointly decided and acted upon joint programming, implementation and evaluation of public research investments at European level on issues that go beyond the capacities of individual countries.

[f] A wide opening of the European Research Area to the world – The ERA could feeding the participation of neighbouring regions of the EU, as well as on developing multilateral initiatives to address global challenges with EU's partners.

Like the entire Lisbon Strategy, the process of creation of the ERA has been **submitted to a revision**. In 2007, the European Commission published a Green paper[1], on the

[1] European Commission (2007) *Green Paper. The European Research Area: New Perspectives.* Brussels.

basis of the work done by a set of expert groups, on the state of implementation of the ERA. The evaluation allowed to identify some important advancements as well as some serious hindering factors

The advancements...

The most **important advancements**, according to the Green paper, have been:

- the substantial increase in the European research funds starting with the launch of the 7th EU Research Framework Programme;
- the launch of initiatives (European Technology Platform, ERA-Net) geared to improve the co-ordination of research activities and programs;
- the more extensive use of the "open method of co-ordination", which supported the convergence of the Member States on common objectives (such as that of reaching the target of 3% of the GDP on research and development);
- the establishment of a "broad-based innovation strategy";
- the increasing importance recognised to "the development of research and innovation capacities, particularly in less developed regions" in the framework of the cohesion policies.

...and two critical points

The document stresses also **two main critical points** in the creation of the ERA.

The **first** is the **high fragmentation of the public research base**. Among the main factors producing this situation, the experts highlighted: the existence of legal and practical barriers hampering the mobility of researchers among institutions, between public and private sectors and among countries; the problems met by enterprises in co-operating with research institutions; the limited co-ordination among national and European research funds; the limited attention given to the European perspective in reforming the national research systems.

The **second** critical point is the poor capacity of the European research base to be competitive enough **to attract private investments on science and technology**. This impedes to overcome the present 1.9% of GDP devoted to R&D.

European Science and Society Action Plan

Another European policy worth mentioning is the strategy geared to **improve science-society relationships**, launched in 2001 and embodied in a specific **Action Plan** revolving around three main axes:

- promoting scientific and education culture in Europe;
- bringing science policies closer to citizens
- put responsible science at the heart of policy making, strengthening the ethical basis of scientific and technological activities, detecting and assessing the risks inherent in progress, and managing them responsibly on the basis of past experience

The competitors

These growing efforts made by European institutions are justified by the fear that

Europe, losing ground in the domain of research, **could not keep pace** with other more dynamic economies.

These worries are not ill-founded (box 4.3.). Actually, main indicators show that **European research is decreasing in weight and quality** in the global scale, with respect to both the traditional competitors (USA, Japan) and the new Asian emerging countries (China, India).

[Box 4.3]
THE COMPETITORS OF THE EUROPEAN RESEARCH

R&D Expenditures. "Europe's R&D intensity remains at a lower level than the R&D intensities of most of the other major world economies such as the US, Japan and South Korea. (….) In 2005, only 1.84 % of GDP was spent on R&D in EU-27. In Japan, the US and South Korea (…) the trend over the past decade has been much more positive, outpacing Europe's performance in R&D intensity growth (….) China will have caught up with the EU by 2010 in terms of R&D intensity."

Human Resources. "Asian countries that have been a major source of mobile human resources in S&T for both Europe and the US are developing their own S&T infrastructures. During the past two decades, two-thirds of foreign students earning a US S&E PhD were from Asia (…) China already surpassed the EU with 4.4 million graduates from tertiary education compared with 2.5 million in the EU."

Private sector. "The private sector contribution to the financing of R&D in the EU has not progressed substantially over the past 10 years. R&D financed by the business sector remained at about 1 % of GDP in the EU, without any noticeable variation over the decade. In 2004, the private sector financed 64 % of total R&D in the US, 67 % in China and 75 % in both Japan and South Korea, compared to only 55 % in the EU."

Scientific Outputs. "The EU is the world's largest producer of scientific output, as measured by its share in the world total of peer reviewed scientific articles: in 2004, the Union represented 38 % of world scientific output, compared with 33% for the US and 9 % for Japan. (….) However, the shares of both the EU and the US have been declining in recent years, because of the rise of new global actors such as China and India. The total number of scientific publications produced each year grew by less than 10% in the advanced economies between 1997 and 2004 (by 6-7 % in both the EU and the US) while, in the emerging countries, it rose by more than 40 %. Chinese annual scientific output almost doubled between 1997 and 2004."

(Excerpts from European Commission [2007] *Towards a European Research Area. Science, Technology and Innovation. Key Figures 2007*, Brussels).

[2]

DEVELOPING SCIENCE AND TECHNOLOGY SOCIALISATION POLICIES

The European engagement in the field of scientific and technological research has been and still is **steady** and **strong**. This allowed to make important steps toward the construction of the European Research Area. However – as stressed by the same European institutions – the difficulties to cope with are still many.

Only part of them can be brought back to e.g. research funds, research infrastructures, number of researchers, legislation or the institutional structure of the European research systems. Actually, with the same investment levels, scientific and technological research in Europe could be more effective and performing if social dynamics, in a broad sense, connected with research were successfully handled.

These dynamics, when ignored or poorly managed, may manifest themselves as constrains and obstacles of different nature (e.g. conflicts, tensions, tendencies to resist changes, lack of co-ordination and communication, lack of skills and capacities, lack of transparent behaviours, etc.) affecting various areas of the research process (research practices, innovation, communication, etc.). The picture is further puzzled by the high fragmentation characterising the 27 member states, each of them displaying different combinations of problems and potentials to be approached through specific strategies.

In this framework, it appears to be appropriate to speak of a **gap** in the capacity of the European and national policies to handle social dynamics embedded in science and technology. This results, in turn, in a decreasing effectiveness of research actors to implement research policies as a whole. It is to be noticed the effort made by European institutions also in devising new policies specifically addressing these issues (e.g. scientific communication, scientific evaluation, university-industry relationships). However, the picture is still fragmented and incomplete. In many cases, what is lacking is a more co-ordinated action able to have impacts on the primary social mechanisms, personal orientations, diffused behavioural patterns, social relationships which day by day contribute in shaping the research process.

As we already anticipated, in this handbook, we are proposing to cope with this broad range of phenomena and processes in a single perspective, that of the **socialisation of scientific and technological research**. This choice should be helpful in mapping up the obstacles to overcome, but above all in developing, at the appropriate level (department, research institution, local level, etc.), effective measures to fill this policy gap.

In this perspective, in Part B, an **interpretative perspective** hinged upon the concept of science and technology socialisation will be elaborated. In Part C, a set of orientations aimed at developing **policies and measures** in support of the socialisation of scientific and technological research will be proposed.

[K]

CHAPTER'S KEY ISSUES

- The last issue to deal with in this part of the handbook is that of the **policies** devised for coping the problems connected with the transformations occurring in science and technology.

- In Europe, the effort in support of science and technology found its utmost expression in the so-called "**Lisbon Strategy**", launched in 2000. Particularly relevant, in this framework, is the objective of creating a single **European Research Area** (ERA). At the same time, the European Union, in 2001, established an **Action Plan** aimed at improving science-society relationships.

- The implementation process of the Lisbon Strategy, as well as that of the creation of ERA, up to now met a set of **serious hindrances**, rendering **European research base** still **highly fragmented** and **not competitive enough** to attract private investments.

- European institutions have tried to cope with these problems by **revising the measures** taken and by **establishing** a series of **new implementation and monitoring procedures**.

- The worries of European institutions about the delay of research seem not to be ill-founded. Actually, main science and technology indicators show that **research in Europe is decreasing in weight and quality** on the global scale, with respect to both the traditional competitors (USA, Japan) and the new Asian emerging countries (China, India).

- In this regard, it appears to be appropriate to speak of a **gap** in policy making exactly concerning science and technology socialisation, to be overcome as soon and effective as possible.

Part

PART B

ORIENTATIONS FOR INTERPRETING

t[B]

CHAPTER ONE

A MAP OF THE CURRENT STATE OF SOCIALISATION

Part A of this Handbook presented some important developments in science and society that took place in the second half of the twentieth and early twenty-first century. Several of these developments may put science and technology, and particularly their role in society, at risk. It is therefore important to pay explicit attention to strengthening the position and role of science and technology in society, in the form of **socialisation of science and technology**. This part B will develop further insights into processes of socialisation, starting from a working definition describing socialisation as "the processes involved in the production, use and circulation of scientific research and its products in an inseparable connection with its social context". This working definition will be further clarified and elaborated in the following pages. To start, the next section will first discuss two different conceptions of socialisation. After that, attention will be paid to existing forms of socialisations and the challenges that face socialisation in Europe today, ending with a call for **'high quality socialisation'**.

[1] TWO CONCEPTIONS OF SOCIALISATION

The descriptive sense

Socialisation can be used as a descriptive and as a prescriptive term. In its **descriptive sense**, socialisation describes the **interconnectedness between science, technology, and society**. Descriptive accounts of socialisation are mainly produced by social scientists analyzing science and technology.

An **important shift in the description of science/society relations** took place in the 1970s (see Box 1.1). Before that time, sociologists and philosophers were primarily interested in the **problem of demarcation**, which is, how to distinguish science from other (intellectual) human endeavors. Yet since the 1970s there is an increasing recognition that science and society are closely tied together and that scientific research and the development of technological artifacts are themselves deeply social phenomena. As a result, science and technology are also deeply social in their outlook, incorporating social values, cultural differences, etcetera.

[Box 1.1] FROM DEMARCATION TO SOCIOTECHNICAL NETWORKS

In the fields of philosophy and sociology of science before the 1970s, the main question was that of **demarcation**. Put briefly, the problem of demarcation is concerned with the question **what distinguishes science from other (intellectual) human endeavors** such as, for example, art and religion. One of the most important propositions of a way to demarcate science from other activities is the principle of falsification, developed by philosopher of science **Karl Popper**. This principle states that a theory about nature can only be considered to be scientific if it allows for the formulation of hypotheses that can be tested, and be rejected on the basis of such testing. Another important way to demarcate scientific research from other human activities is the more sociological approach developed by **Robert Merton**, who lists four core values of scientific enterprise. According to Merton, science is characterised by communalism, universalism, disinterestedness and organised skepticism. Scientists should strive to work according to these values that function as internal measures of quality in science.

A shift in the scholarly attention for science and technology occurred following the work of physicist and historian **Thomas Kuhn**, who stressed the important role of social relations in the training of scientists and rejected the idea of ongoing progress in science in favour of a distinction between 'normal science' which is similar to puzzle solving and 'revolutionary science', which is when one undisputed paradigm is replaced by another one.

Following Kuhn's work, some sociologists started approaching **science is a social activity like many others**, which eventually lead to the insight that science and society are closely related in what one could call socio-technical networks. An early version of this position was developed as the Strong Programme, based on principles described by **David Bloor** that it seeks causal explanations, looks impartially at successful and unsuccessful claims, uses symmetrical explanations for success and failure and is reflexive towards its own claims. Later work in social studies of science criticised Bloor and others for their emphasis on how social processes shape science and technology. This position, elaborated in **Actor-Network Theory**, maintains that scientific facts are not only shaped by their social context, but that in the process of scientific research, the social context is re-shaped as well. **Social and natural phenomena should therefore be treated symmetrically.**

Literature:

Bloor, D. (1991 [1976]) *Knowledge and Social Imagery*. Chicago: University of Chicago Press.

Kuhn, T. (1996 [1962]) *The Structure of Scientific Revolutions. Chicago:* University of Chicago Press.

Latour, B. (1987) *Science in Action.* Cambridge: Harvard University Press.

Merton, R. (1973) The Normative Structure of Science. In: *The Sociology of Science. Theoretical and Empirical Investigations*. Chicago: University of Chicago Press (267-278).

Popper, K. (2002 [1963]) *Conjectures and Refutations: The Growth of Scientific Knowledge*. London: Routledge.

The prescriptive sense

The second, **prescriptive** meaning refers to **socialisation as an objective for science and technology**.

In this sense, socialisation means the need for a growing awareness of how important it is to strengthen ties between science, technology, and society. This awareness also ought to be translated into action. Following this second meaning of the term socialisation, it is of vital importance **to strengthen the position of science and technology in society** not only by promoting it, but also by taking on board the importance of social processes and values for socialisation.

An example: the Public Understanding of Science

This point may be clarified by a brief analogy with attempts to stimulate public acceptance of scientific research through the strategy of '**public understanding of science'** (PUS). Traditionally, PUS was based on the assumption that presenting the scientific facts in a clear way to the broader public would automatically result in a broader acceptance of science and technology. What this position fails to recognise, however, is that a lack of 'scientific literacy' among the public is not necessarily the only or even main reason for people to object to certain forms of scientific research. Deeply held values may be equally important, as demonstrated by the example in Box 1.2. Therefore, socialisation as an enterprise should be aimed at strengthening both the role of science in society and of society in science.

[Box 1.2]
AN EXAMPLE OF HOW SOCIAL CONCERNS MAY AFFECT SCIENTIFIC RESEARCH

Following the Human Genome Project, several scientists started thinking about the idea of developing a project to chart the diversity of humanity, particularly by collecting and analysing blood samples from indigenous peoples. For a long time, they were unsuccessful in establishing such as project, both for scientific and social reasons. Scientifically, the method of taking random samples of indigenous people proved to be problematic. Socially, the project was met with much resistance from the people who were to be studied. Arguments referring to North/South relations, colonisation, intellectual property rights and the origins of human diversity were used to reject this research. Only if scientists would take these issues seriously, and find a way to solve these problems can such a research project be established successfully.

For more, see Reardon, J. (2001) The Human Genome Diversity Project. A Case Study in Co-production. *Social Studies of Science*, 31 (3), 357-388.

An under-socialised science cannot function

The idea that **science and society cannot be seen as separate entities** implies that socialisation in its prescriptive sense is an assignment for scientists, research managers, board members of universities and research institutions, policy makers, and the public at large. It also means that for a 'good' level of science and technology it is necessary to have a 'good' degree of socialisation. **Science cannot function when it is not adequately socialised**. This part of the Handbook will therefore outline some of the challenges and possible directions for the socialisation of science and technology in Europe. These directions will be further elaborated and operationalised in part C for the different **socialisation areas**, described next.

[2] SOCIALISATION AREAS

The **socialisation areas** described here and more fully in part C, cover some of the most important interactions between science and society – even though there may be other areas not covered by this list. The different areas of socialisation cover social interactions within scientific research, as well as the 'broader' social issues surrounding science, such as how to publicly govern science and respond to its results. In addition, the socialisation areas also cover different kinds of interactions between science and society. In total there are six areas of socialisation, listed in box 1.3

[Box 1.3]
THE SIX AREAS OF SOCIALISATION

- Scientific Practice
- Scientific Mediation
- Scientific Communication
- Evaluation
- Governance
- Innovation

Scientific practice

The first area, of **scientific practice,** focuses on the social processes relevant to doing research. On the one hand, these are **processes within research groups**, such as the contact between different researchers, hierarchies and distribution of tasks within research groups, etcetera. On the other hand, scientific practices also need to deal with **outside influences affecting research practices**, as far as they affect the actual process of doing research.

Scientific mediation

The area of **scientific mediation** refers to the – often informal and ad-hoc - **interactions between science and various social 'micro-environments' around it**, or in other words, the interactions between science and the immediate context that is not part of scientific practice itself. Examples include the interaction between research groups and other groups within the same institution or between research groups and for example companies or agencies funding research. Thus, the area of mediation deals with processes in which research groups and institutions position themselves in relation to others.

Scientific communication

The area of **scientific communication** is concerned with **exchange of ideas and information between science and society**. This exchange of ideas and information takes several forms. Scientific communication thereby explicitly focuses on processes and mechanisms for exchange of ideas and information between science and the outside world.

Evaluation

The area of **evaluation** includes the set of practices, programs, or actions aiming to measure **and evaluate all aspects directly linked to science and technology**. Again, evaluation is partially internal to science, but science and technology are also constantly evaluated from the outside. In simple terms, evaluation assesses whether science and technology 'work'. This means that evaluation aims to understand the impact of science in society, and is used to support decision-making about e.g. science funding.

Governance

The area of **governance** of science and technology is concerned with the **steering of science and technology in society.** This steering can take place at different levels, ranging from international organisations, supra-national bodies to national, regional, and even local government. Governance includes a variety of forms for steering science and technology, and a diverse set of actors –with an increasing role for (representatives of) the general public in recent years

Innovation

The area of **innovation** 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. From the perspective of socialisation, the area of innovation includes two issues. One of these issues is the perceived 'gap' between investments in research and the emergence of profitable new products; the other one is the question how to deal with innovations in society.

[3] SOCIALISATION AND THE SOCIAL SCIENCES

The potential contribution of social sciences to socialisation

For the different socialisation areas introduced above, many of the dynamics and mechanisms that are part of the relations between science and society have been investigated and interpreted in several branches of the social sciences[1]. **How can these social sciences contribute to socialisation of science and technology?**

First of all, it should be underlined that the different branches of the social sciences each hold an interest in different aspects of science and technology. One way to distinguish them is by looking at the different connections between social sciences, which indicates that there are two different "coalitions" within social sciences.

Two different "coalitions"

Economic and policy approach

- The first coalition focused on an **economic and policy approach** to science and technology. This coalition includes disciplines such as political science and economics, that have some specialisations in the area of science and technology, such as the study of science policy, management studies of science, evaluation sciences and economic studies of science and technology.

Social anthropological approach

- The second coalition is based on **social anthropological approach** on the other. This type of approaches more explicitly address the dynamics of how science and society relate, and how science itself functions in sociology, anthropology and science and technology studies (STS).

There is also a distinction between the various social sciences in terms of **how useful they are considered** to be for steering science and technology, in which a more prominent role is attributed to the political and economic approaches than to sociology and anthropology.

The actual uses of social sciences

But, beyond that, it is particularly important to understand **how social sciences are presently used to stimulate socialisation of science and technology**. Research carried out within the SS-ERC project on 217 social research institutions specialised in the study of science and technology provides some indications.

Interpretative use

The first use of social sciences is an **interpretative** one. This use refers to the more traditional role of social sciences of investigating and interpreting social phenomena and processes. These include the internal dynamics of science and technology, as well as the interactions between science, technology, and society. **This use can have different forms.** As a perspective on the relation between science and society, the interpretative use of social sciences is both the most widespread (more than 55% of the investigated insititutes) and the most well-established.

Functional use

A little less diffused use of social sciences (more than 30% of the institutes) is a **functional** one, in which the social sciences **produce knowledge that is helpful for solving problems** confronted by researchers and research institutions. It is especially this orientation towards problem-solving that distinguishes this use of social sciences from the other ones. One of the most prominent areas of functional social sciences is the field of **science policy studies** that explicitly addresses the question how science is steered and which kinds of problems arise therein. Whereas in the natural sciences especially such functional contributions from the social sciences would be very much welcomed, a complicating factor is a generally reserved attitude towards a role as 'problem solver' for the natural scien-

[1] This section is based on the final report of the SS-ERC project. More on the role of social sciences in socialisation can be found there.

ces in much of the social sciences.

Substantive use

The third of these is a **substantive** use of social sciences. This substantive use means that social sciences contribute to the investigation of a particular subject of the natural sciences, making social science part of the same scientific field. A substantive use of social sciences can have different forms, ranging from placing scientific questions in a broader perspective to identifying ethical or social concerns, or supporting the establishment of interdisciplinary approaches. Together, these forms of involvement from the social sciences affect the substance of doing scientific research.

Practical use

The fourth and final use of the social sciences for socialisation is **practical**, which appears to imply a shift from a 'scientific' role of social sciences to a more 'operational' one. According to this view, **social scientists should act as facilitators and operators in the relations between science, technology, and society**. The role of social scientists then becomes one of building bridges, for example between science and government, or science and the broader public. The practical use of social sciences appears to be scarcely diffuse (aroung 8% of social research institutions specialised on science and technology).

The marginal position of social sciences

An overarching concern with all four uses of social sciences in socialising science and technology, which is explicitly addressed by this Handbook, is the so far **rather marginal position of the social sciences**. Safe for some exceptions discussed below, knowledge produced by the social sciences is so far largely unsuccessful in gaining access and acceptance in natural sciences and circles of policy makers, which results in some risks for socialisation.

Two major problems

Actually, despite the large role social sciences could play in the socialisation of science and technology, there are **two major problems** that need to be dealt with first.

Lack of socialisation within social sciences

One of these problems could be described as the **lack of socialisation within the social sciences**. This means that many researchers in the social sciences are scarcely interested in science and technology, despite their overwhelming importance for contemporary societies. Also, many social scientists still do not consider science and technology a topic for investigation and analysis. Of course, such a position towards science and technology also mean that social scientists are often unlikely to invest in or contribute to processes of socialisation. Therefore, to make socialisation work, **an important step is to also socialise social scientists.**

Lack of cooperation between social and natural scientists

Part of such an effort would be to address the second major problem, which 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 the approaches of different scientific fields. Nevertheless, for socialisation to work it is important to forge a connection between social and natural scientists.

Roles of social sciences

Some **examples** of different roles for social sciences in socialisation are listed in box 3.1.

[Box 1.4]
POSSIBLE ROLES OF SOCIAL SCIENCES IN SOCIALISING SCIENCE AND TECHNOLOGY

- Education of scientists and engineers
- Involvement and cooperation in research projects
- Advising on social and political issues surrounding science and technology
- Acting as public intellectuals, initiating and contributing to debates about science and technology

Education

A first possible role for social sciences is to contribute to the **education** of natural scientists on issues pertaining to the social relevance of their work. At the moment, the training of scientists often does include an obligatory course in ethics, and for more applied sciences courses in, for example, economics may be included. But such courses seldom address the role of scientists and their work in society explicitly. Therefore, a more integrated approach to issues of socialisation in science education should be developed. Such an integrated approach should explicitly be **multidisciplinary**, both combining social sciences with science education, and combining several aspects of the social sciences. The main objective of such education is not that trained scientists should have a profound knowledge of the social sciences, but that **they can recognise, incorporate and act upon the societal relevance of their work.**

Involvement of social scientist in research projects

This role of the social sciences can also be stimulated through a greater direct **involvement of social scientists in research projects**. One example is so-called ELSI (ethical, legal, and social issues) research, where social science research is part of a broader research program. Originally, such ELSI research has been set up rather broadly; for example, part of the entire budget for research in genomics would be allocated for research concerning ethical, legal, and social issues. One way to make this research productive for socialisation is by explicitly stimulating interdisciplinary approaches and by identifying supporting and hindering factors for socialisation.

Advisory

Another traditional role of social scientists is an ***advisory*** one. Social scientists are increasingly included in scientific advisory councils for policy and similar institutions. Such a development should be stimulated, because social sciences can make valuable contributions to the development of policies in a world where the connections between science, technology and society are getting ever stronger and more complex. But the advisory role of social scientists does not have to be limited to policy advice. Keeping in mind the different areas of socialisation, the insights from social scientists may also be valuable at the level of scientific practice, or for how to use technologies in other professional practices. The outcomes of such research can be very useful for improving these practices, as well as it can be used for other areas of socialisation.

Public intellectual

One final role of social scientists could be that of a ***public intellectual*** [2], commenting on social developments in public forums. So far, the social character of science and technology and its more complex influences on people's everyday lives have received fairly limited attention in the mass media. There is a task for social scientists to try and get this message across, and to try and engage interested citizens in debates about what this means and how such developments should be governed. For the social sciences it means an approach similar to the socialisation of the natural sciences promoted here; one that combines following an academic agenda of particular research interests with political and social engagement.

Contributing to science-society mutual adaptation

In conclusion, the **different possible roles of social scientists** in processes of socialisation are not those of stimulating the development of science and technology at all cost, or of serving as a lubricant to make social acceptance of science and technology more smooth. Instead, social sciences should use their analytic tools and approaches to **broaden the perspectives on science and technology** in order to **make science and society better able to adapt to each other.** In that sense, the descriptive and prescriptive role of social sciences can not entirely be separated.

Based on such analyses, social scientists could contribute by stimulating action, or coming forward with advice on the basis of their own research. But as said, this first of all requires an **interest in and willingness to study the social relevance and dynamics of science and technology among social scientists**. Only when social scientists develop an interest in studying and solving problems around science and technology they can contribute to socialisation.

[4] SOME EXAMPLES OF SOCIALISATION PROCESSES

Socialisation initiatives in Europe have so far largely been small-scale, fragmented, and have above all rarely been part of a co-ordinated effort to strengthen the social position of science and technology. Nevertheless, there are some examples of attempts to socialise science and technology in Europe. **Three of such examples** will be introduced below. Some more specific examples will be provided in box 1.5.

Example 1: societal and ethical aspects of new sciences and technology

A first and rapidly growing example of socialisation is the involvement of research into the **societal and ethical aspects of new science and technology in large-scale research**

[2] Bijker, W. (2003) The Need for Public Intellectuals. A Space for STS. *Science, Technology, and Human Values,* 28 (4), 443-450.

program. This example of socialisation originates from the budget that was made available for studying **ethical, legal, and social issues** (ELSI) as part of the Human Genome Project. Ever since, large-scale investments in relatively new forms of science and technology often include some resources for research in the social sciences assessing the consequences of emerging fields of science and technology. Examples include further research in both human and non-human genomics following the Human Genome Project, research in the field of nanotechnology, and attempts to find and develop alternative, sustainable forms of energy. At the moment, such projects are increasingly becoming interdisciplinary, supporting cooperation between antural and social sciences.

Example 2: experts in policy making and advice on science and technology

A second example of socialisation that has grown in importance over the last two decades is the **broadening of the category of experts in science policy making and advice about scientific and technological developments**. This follows from recognition that scientific and technological developments may have substantial social consequences that are better analysed by social scientists and ethicists, who may therefore make valuable contributions in advising public policy makers. Still more recent, and partially in response to broad public resistance to developments in for example nuclear energy or genetically modified organisms (GMOs), public stakeholders and the public as such have gotten involved, in various ways, as well.

Example 3: technology transfer

A third example of socialisation that is more closely linked to the validation of scientific research is the establishment of **technology transfer offices** and 'incubators' for start-up companies at European universities. On the one hand, such offices should support researchers in making their inventions and discoveries available to society, without having to go through the bureaucracy of filing for patents or developing business plans. On the other hand, it should allow society to have swift access to innovative ideas and artifacts produced at research institution, which is to the benefit of the research institution as well as the (regional, national, and European) economy.

[Box 1.5]
EXAMPLES OF SOCIALISATION INITIATIVES IN EUROPE

- The Economic and Social Science Research Council (ESRC) Genome Network in Britain
- The Social Science Branch of the Dutch NanoNed research program
- The public GM Nation debate in Britain
- The Innovation Platform, established by the Prime Minister of the Netherlands

[5]

SOCIALISATION AGENTS, FIELDS AND THEMES

Most of these initiatives are rather haphazard and fragmented, and have not necessarily been developed with the explicit aim of strengthening the socialisation of science and technology. Nevertheless, some conclusions can be drawn about the **agents, fields, and themes** that are part of socialisation.

[A] SOCIALISATION AGENTS

Any social actor can be a socialisation agent

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**. Even though actors are often not aware of this role, their commitment to improving the position and role of science and technology in society is important from the perspective of socialisation. At the same time, the lack of awareness of their own role and of the dynamics of socialisation among different actors means that it is necessary to steer and manage the diverse contributions in order to make socialisation processes productive.

Some examples

In **the examples introduced above**, this is a more specific role adopted by **particular agents**.

Governement institutions

An important role as socialisation agent is available for **government institutions**. These institutions, including scientific advisory bodies, have developed various ways to include insights from the social sciences and opinions from the broader public in order to be able to deal with the increasing complexity of the social influences of science and technology and public resistance to science and technology. Thus, socialisation as a way to strengthen **democratic legitimacy for policy making on science and technology** is connected to some of the major shifts in social relations in the latter half of the twentieth century that were discussed in part A.

Scientific advisory bodies and funding agencies

A slightly different, but related motivation lies at the basis of the way **scientific advisory bodies** and **agencies funding (large-scale) research programs** function as socialisation agents. Their aim is to understand the impact of science and technology in ever more complex societies. This is why 'social expertise' is required, either in policy advice, or as an aspect of large-scale research.

Technology transfer offices

The final example of socialisation initiatives described above is slightly different. **Technology transfer offices** are primarily related to trends towards increasing calls for 'valorisation' or economic and social benefits of scientific research. Such offices, often established by university managers in cooperation with local and regional government and commercial businesses, aim to make sure that innovations from a particular research institution, or a set of institutions, will become publicly available and are (financially) beneficial to the research institution. In this way, socialisation agents in this area aim to stimulate innovation and the valorisation of research.

[B] SOCIALISATION FIELDS

Socialisation processes are **active in all fields** of science and technology.

Differentiated development of socialisation initiatives

However, in some fields - such as health (care), biotechnology, nanotechnology, sustainable development, etcetera, - **socialisation initiatives are more visible** and **more strategically developed**. These initiatives concern either **large scale science**, such as programs investing in genomics and nanotechnology, or **small scale developments** including the marketing of individual patents or stimulation of start-up companies. For such small-scale developments, the strategy followed in socialisation is primarily one of stimulating and nurturing innovative ideas and artifacts in the hope of turning them into successful and influential business ideas. At the **larger scale**, socialisation is concerned with the **broader influence** of science and technology on, and relevance for, social relations as well.

Three reasons of differentiation

Particular fields of research **are considered to be interesting or relevant for initiatives aimed at socialisation** for many reasons, three of which arise from the examples addressed above.

Economic benefits

The first of these is the **possibility of economic benefits** arising from forging a strong connection between science and society. The **role of socialisation** in these instances is **to identify or create markets for an innovative product arising from scientific research**. This includes the identification of needs, the development of business plans, and marketing of the innovation. To be sure, this is not only an activity taking place in technology transfer offices; part of recent ELSI initiatives has also been to do research into, for example, if and when customers would consider purchasing products that have been genetically modified to be more healthy. And advisory bodies in the area of health care increasingly include considerations about the cost-effectiveness of new treatments in their assessments of medical innovation.

Expected scale of impact

A second reason why particular fields of science and technology have explicitly been subjected to examples of socialisation is the **expected scale of impact**. This means that for some of the broader fields of research mentioned before – genomics, nanotechnology, sustainable energy – the scale of consequences, as well as their variety, is considered to be so vast that these fields will affect several areas of social and personal life. One example could be how the development of new energy technologies is directly linked to all sorts of global political questions, including food supply in poorer countries and the geopolitical consequences of a decreasing dependence on fossil fuels. Clearly, the scale of such developments associated with science and technology **merits extensive attention for the socialisation of science and technology**.

Controversial nature of some science and technology

This discussion of the role of expected impacts brings us to a third and final reason for developing socialisation processes, which is the **controversial nature of some science and technology**. Some of the earliest attempts to involve the broader public in decision making about science and technology resulted from **widespread protests to the use of nuclear energy**. At present, the controversial nature of specific forms of research and technology is still an important reason to involve the broader public, or social stakeholders in decision making. Although socialisation processes do not necessarily lead to an end in social opposition, resistance to new technologies is an important reason for governments to start thinking about the socialisation of science and technology in the first place.

[C] SOCIALISATION THEMES

As we already stressed, socialisation dynamics **involves a broad range of areas**, ranging from daily scientific practices to governance. Consequently, the themes considered in these socialisation processes are very different.

Socialisation-sensitive themes

However, in order to get some insight into the **current state of affairs for socialisation in Europe**, it should be noted that **some themes** are **more socialisation-sensitive**, that is are more likely to arouse a public interest in socialisation. Part of the problem of socialisation is, furthermore, that these themes often conflict with each other.

Economic consequences of science and technology

One of the core themes in socialisation is the theme of **economic consequences of science and technology.** As argued above, questions about the way science contributes to innovation and how such innovation can be made profitable are very significant from a societal point of view. In fact many (socialisation) policies for science and technology explicitly aim to improve the economic profitability of science and technology, or at least see an important role for science in enhancing a society's innovative capacity.

Ethical issues

Another important theme is the question of **ethics**. Ethics as a theme in socialisation does revolve around the resistance to science and technology cited above, questioning how to deal with concerns about the consequences of science and technology, or unanticipated and unwanted consequences of science and technology in general.

Consequences on social structure

Socialisation processes also address consequences of science and technology for society not only in terms of good or bad, but also with regard to **how the structure of social organisation** can be affected by science and technology. This means that initiatives to socialise science and technology are also geared towards understanding changes in social organisation due to science and technology, akin to the examples of how sustainable energy research can have political ramifications on a global scale.

Democracy

Such considerations about the ethical and structural social consequences are related to the fourth important theme: that of **democracy**. Implicitly, initiatives to address public concerns about science and technology by increased involvement of stakeholders or the public at large, contribute to the democratisation of science and technology policy making. Because of the great importance of science and technology in contemporary societies and their simultaneously decreasing status, the theme of democracy is one that is of vital importance for socialisation overall.

[6]

CHALLENGES FOR SOCIALISATION IN EUROPE

The weak socialisation of European research

Despite the examples discussed above, socialisation in Europe can be considered as **quite weak and underdeveloped**. Rarely is the socialisation of science and technology an explicit policy objective. As was noted above, socialisation agents most of the time are not aware of their role and the opportunities to contribute to socialisation. That socialisation of science and technology is low on the agenda in Europe has several origins that pose particular **challenges to socialisation**.

Challenge 1: overcoming the view of science as a separate sphere

Much of the problems in the social positioning of science and technology arise from the **view of science as a sphere separate from the rest of society**. In this view, science and technology function at their best without any social interference. This view, which is still strong among scientists, policy makers and the general public alike, quite naturally sees no significant role for socialisation processes. The only proactive forms of 'socialisation' that could exist following this view are forms that regulate science and technology after research and development have taken place, to safeguard the public from possible negative consequences. This, however, is too narrow a conception of socialisation, as this Handbook shows.

Challenge 2: overcoming fragmentation in approaching socialisation

The idea that science and technology develop autonomously also implies that **not much can be done to change the trajectories of scientific and technological development**. This may explain the **limited and fragmented nature of socialisation initiatives** as they currently exist. This is problematic, since much of the benefits produced by particular socialisation processes could be valuable for other issues if socialisation would be explicitly addressed in policy making and problem solving.

Challenge 3: recognising socialisation as necessary both for science and for society

As was further recognised in part A of this handbook, a **lack of socialisation** of science and technology does not only **negatively affect** the position of science and technology in society, but **also science and technology themselves**. A problem described in part A of the handbook was that careers in science and technology decrease in status and that low priority is given to education in science and engineering in many European countries. What is important to recognise from the perspective of socialisation is that **this is not an internal problem for science and technology alone**, but a problem of the relation between science and society.

Challenge 4: fostering a broad public debate on science and technology

Another problem related to the lack of recognition for the essentially social nature of science and technology, and of the limitations to existing socialisation processes in particular, is that that there is a **lack of broad public debate about science and technology**. Of course, in some cases the products of science and technology become the subject of public debate, but **rarely do debates explicitly address science and technology as** such, or the **dynamics along which they develop**. Considering the significant impacts of science and technology in people's lives, the absence of broad public deliberation on how science and technology (should) develop is problematic.

The lack of public debate and influence in the development of science and technology also gives rise to two more particular challenges.

Challenge 5: opposing the outright rejection of science and its products

One of these is based in the view that science and technology cannot be significantly influenced and can therefore either be uncritically accepted, or be rejected. **Outright rejection of science and its products** can result in several problems for science and technology, depending on the shape such rejection takes. One form of rejection could be that people are no longer interested in science and technology, which contributes to the ivory-tower image of science and a **downward spiral** in which some of the problems described before become ever greater. A second form of rejection that is more extreme is the use of violence against researchers, research facilities, etcetera. This kind of rejection has great financial and personal costs, but also leads to considerable social unrest.

Challenge 6: opposing the tendencies toward a decrease in funding of science and technology

The lack of public interest (and therefore influence) in science and technology can lead to a **decrease in funding of science and technology**. A decrease in financial means for science and technology has all kinds of consequences for science and technology. It would mean that less scientific research is possible, meaning that science would be considered to be less important still. It may also pose challenges to how science contributes to several social domains such as health care, agriculture, industry, etcetera. And a decrease in funding is especially problematic considering the growing recognition of the importance of science and technology for innovation and economic development.

Challenge 7: opposing the decrease in status for science and technology

The major risk arising from a lack of socialisation in Europe is one of an **overall decrease in status for science and technology**, particularly compared to other regions in the world. Elsewhere science and technology are often more highly regarded, particularly in economically emerging countries like India and China. We will turn to some of the similarities and differences with these countries below. But first it is important to note that even though socialisation should not be understood as a form of promotion for science and technology, **a decrease in its status overall is nonetheless problematic** – economically, socially, and culturally science and technology have made great contributions to the development of Europe, and in order to keep on making steps forward it is important that high quality socialisation is maintained and further developed.

[7]

HIGH QUALITY SOCIALISATION

Science as an intrinsic part of present day society

As demonstrated before, a lack of socialisation may have several serious consequences. This is all the more problematic when taking into account **the enormous value science and technology can represent, economically, socially, and culturally alike**. This value can be easily demonstrated by recalling the pivotal role played by science and technology, in making possible the current **standard of living** in the Western world in terms of prosperity, life expectancy and health, as well as many other **social developments** (including the 'shrinking' of the world as a consequence of new transportation and communication technologies, or the growth in access to information and education for the majority of the population) and the development of new forms of producing and distributing **cultural artifacts**, which makes them more accessible for people.

In addition, an argument can be made for **scientific enquiry** as a **model for open and diverse social interactions**, which is why science is often explicitly linked to modern, Western liberal democratic societies.

Of course, all this does not mean that science and technology should only be seen as beneficial forces in the world. A list of **negative consequences** at least as long as that of the benefits of science and technology can be produced. Some of the more **critical comments** include concerns about a global decrease of **cultural diversity**, **pollution** and damage to the natural environment, the destructive force of **military technology**, and the closed, elitist rather than open character of ever more specialised science.

But regardless of whether one evaluates developments in science and technology predominantly as positive or negative, such examples demonstrate yet again **how science is an intrinsic part of present day societies**

This means that a lack of awareness of its socialised character can bring about **considerable risks** for the European economy, culture and social relations.

Science socialisation and European competitiveness

These risks are especially associated with the **competitive position of Europe** compared to other regions including the U.S., Japan, India, China, and South-east Asia. This argument of competitiveness is most commonly framed as an economic problem, summarised in the claim that Europe may become a lagging region in the global economy, considering the rapid economic growth partially based on investments in science and technology and innovation in some regions.

Risks beyond the economic sphere

This idea was already discussed in part A, but it is important to also take into account that **these risks are not exclusively economic**. Many social security arrangements in

Europe are constituted on the basis of the expectation of continuing economic growth and are already under pressure as a result of both demographic and global economic developments. There may also be severe cultural consequences in the long run, including a possible decrease in openness, tolerance, and solidarity. Although this is quite a **gloomy scenario**, it should be clear that the risks of a lack of socialisation in Europe compared to other regions contain elements that are broader than the economy alone.

Difference in socialisation intensity

The exact differences between the **degree** and **kinds of socialisation** in Europe and elsewhere are more complex than can be caught in a simple binary scheme of more/less. Yet there are some indications that **socialisation in some areas is better developed in other regions**, particularly when it comes to the status of science and technology. For example in the United States, and particularly in East Asia, careers in science and technology for young people are much more stimulated and appreciated. And national governments in, for example, India and China support the establishment of innovative, science-based industries in particular regions. These examples from other regions in the world show much greater interest in the role science and technology can play economically, but also socially and culturally if and when approached as an integral part of society.

Socialisation models cannot be instantly copied

Such developments should be of concern to Europe from a competitive point of view, but **this does not mean that they should instantly be copied**.

On the one hand, **social and cultural factors play an important role** in the way science and technology are established and perceived in different regions of the world. Taking this point seriously, it is unlikely that the establishment of a new elite technical university like in China will be possible in Europe, or even in one of the EU member states, for example because there are many established interests of existing educational institutions, national governments, etcetera at stake. Furthermore, the **lack of democratic checks and balances** in China makes it easier for central government in that country to develop and carry out such initiatives.

Investing in a peculiar "high quality" socialisation

The European alternative should therefore be not to invest in science and technology alone, but to invest in a **'high-quality' socialisation** of science and technology. This high quality means that investments in reifying the status of science and technology in the public sphere should explicitly address the social aspects of science and technology, in scientific practice as much as in how science and technology affect the economic, cultural, social, ecological, etcetera, state of affairs. This means that socialisation of science and technology should explicitly take into account values such as sustainability, solidarity, fairness and democracy. Socialisation policies should explicitly address social concerns, and take into account how science and technology can be beneficial for society. How such policies ought to be developed is the focus of the next chapter.

[K]

CHAPTER'S KEY ISSUES

- Socialisation of science and technology is both a **descriptive** and a **prescriptive concept** for how science and society are and should be related.
- There are **six areas of socialisation**; scientific practice, scientific mediation, scientific communication, evaluation, governance and innovation.
- **Social sciences** can stimulate socialisation in **different ways**, (substantive, interpretative, functional, and practical) and can have different **roles**. Social scientists can therefore play important **tasks** for socialisation (education, research, advise, serve as public intellectuals commenting on social aspects of science and technology).
- The most visible **socialisation practices** currently existing concern social science involvement in large scale research programs, the role of societal actors in scientific advice, and technology transfer offices.
- **Variables** strongly influencing socialisation dynamics are those of the **actors** involved (socialisation agents), **disciplinary fields** and the **themes** around which socialisation processes are activated.
- Socialisation has so far been **fragmented** and **marginal**, which is related to views of science as a separate sphere and a decrease in the status of science and technology.
- **Socialisation in Europe remains weak**, and is associated by public feelings of a lack of control over science and technology, opposition to science and technology and decreases in funding of science and technology.
- Socialisation is directly related to the economic, social, and cultural competitiveness of Europe on a global scale; to improve Europe's position, investments should stimulate **high quality socialisation**.

CHAPTER TWO

SOCIALISATION PROCESSES AND POLICIES

The preceding chapter provided an outline of current socialisation practices in Europe, the challenges that exist for socialisation, and reasons for why socialisation is an important theme. The chapter was concluded with an argument for investing in closer ties between science, technology, and society through the development of 'high quality socialisation'. **A proposal for developing such an approach to socialisation** in the form of particular processes and policies is elaborated **in this chapter**.

[1] SCIENCE POLICY AND SOCIALISATION

Science, technology and society may be at risk

One of the main conclusions of the first chapter of part B was that **science, technology, and society may be at risk** when science and technology are insufficiently socialised. Moreover, an argument was made that science and technology have both brought great benefits to humanity, but also lie at the basis of some of today's most pressing global problems. **Socialisation of science and technology** can therefore not have as its exclusive focus to resurrect the special status of science and technology and stimulate social acceptance of its products, but needs to take into account how science and technology work and how they relate to certain deeply held social values, pressing political problems, and democratic governance, allowing us to deal with problems as diverse as climate change, global poverty and inequality.

Designing socialisation policies and processess

Consequently, it is of great importance to **design explicit socialisation processes and policies** that have as their central aim to improve the conditions for scientific, technological and societal development in a broad sense. Such policies will have to contain elements that allow stimulation of science and technology, while at the same time taking public concerns seriously. They need to explicitly address how socialisation of science and technology can be shaped for the different areas of socialisation listed above.

Socialisation policies are different from research policies

Yet a first important point to notice is that **socialisation policies are explicitly different from existing policies in the area of science and technology**. On the one hand, there are many policies in diverse areas aimed at steering and monitoring science and technology in society, but these policies rarely address the development of science and technology as such. On the other hand, there is a field of policy making that explicitly addresses science and technology, which is science policy.

Three differences

There are, however, **three important differences** between science policy and what policies and processes of socialisation should be.

The first important difference is that science policy is still mainly oriented towards the **funding and stimulation of science and technology**. To some extent, this is still based on the idea that science and technology are most likely to come to fruition when left alone. Related to this view is the idea that stimulation of science without further interference is also most likely to produce economic benefits. Such a role for science policy also means that its role in managing the negative aspects of science and technology is marginal at best, and is usually left to the policy areas directly affected by these consequences. From the perspective of socialisation, however, **science and technology should be stimulated, but in a way that is socially accountable**.

Stimulating science and technology in a way to be socially accountable

A second important difference concerns **the actors involved in policy making**. In the area of science and technology policies, actors involved in policy making are primarily policy makers and politicians on one side, and scientists and their representatives on the other. Most of the negotiations between political authorities and science takes place via organisations such as national funding bodies, the management of investment schemes, federations of universities, representative groups of particular scientific disciplines, and similar kinds of intermediary actors. In some funding schemes in Europe civil society organisations have started to play a bigger role, for example in evaluating the 'societal relevance' of research proposals. But often civil society organisations get first and foremost involved after 'the damage has been done'. Instead, **socialisation calls for a broad involvement of diverse actors**, including civil society groups and scientists themselves, to develop processes and policies.

Enlarging the involvement of diverse actors

A final point on how socialisation policies and processes differ from science policy making is **the scale at which they work**. Science policy making is often quite broadly oriented towards science as a whole. Rarely does science policy at the level of government decide about the funding of particular research projects. This task is usually left to specialised institutions or committees. In contrast, the different areas of socialisation indicate that it is not exclusively a matter of government policy making. Even though this is an important aspect of socialisation, equally important is the role better **incorporation of social dynamics** can play **in scientific research and technology development** at a lower level. As the phrase of socialisation "policies and processes" indicates, socialisation is also explicitly something to be stimulated at the level of practice, to engage scientists, managers, companies, etc. in building science in such a way that it meets social demands and knows how to deal with internal social dynamics.

Incorporating social dynamics embedded into research process

[2]

A FRAMEWORK FOR SOCIALISATION PROCESSES AND POLICIES

To create more clarity about what socialisation policies should be about, the remainder of this section will discuss a **frame for how to conceive such policies.** This frame, summa-

Actors, arenas &

mechanisms of socialisation

rised in box 2.1 consists of three different elements that will be discussed in turn. A first element of socialisation processes and policies is formed by the **kinds of actors and institutions** that should be involved in socialisation processes and policies. A second element is formed by the **arenas** in which exchange of ideas, opinions, and the development of new initiatives between these actors can take place. Finally, a third important element concerns the **mechanisms of socialisation**, or, in other words, how the diverse input of different actors can be used in ways that actually contribute to socialisation. In the course of this argument, the importance of developing policies as 'practices' for socialisation will be elaborated.

[Box 2.1]
ELEMENTS OF SOCIALISATION POLICIES

Actors and Institutions

Who can contribute to socialisation and participate in debates depends on the specific problems

Arenas

Instead of opening up traditional spaces of public debate, socialisation requires practical arenas, such as experiments demonstrating the value of socialisation.

Mechanisms

Particular mechanisms need to be in place to assess the effect of particular interventions, and to develop new ones.

[A] SOCIALISATION ACTORS AND INSTITUTIONS

As was argued earlier, the group of socialisation actors is a broad one, since in principle **any actor or institution** working on the crossroads between science and society is to some extent an **actor in socialisation**. At the same time, most socialisation actors are not aware of that role, a situation that ought to be improved when taking the idea of 'high quality socialisation' seriously.

Identifying and involving the relevant actors

This section will therefore discuss who can be considered to be **relevant actors in different instances**, and **how they should be included** in socialisation processes and policies.

Two elements are important in this regard. The **first** of these is that the actors that should contribute to socialisation differ according to the form and kind of 'problem' that is addressed. The **second point** is that actors can have different roles.

Different problems,

To start with the latter, socialisation covers a broad range of relations, interactions, problems, etcetera. Processes and policies for socialisation include issues that are as diverse as public debates about investments in research on nuclear energy to initiatives at the level of individual research institutions to develop better career paths for young scientists. In all of these issues, **diverse actors may be included that can have different roles in constituting a practice that can contribute to socialisation of science and technology**. The roles of scientists, civil society groups and research institutions changes along with the question to be dealt with. The point is that **actors do not have one role in socialisation**, but that their roles may be **diverse and multiple**, just like socialisation is a diverse phenomenon.

different roles

This brings us to the other important question for this section, which is **how to identify actors** that should be involved in the development and establishment of socialisation processes and policies. Like for the role of different actors, this very much **depends on the exact problem** that should be put on the agenda, discussed, and solved. Although socialisation aims to strengthen the ties between science and society, **this does not mean that any social actor should be included in socialisation initiatives**. In fact, particularly smaller scale initiatives, like the 'young scientists' example above are likely to function very well without broad public involvement. But also for a broader public debate it depends on the nature of the problem and the exact actions that should follow from such a debate, which actors should be involved. In particular, certain issues lead to relatively little controversy and can, for example, be addressed by a panel of experts, whereas other problems are socially more sensitive and should therefore be discussed with a larger group of stakeholders, or even the public in a broad sense.

Different problems, different actors

The main point of this section, then, is to point out that there is no easy checklist for the inclusion of particular actors or institutions, but that the **selection of relevant actors itself is part of the process of socialisation**, since it requires diverse actors that are either already involved with a problem, or think they have a stake in it, to think about the problem they are facing, its social significance, which actors are already active as "agents of socialisation" and how involvement of other social actors may help in solving the problem.

Identifying relevant actors as part of the socialisation initiatives

[B] SOCIALISATION ARENAS

A second concern is **where socialisation processes and policies** that involve such diverse actors **should be developed**. Again, in principle, it largely depends upon the kind and size of problems to be coped with.

An important issue in this regard is the decrease in trust of social authorities, including science and politics, described in part A of this handbook. For much of today's citizenry traditional areas of political decision making are considered to be the playing ground of a closed elite that does not pay too much attention to the opinions of the general public. To strengthen the status of science and technology through socialisation it would therefore be advisable **to let socialisation take place via alternative arenas** that are able to host diverse actors, and that are adapted to the specific area of socialisation that is addressed.

Allowing alternative arenas

For broad public deliberation, it is above all important to have **open, transparent arenas for deliberation**. Even when a limited number of interested groups and stakeholders

Ensuring transparency

is involved because the problem at hand is not too complex, the outcomes of such deliberations and how they are used in policy making should be widely available. A practical approach could also be to include diverse actors in attempts to actually solve the problem. This would for example entail the establishment of a working group consisting not only of policy makers and scientists, but also of civil society groups and the broader public to try and develop scenarios or approaches to solve particular problems in the area of science, technology, and society.

Focusing on processes rather than on policies

More productive still may be to focus on 'processes' rather than 'policies', or, in different terms, on how socialisation may be strengthened through **developing practical initiatives** in which diverse actors are involved in the different socialisation areas.

As was mentioned at several points above, an important part of socialisation has to be performed by establishing contacts between different **social actors** having a shared interest in the area of science and technology and by **explicitly addressing some of the social dynamics in the everyday life of doing research**. In fact, the majority of the six socialisation areas discussed above should be sought at this more mundane, everyday level of practice. In fact, establishing processes that solve small scale social problems around science and technology is likely to be the most fruitful way to improve socialisation.

Using experiments as socialisation arenas

The best way to do so, is through **experiments as socialisation arenas**. In such experiments it is no longer debate about socialisation that takes place, but the actual work of trying to socialise research or new technologies. These arenas thereby serve a **double function**, as does any experimentation. It is both an **arena of proof** and **one of demonstration.** The idea of an arena of proof refers to the way socialisation experiments are valuable in their own right, for the particular problem confronted with that experiment. At the same time, proving the use of an experiment in this way can also serve as a demonstration of the value of experimentation in a broader sense. This means that the value of a particular experiment or arena, after it has been proven, can be copied and applied (often with some modifications) in other circumstances. Thereby, approaching socialisation through experiments holds the benefit of both confronting certain problems and simultaneously stimulating socialisation more broadly.

[C] SOCIALISATION MECHANISMS

Facilitating the interactions between the actors

Like for socialisation actors and arenas, the diversity of the problems addressed should be taken into account when devising mechanisms for socialisation. What socialisation mechanisms should therefore do, is to **facilitate the interactions between different actors**, for example to make sure that inequalities between different participants do not hinder socialisation processes, or to assist in setting up experiments for the purpose of socialisation.

Promoting shared

This facilitation of interactions between different socialisation actors should then **result in a shared view** on how to manage science and technology in ways that are socially acceptable. Following from the above, this shared view should above all concern the practice of socialisation and the way experiments for socialising science and technology should be set up, while taking the broader context into account.

Several examples of what socialisation mechanisms can consist of can be given. Again, there may be an **important role for social scientists** here, to analyse socialisation problems and bring forward who are important actors, and which issues are important to deal with. Furthermore, a bit of practical involvement of social scientists could also be useful in making contacts between different actors such as scientists, companies, civil society groups, etcetera.

views of problems and solutions

The potential supports by social scientists

[3]

OVERALL EXPECTED RESULTS: SCIENCE IN SOCIETY

The preceding section of this chapter outlined a frame for developing socialisation processes and policies. In this section, more attention will be given to the **overall expected results** from developing such policies, beyond the specific outputs they produce.

This is particularly important, because there are some **threats to the establishment of socialisation policies.** These arise for example from the conviction that social and political involvement in the practice of scientific research forms a threat to the open character and quality of scientific research. Furthermore, there are also some practical problems for socialisation. Part of these problems is caused by difficulties in organising socialisation policies and processes. These problems relate to questions on how to work with the framework introduced above, but also concern questions about how to make socialisation processes useful.

One of the most relevant aspects, then is **a large diffusion of a profound awareness** of the **close interrelatedness of science, technology, and society.** Social scientists have analysed the close relations between science and society. **The most important point** is that the **social is not mere context** to science and technology that may occasionally interfere with the way science and technology develop. To the contrary, **science and technology** and the way they develop **are shaped by historic circumstances, developments, and the relations between different actors**.

An awareness of the interrelatedness of science, technology, and society

Three main aspects related to the necessary interrelatedness of science, technology, and society, and its significance for policy making should be stressed here.

Three main aspects

A first important aspect is that there is **no self-evident primacy** of the natural as products of science and technology over the social, or the other way around. This demonstra-

Virtually all policy

problems have at the basis the entanglement of science and society

tes the need for **socialisation policies**, since both the natural and the social, in shaping each other, shape the world we live in. Furthermore, policy makers should also be aware of the **indistinguishable entanglement of science and society**, since it is at the basis of **virtually all policy problems in contemporary societies**. This means that policy problems apparently caused by simple technical failure also have a social element to them. An example thereof is that the levees that broke in New Orleans in 2005 were considered to work under the criteria of the U.S. Corps of Engineers that they should flood no more than once in a hundred years[1].

Well-coordinated interventions in the development of science and technology for the benefit of society are possible

From the perspective of socialisation this is important since it means that **well-coordinated interventions** in the development of science and technology for the benefit of society are possible. This is a second aspect. When policy makers would be aware of the importance of social interactions for the development of science and technology, it would enable them to see, first, how science and technology can never simply be solutions for social problems, and second that solving technical problems always also requires social investments. Regarding the first point, science and technology are often considered to be able to solve social problems by steering people's behavior. However, technical artifacts can rarely only be used in one specific way. Most of the time it is also possible to use it differently, or to simply ignore the behavior 'prescribed' by technology. Regarding the second point, in designing new technologies, choices need to be made. These choices have consequences for society, which emasn that social values can and should be incorporated in these choices to assure a better fit between society and technology.

An understanding of the role of society in science and technology affects the interpretation and solutions of policy problems

A third aspect is that an understanding of the role of society in forming science and technology affects the **interpretation and possible solutions of policy problems**. This means that to change the role of science and technology in policy, social processes affecting science and technology should explicitly be taken into account. The particular value of such a perspective lies in adapting developments in science and technology to the broader social trends affecting them. Broader social changes, like the ones discussed in part A, are not purely concerned with social images of science, but are related to the functioning and presentation of science itself as well. Therefore, to solve these problems, socialisation policies need to address both public attitudes towards science and technology, but also the organisation, representation and internal dynamics of science and technology themselves.

An integrated approach

Socialisation processes and policies should thus develop an **integrated approach** to these issues in which both science itself and the public attitudes towards science are included. This way such policies can help in addressing the broad social changes and their impact on science and technology.

[1] Bijker, W (2007) American and Dutch Coastal Engineering. Differences in Risk Conception and Differences in Technological Culture. *Social Studies of Science,* 37, 143-151.

[4]

OVERALL EXPECTED RESULTS: THE SELF-GOVERNANCE OF SCIENCE

In the previous section we have seen one of the overall expected results of socialisation policies, an increase in the awareness on the interrelatedness of science, technology, and society.

Improving the internal governance of science

Another expected result of socialisation policies concerns **the improvement of the internal governance of science itself**. This is related to the social character of science and technology in the sense that science governance particularly concerns the social relations and interactions in science and technology itself. The social shaping of science and technology does not only arise from a broad social context or political circumstance, but does for example also include how designers 'configure' the users of particular technical artifacts[2] or the interactions between scientists, university managers, and financiers.

Governing the ongoing changes of scientific research

The latter aspects of social shaping of science and technology will be discussed in this section. These are of particular interest against the background of **ongoing changes to the very structure of scientific research**. Phrases such as 'Mode 2 science' or 'Triple Helix' (of science, government and industry) all allude to a more applied, interdisciplinary, commercially oriented practice of doing science that is supposed to have arisen over the last few decades. Such developments indicate the rise of stronger links between science and society, which necessitates investments in socialisation to make this connection work.

Problems and challenges

To begin with, the rise of more applied and interdisciplinary science is often associated with **some particular problems and challenges for scientific research**. Some of these problems concern the inner workings of science itself.

Interdisciplinarity

- Especially the demand of **interdisciplinarity** is often difficult to realise in practice because of the different styles and approaches to doing research in different scientific disciplines.

Unrealistic expectations

- A second problem originating from the changed way of doing science is that 'the outside world' (and particularly financiers such as government agencies or companies) may have **unrealistic expectations** about what science can do for it. These expectations result in a feeling among scientists to be under pressure to come up with useful results and a feeling of losing valuable time in incorporating such demands in research projects.

Interference of commercial enterprises

- A third and final problem is the fear that society, and especially **commercial enterprises will unduly interfere** with both research projects and their outcomes. This

[2] Woolgar, S. (1991) Configuring the User – the case of usability trials. In: Law, J. *A sociology of monsters – Essays on Power, Technology and Domination.* London: Routledge (58-99).

idea is related to the view that science should set its own agenda, and that enterprises have diverging interests that may cause them, to manipulate research outcomes.

Unrealistic images: science as a fully self-governed body

Such **concerns about interference from society with science** present a considerable challenge for socialisation at the level of scientific research. No matter how unrealistic it is to proclaim an autonomous, entirely self-governing science, given the social developments and the way these relate to how science is performed, in the last half a century, as **an ideal it is apparently still very much alive** in the scientific community.

Unrealistic images: science as an innovation-machine

As an **opposite position**, in some circles there appears to be a concern about how much science actually contributes to society. Stimulating innovation is a core objective of science policies, for example in the EU, but research has shown that innovation processes are much more complex and insecure.

Tasks of socialisation policies

In the light of such largely unrealistic fears and expectations and the trend towards ever closer ties between science and society, **two important tasks of socialisation policies** for science governance are:

Clarifying science- society relationships

- on the one hand to clarify that the **tight knitting together of science and society is already a fact of life**, one that will grow more important over the years;

Improving science at the micro-level

- on the other hand that to confront the fears and expectations described here, policies are needed to improve the socialisation of science and technology also **at the micro-level of how science is organised and performed**.

Protecting the identity of scientific research

At the same time, it is important to note that socialisation does not make the governance of scientific research a matter exclusively for (external) social institutions. The continuity of scientific research, particularly for **individual research groups** that have other research projects, teaching obligations, and therefore **need to maintain some sort of identity**, is also important.

Preserving the quality of research

Socialisation policies also serve the **development of scientific research as such**. First of all, an insufficiently socialised science is a science that simply does not work, because of the importance of social processes in scientific research. In addition, science that is not responsive to social concerns runs the risk of being considered to be irrelevant.

Enhancing the cultural role of science

Socialisation processes further stimulate the **cultural role of science** in contemporary democracies, one that serves democracy as well as science. Science plays an important role in contemporary societies, which requires an active engagement of scientists with the outside world.

Socialisation can contribute to science itself

Specific socialisation policies can therefore also **contribute to science itself**. The status and value of science would benefit from closer cooperation with societal actors, and an improved understanding of the social processes in science could make science more efficient, and more able to meet social demands. Through socialisation policies it should be possible to pick up issues that are considered to be relevant in society and combine these with issues considered to be of interest to scientific research, combining them in such a way that research questions can serve different objectives. Obviously, this would also contribute to **strengthening the social status** of science as a social and cultural activity. Put briefly, much of the social acceptance of and engagement with science and technology has its basis in adequate socialisation of how research is done. Consequently, the next chapter will develop that socialisation at all different levels requires the **stimulation of *technological responsibility*** in actors at all these different levels.

[K]

CHAPTER'S KEY ISSUES

- The importance of socialisation calls for the establishment of **explicit socialisation policies.**
- The policies need to address the different elements of a frame of socialisation **actors** and **institutions**, socialisation **arenas**, and socialisation **mechanisms.**
- For socialisation at the macro level, it is important to recognise that **science and society are closely intertwined**, greatly influencing each others development.
- Socialisation is also important for the **governance of science** itself, since scientific research, and the organisation of it are also full of social interactions.

CHAPTER THREE

TECHNOLOGICAL RESPONSIBILITY AND SOCIALISATION

In the previous two chapters, the concept of socialisation was introduced. Two important premises behind the proposal to develop policies to strengthen socialisation were, on the one hand, the strong and inseparable connections between science and technology that have existed for a long time and are growing stronger, and on the other, the important social and cultural role of science and technology. This chapter will broaden the perspective on science and technology by introducing the **concept of technological responsibility** as an aim of socialisation, elaborating on the aforementioned importance of the social sciences to stimulate and support socialisation, and discussing the importance of sensitivity for context in socialisation.

[1] TECHNOLOGICAL RESPONSIBILITY

So far, this book has primarily relied on **'strengthening the ties between science and society'** as a motivation for socialisation. This means that socialisation should also be based on an idea of what stronger connections between science and society should lead to, such as: an improvement of science and technology; an improvement of their contributions to the world in which we live; a decrease of science's elitist character.

The need for a generalised approach to socialisation

However, there is also a **broad objective** behind socialisation. This broad objective could be described as the need to not only socialise particular forms of science and technology, but to also **develop policies for science and technology as broad categories**.

Overcoming the ad-hoc approach

That this aim requires a particular **generalised approach** can for example be deduced from the **socialisation policies that currently exist** (some of these were described in the first chapter of part B), **which are rather ad-hoc**. This means that such activities do not significantly contribute to a broad public form of socialisation.

The lack of explicit socialisation policies

A further problem for broad public awareness of socialisation of science and technology is that **explicit policies for socialisation are so far largely absent or unspecified**. The processes and policies that were proposed above to explicitly address the relations between science, technology, and society from the perspective of socialisation, have not yet really been established

The complexity of changes affecting societies as well as science

Yet a recurring concern, also for explicit socialisation policies, remains the **complexity of the broader 'landscape'** in which socialisation takes place. As has been argued above, there are some broad changes to the fabric of society that also affect science and technology. In addition, there are also some changes to the structure of science proper. Paradoxical developments of ongoing specialisation and simultaneous growth of interdisciplinary research, as well as increasing demands on science to produce economic benefits, present problems for socialisation. Developments of this kind go beyond the effects individual experiments can produce, which makes another argument for explicitly addressing socialisation as a point of broad public interest. **Only addressing socialisation at a broad social levels** can assure that the joint development of science and society will be of a high quality across the board.

Hindering factors

However, achieving such broad socialisation may be difficult for some reasons that are more connected to **the very idea of socialisation itself** than to social developments that may hinder the establishment of socialisation policies.

Abstractness of a "general public socialisation"

On the one hand, it may be the rather **abstract idea of 'general public socialisation' of science and technology**. Above an argument was made for small scale socialisation experiments especially because these would have some results to speak for them. This is a lot more difficult to realise in practice if we understand broad socialisation to mean a general change in attitude of the people towards science and technology. For socialisation of science and technology as a general public aim we therefore need to devise this **broad socialisation in a way that has practical ramifications for individuals.** This is why such a broad category of socialisation needs to be connected to individual rights and responsibilities, as we will see below.

Ideological resistance to socialisation

A second problem with socialisation itself could be that the idea of stronger ties between science and society will evoke **some resistance, both from science and society**, because of the still strongly held view that science is and should be a separate, autonomous social sphere. This view is sometimes a very ideological one. Therefore, it should be stressed that socialisation is to a large extent a **balancing act**, and not an act of subjecting science to society's general will.

Highly differentiated public attitude to socialisation

A final point that should be noted, is that **public attitudes to socialisation can be vastly different**. This is not only an issue regarding the differences in scientific, political, and general cultures in different EU member states (let alone beyond Europe), it can also be true for different groups in a given society.

Relevant differences between European countries can both be general attitudes towards science, public involvement in decision making and the like and the way relations between science and society are structured. Cultural differences mentioned above include how the role of science in the public domain is perceived, whether scientists and engineers are attributed a significant role in solving public problems, etcetera.

Within particular countries similar differences can play a role and lead to different ideas about socialisation in different social groups. For example, political parties can differ in how they think of science's role in society, social groups can differ in the extent to which they accept scientific claims as authoritative in defining and solving problems, and some groups may develop their own alternatives to scientific claims to be part of public discourse.

Technological responsibility as a broad public attitude

In order to confront these problems, the broad public approach to socialisation should warrant that diverse perspectives can be employed and will be heard. It is an approach that should establish the value of socialisation population-wide and describes both the rights and responsibilities of different actors with regard to science and technology. What is needed is a **general objective of socialisation** that recognises that both stimulating and monitoring the role of science and technology is a **social duty shared by the population at large**. What is needed, in brief, is that different socialisation policies contribute to the development of a broad public attitude of **technological responsibility**.

This technological responsibility is **both a social and an individual assignment.**

Technological responsibility as a social assignment

- It is a **social assignment** in the sense that societies as a whole value the development of science and technology, but simultaneously organise procedures to monitor these developments and put them up for public deliberation.

Technological responsibility as an individual assignment

- It is an **individual assignment** in the sense that individual citizens themselves are responsible for being aware of the developments in science and technology and the importance of science and technology for their individual lives as well as society as a whole. In that sense, individuals need to become aware of the fact that science and technology are deeply political, since they contribute to the shape of the world we live in.

Awareness of the socialised nature of science and technology

An important element of technological responsibility is that it does not only contribute to socialisation as a normative assignment, it also implies that individuals are **aware of the socialised nature of science and technology** in the first place. This awareness goes in **two directions**.

How science and technology shape society

- On the one hand, it is an awareness of the **scientific and technological shaping of society**. Put somewhat bluntly, the developments in science and technology that have fundamentally altered the appearance of our planet throughout history are currently all but absent in education. This is at odds with some important recent insights from the social sciences; it is also at odds with people's experiences of being confronted with science and technology every day.

How society shapes science and technology

- On the other hand, an awareness of socialisation should also include the **social shaping of science and technology**. Continuing on the claims about education made above, history classes should also address the developments of science and technology in their rightful context of social, cultural, and political developments at the same time. This means that both the importance of technology as a component in changing how the world is seen should be addressed, but also the relevance social developments for how the world is studied.

The dual perspective on technological responsibility

This dual perspective on socialisation also implies a **dual perspective on technological responsibility**. Technological responsibility includes both the way science affects society and the way science and technology are shaped socially, and requires citizens to engage in understanding these processes and in acting accordingly.

[2]

LAYERS OF TECHNOLOGICAL RESPONSIBILITY

Returning to the broader perspective on technological responsibility as an assignment contributing to socialisation of science and technology in an abstract, general sense, it can be useful to introduce **three different 'layers' of socialisation**. For each of these layers technological responsibility has a particular meaning, and implies particular ways of taking responsibility for science and technology. The different layers are listed in box 3.1.

[Box 3.1]
THREE LAYERS OF TECHNOLOGICAL RESPONSIBILITY

Layer 1. Scientific Practitioners
Responsible for both the process and products of scientific research, to balance their scientific agenda with societal concerns

Layer 2. Interfaces
Responsible for bringing science and society together in productive ways that stimulate processes of simulation

Layer 3. General Public
Responsible for being aware of developments in science and technology and their role in society. Related to scientific citizenship as a set of rights and responsibilities for the socialisation of science and technology.

In this section we will discuss the three different layers of technological responsibility in more detail. What should be noted beforehand is that **these layers are not mutually exclusive**, as if individuals can only 'belong' to one layer. Instead, people can have different social roles that mean they somehow relate to all three layers of technological responsibility.

First layer: scientific practitioners

The **first layer** is that of ***scientific practitioners***, such as scientists and engineers. For this layer, technological responsibility means a socially responsible way of doing research and development, but it is not limited to the work done in laboratories. Since science and technology have a necessarily social character, scientists and engineers can and should also accept a **degree of responsibility for the outcomes** of their work. In other words, layer 1 of technological responsibility includes both the processes and products of doing science and technology.

Improving socialisation of the research process

With regard to the **processes** of doing research and making technology, technological responsibility encompasses more than adhering to existing ethical guidelines and standards alone. It includes the **whole research process**, from designing a research plan and questions to actually doing and reporting the research. This entails a proactive engagement to **improving the socialisation level** of the research process, in order to improve the quality of the research results – which should include the incorporation of social concerns, demands and interests in the design of research projects.

Reflecting on the impacts of research

For the **products** of science and technology, scientific responsibility in the first layer is intended more broadly than in terms of legal liability for the negative consequences of science and technology. Instead, scientific responsibility should again be sought in attitudes and as a form of reflection on **how the outcome of research and technological development affects society**. This does not only have to address the negative consequences and how to avoid them; the positive contributions of science and technology to social affairs are at least as important, and researchers should contribute to debates about how to use them adequately. In addition they should present their work to the broader public, to allow the public to engage with developments in science and technology.

Second layer: science-society interfaces

The **second layer** of technological responsibility concerns actors and institutions that form **interfaces** between science and society. As discussed earlier, the layer of interfaces between science and society can consist of a **large variety of actors** that are **not always aware** of their intermediary role. Yet the role of interface can exist in several different ways that ring science and society together. Much improvement could emerge from making such unintended socialisation actors more aware of their role.

But there are also organisations that were **explicitly established to play the role of interface**. These include science museums, science journalists, funding agencies, professional organisations of scientists, etcetera. These interfaces should also be more aware of their pivotal role in socialisation and be stimulated to contribute to high quality relations between science and society.

Balancing science and society

By making science and society aware of each other's existence and interests, the main component of the second layer of technological responsibility is to **balance science and society**. This means that on the one hand actors in these categories need to make sure that **social values are also included in scientific research** and the development of technological artifacts. At the same time, however, the **agenda of science itself should be stimulated and receive public recognition**. This is why funding agencies should assess both the social and the scientific relevance of research proposals. It also implies a responsibility to inform the public about reasons why specific research projects are important and need to be carried out, even if no direct benefits for society may be apparent. Finally, there is also an important role for the interfaces between science and society in engaging society with science in such a way that the aforementioned problems of a decrease in status and funding of science can be solved.

Third layer: general public

The **third and final layer** of technological responsibility is the layer of **society in a broad sense**. It is here that the general public needs to engage with science and technology and that individual sciences need to start taking into account how science, technology, and society relate to each other.

Scientific citizenship

Technological responsibility can here be described as a **civic duty**, as part of a **scientific citizenship**, implying a broad public engagement with science and technology, and an understanding of the significance of science and technology for contemporary societies.

The broad formulation of this third layer of technological responsibility also implies that **actors in the first two layers are also part of this one**, in their role of citizens rather than as scientists and intermediaries. These actors should also explicitly be scientific citizenship, with an engagement broader than their scientific and intermediary work alone. Such scientific citizenship also implies that people should be educated into being scientific citizens, just like for other forms of citizenship. But it is important to note that this is not a claim for more so-called 'scientific literacy' per se. For scientific citizenship, a broader engagement with the role of science and technology in society is required that does not rely on knowing the facts, but **understanding the importance of science and technology** and the **political issues they produce** – both in terms of benefits and risks.

Rights and responsibilities

Technological responsibility at the level of the general public thus includes **both rights and responsibilities for individual citizens**. People have the right to be engaged, but are therefore also responsible for the way they shape their engagement, by seeking information, formulating a position, etcetera.

Scientific citizenship requires action

Scientific citizenship is therefore **not a condition** that comes with the simple fact of being a scientists or citizen but **requires action**. People can be scientific citizenship by incorporating the importance of science and technology in their decision-making, in the choices they make, products they purchase and consume, etcetera.

[K] CHAPTER'S KEY ISSUES

- Socialisation does not only aim to solve particular problems, but is also aimed at the **broad social role** of science and technology.
- To adequately handle science and technology there is a **broad social assignment of technological responsibility.**
- Technological responsibility is characterised by **different layers**; of scientific practitioners, interfaces between science and society, and the general public.

CHAPTER FOUR

SOCIALISATION PROCESSES AND POLICIES IN CONTEXT

This brief chapter **will provide a summary of part B** of this handbook and highlight the importance to develop socialisation policies and processes that are sensitive to the context in which they are established. The three chapters that form part B of this Handbook have shown how to deal with the changing contexts of science, technology and society through the development of socialisation policies.

The concreteness of socialisation policies

One of the most important insights that was generated in these chapters is that **socialisation policies should be concrete rather than abstract**. Even though there socialisation is in the end a matter of changing public attitudes and strengthening engagement with science and technology in society, such general changes can only be achieved if socialisation has something to speak for it. This 'speaking for' socialisation will have to come from hands on experience, from real life demonstration that socialisation policies actually work and can make a change to science, technology and society. This is one important reason why it is a good idea to start socialisation policies off with relatively **small scale experiments**.

Socialisation policies are to be context sensitive

What is very important for showing the immediate applicability of socialisation policies is that they are **context sensitive**. Only policies that take into account their context can adequately contribute to practices of socialisation. Several elements of this context are particularly relevant for socialisation.

Field of science and technology

First of all, this is the **field of science and technology itself**. One important characteristic of particular scientific fields is that they each work with their own particular questions and materials that bring about different social concerns.

Scientific disciplines

Another point has been raised by research in science studies showing that **different scientific disciplines** also have different styles of doing research. Differences in style include things such as how data are collected and analysed, which criteria are used to review papers for publication, but also how researchers interact with one another. A second important aspect of the context of socialisation related to this, but deserving of explicit attention, is how the particular styles and norms of individual scientific fields shape the interactions of a discipline with society, particularly with regard to how disciplines handle social cocnerns

Technological and political cultures

A third element of context that is important is the broader public context, and in particular **differences between technological and political cultures**. This means that there are very profound differences in how different countries, regions, or groups of people deal with science and technology, and in how politics are organised and performed. For example, in some countries the status of scientific expertise is still quite high, whereas in others it is not. Also, there are considerable differences in how political processes are organised; whether they are very formal or informal, based on a two- or multi-party structure, etcetera. Finally, cultural differences are also more complex in the sense that what is understood as scientific evidence useful for policy making, or what is understood as a matter for political debate in the first place can differ[1].

[1] Jasanoff, S. (2005) *Designs on Nature. Science and Democracy in Europe and the United States.* Princeton: Princeton University Press.

Such **complexities** in the context of socialisation add depth to the frame for socialisation policies discussed above.

A case-by-case approach

It indicates that **socialisation actors**, **arenas** and **mechanisms** need to be identified on a **case-by-case basis**. Only very meticulous consideration of the elements that constitute a particular socialisation problem and provide possibilities for a solution can produce workable policies. This is another area where social sciences can be helpful; in mapping the problem and indicating who could be involved in solving it.

Lack of standardised recipes

It is also because of these complexities that this handbook cannot provide a **standardised recipe for socialisation**, listing its ingredients and prescribing how to prepare it. Rather, it indicates some possible directions for how socialisation in particular areas might work. In the discussions of different socialisation areas below both the general use of socialisation and its use in relation with particular socialisation experiments that have been carried out will be demonstrated.

Socialisation policies as a collective product

What socialisation policies therefore need to do is to **assist actors in collaboratively developing actions** with the aim of socialising science and technology, for which they take responsibility. This means that processes for **socialisation,** in the sense of what actually needs to be done, **have to be developed collectively by the actors** gathering over a particular problem, and that in this process specific tasks need to be appointed to specific actors. Only when actors are in this way involved in and responsible for the socialisation of science and technology can technological responsibility come to fruition.

Creating spaces for cooperation

This means that socialisation policies at a broader level, as **government strategies**, take the shape of stimulation, raising awareness, etcetera. It requires an involvement on the part of particular actors that should contribute to the formation of spaces where different socialisation actors can exchange their views and idea, decide on a particular way to approach a given problem, organise experiments or actions aimed at developing and implementing effective solutions. What is important, is to develop processes that help in building trust between different actors.

Leveraging on the existing strengths

One possible way to make such socialisation policies work, is by **building on existing strengths**. In the first place this means that existing approaches to socialisation could be used and adapted to serve socialisation in a broader sense, despite the limitations of these existing strategies. The discussion above also indicated that there are some encouraging developments, such as the increasing role of societal stakeholders in committees producing advice for policy. It could be promising to continue forward down this road, in order to strengthen socialisation without the need to develop new institutions.

The role of existing institutions

Existing institutions could perhaps not only **broaden their work**, they could also use their expertise and experience to **contribute to strengthening socialisation** more broadly. One way they could do so is by stimulating the establishment of experiments as a way to deal with (existing and new) problems of socialisation. One contribution of existing institutions is to explicitly start addressing new fields of science and technology that have so far not been part of socialisation strategies. As indicated earlier, so far especially novel and controversial examples of science and technology have been addressed. Nevertheless, socialisation also aims to stimulate the recognition of the importance of science and technology by the general public, which implies that socialisation should also address more mundane technologies. The role of existing institutions therein could be one of stimulating such involvements through research and debate.

The need for a holistic approach to socialisation

It should however be noted that existing **approaches are not sufficient for broad socialisation**. As noted above, there are several challenges for socialisation, some of which need the establishment of new approaches. Moreover, **socialisation can be seen as a chain that is only as strong as its weakest link**. This means that investments in **socialisation as a whole** are needed. Fragmented forms of socialisation run the risk of being seen as a not so relevant part of policy making, or as approaches that only serve particular goals and places some questions outside of the discussion. It is the responsibility of all socialisation actors, as well as social scientists in their role of facilitators, to make sure that there is a broad commitment to socialisation and that relevant perspectives on a particular matter get included.

Throughout part B of this Handbook, much was made of the importance of practices of socialisation. The value of this approach will be further elaborated in **part C.**

This part explicitly addresses **socialisation policies for the six different areas** of scientific practice, scientific mediation, scientific communication, evaluation, innovation, and governance. Based on experiments carried out in different EU member states, the chapters will not only discuss socialisation in these different areas in a broad sense, but will also contribute to an understanding of how practices of socialisation work.

[K] CHAPTER'S KEY ISSUES

- Socialisation policies need to be **context sensitive**, with regard to both technological and political cultures.
- Socialisation can and **should not be set recipes** for socialisation but rather stimulate actors.
- Socialisation policies should build on the **strengths of existing approaches**, but also have to invest in **strengthening weaker areas** of socialisation.

[c]

Part

PART C

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

CHAPTER ONE

SCIENTIFIC PRACTICES

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 is organised in six chapters, each of them devoted to a specific socialisation area, i.e. scientific practices, scientific mediation, scientific communication, evaluation, governance and innovation.

Chapters are organised on the basis of a common four-section structure.

- In section one (which is untitled), an **overall presentation** of the socialisation area is given.
- In section two, a set of "**key issues**" pertaining to the socialisation area is elaborated.
- Section three provides a set of "**operational indications**" of both strategic and practical nature.
- Finally, in section four, some **sources of information and further readings** are mentioned, in order to deepen the issues dealt with in the chapter.

The six areas represent a scheme to approach socialisation of science and technology as a whole. Other schemes could be used and other socialisation areas could be also added to the scheme. There are **many overlaps** between the areas and each one is closely linked with the others at different level.

However, each socialisation area is autonomous from the others, both in theoretical and in practical terms. Therefore, **each chapter can be read independently from the others**, so the part does not have to be read straight through or in order.

[*]

Changes in scientific practices

The profound changes affecting science and technology have significant effects on scientific practices, which means practices, knowledge, skills, know-how and forms of scientific co-operation through which research is concretely carried out.

This does not mean bringing into question the scientific method. The great scientific and technological advancements occurring in the last decades in almost all sectors can testify how **science is still working** and **producing results** with increasing pace, despite the transformations affecting it.

The "professsion

However, the "**profession of scientist**" – and therefore the concrete patterns through which the scientific method is interpreted and applied – is rapidly changing, due to broader modifications of scientific research which are pushing it 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.).

of scient-ist"

These modifications in the scientific and technological field seem to strikingly affect the "elementary bricks" on which the entire building of research is based, that is "**research groups**", which represent entities of growing importance in the context of the new forms of production emerging in the scientific and technological research.

The pivotal role of research groups

In the **sociological domain**, knowledge has been increasingly interpreted, not as a product of individuals, even in interaction with others, but rather as an outcome of the action of more or less organised groups, mostly grounded on face-to-face trust-based relations and structured around shared ideas and motivations. This obviously does not mean underestimating the role of individuals' creativity and responsibility. However, it should be remarked that the most recent trends in scientific research (such as trans-disciplinarity, competitive access to funds or enlargement of research networks) are reinforcing the weight of groups. In this sense, groups can be understood as the **elementary unit** of knowledge production, the importance of which can be compared only with the role played by enterprises in economic life[1].

The key role of groups has been even more recognised by the theorists of **knowledge management**. Groups perform a **broad range of functions**, both related to producing, handling, coding or storing knowledge and connected with the creation of the contextual conditions (e.g. development of a "culture" of the group, management of resources) allowing an effective management of knowledge[2].

Broader and no less important is the reflection on groups developed by **social psychologists**, starting from the 40s[3]. Groups have been increasingly understood as a free-standing entity, autonomous from the group's members, able to perform functions and to reach levels of performance the individuals cannot ensure. In this framework, particularly important is the capacity of the group, not only to influence the members' opinions and ideas, but above all to affect individuals' perceptions and to channel their energies and intentions. More recently, this reflection gave birth to specific research strands within psychology of science on the **role of groups in the mechanisms of scientific production**[4].

Finally, the role of "**virtual" networks** involving scientists and, to a lesser extent, also other actors committed to research processes should not be forgotten. This role goes far

1 Laredo, P., Mustar, P. (2000) Laboratory Activity Profile: an Exploratory Approach. *Scientometrics*, Volume 47, N. 3.

2 Davenport, T.H., Prusak, L. (1998) *Working Knowledge*. Boston: Harvard Business School Press; Holsapple, C.W. (2004) *Handbook on Knowledge Management*. 2nd Edition. Berlin: Springer-Verlag.

3 Lewin, K. (1948) *Resolving Social Conflicts, Resolving Social Conflicts: Selected Papers on Group Dynamics*. New York: Harper & Row.

4 Gorman, M.E., Gorman, M.E., Latta, R.M., Cunningham, G. (1984) How disconfirmatory, confirmatory and combined strategies affect group problem–solving. *British Journal of Psychology*, 75.

beyond the simple forms of interaction with scientific community. Actually, networks are increasingly becoming "inter-subjective" places of knowledge production, insomuch as to support the idea of a "**networked intelligence**", that is an intelligence that cannot be specifically attributed to any individual member of the network[5].

These different analytical perspectives suggest that research groups **play a pivotal role** at least on **two levels**.

Groups produce new structures and...

On the one side, they produce **new "structures"** (that is rules, orientations, preferred practices, behavioural models, etc.) which, generating an original group's identity, contribute to **channelling the energy of researchers into shared objectives**. In this way, groups limit the dispersion of energy toward secondary, unrealistic or unimportant aims.

...provide resources

On the other side, research groups provide members with **resources** of different kinds (ideas, information, specialised knowledge and expertise, psychological support, etc.), necessary for its members to carry out their own research.

Diversification of research groups

Research groups are usually **small entities**[6], mainly characterised by strong **informal face-to-face relations**, based on trust, shared ideas and common motivations. Research groups **tend to increasingly diversify**, depending on different variables, such as disciplinary domain, leadership style of the principal investigator, the average age, gender, social and ethnic composition of the membership, the institutional setting (university, private company, public research agency, etc.) and mainly the **prevailing functions** they are centred on (research, teaching, innovation, scientific communication, etc.)[7]. This growing diversification implies different ways to interpret and practice science.

Quality of research groups

Needless to say, some research groups **work very well** (being a good environment allowing any member to "grow up"), many work well enough, but other groups work **quite badly** or **very badly**. They could meet different kinds of obstacles having more or less serious effects, including that of lowering the quality levels of the research process.

The frailty of research groups

Research groups are **frail entities**[8]. To emerge and survive, they need a **steady investment of "energy" by the group members**, in terms of engagement, motivation, agency, passion, willingness to co-operate, prevent and manage conflicts.

This explains why many groups that **could come into existence**, **actually do not do**

5 Hakkarainen, K., Lonka, K., Paavola, S. (2004) *Networked intelligence: How can human intelligence be augmented through artifacts, communities, and networks?* Paper presented at the Scandinavian Summer Cruise at the Baltic Sea.

6 Sometimes, research groups can be even very large, but usually they are organised into small research units.

7 Laredo, P., Mustar, P. (2000) Laboratory activity Profile: an Exploratory Approach. *Scientometrics*, Volume 47, N. 3.

8 Hackett, E.J. (2005) Essential tensions: Identity, Control and Risk in Research. *Social Studies of Science*, 35.

so (because of e.g. lack of a good institutional environment, lack of motivations and interests of senior researchers, etc.). At the same way, many **research groups which could survive and even develop, actually disappear**, since they do not succeed in overcoming the most difficult "**biographical turns**" occurring in their life, such as the retirement of the principal investigator, the transfer of members to other institutions or positions, the raise of inner conflicts or even positive events, such as the initiation of new important research projects.

The organisational and institutional context

Moreover, it should be taken into account that research groups are not isolated. They act within a **specific organisational and institutional context** (such as a university department, a private company or a public research agency). Groups interact with their context through a dense and multifaceted set of relations of different nature (administrative, juridical, political, cultural, and even theoretical or epistemological).

Often, this context represents an **enabling environment** for the research group (since it provides the group with support for e.g. accessing and managing resources, promoting international partnerships, improving research facilities, delivering student services). However, institutional and organisational context can also be an "**acid environment**", complicating the group's life rather than facilitating it. For example, research institutions might be characterised by long-lasting conflicts among research groups or senior scientists related to resources distribution, new research positions, scientific careers or use of research facilities, by low quality management styles or by slow and inaccurate administrative procedures. All that can toughly affect groups' daily life and influence their future in the middle and long run.

The groups' "temporal capital"

Both in the group's inner life and within the institutional context, beyond the so called "**scientific capital**" (in terms of scientific reputation, publications, scientific influence, etc.), a deciding role is played by the "**temporal capital**"[9] that individual scientists and research groups are able to mobilise. The notion of "temporal capital" refers to the set of means, resources, relations and other tools which can be used to influence the organisational, economic, financial and political aspects connected with science and technology. The higher the temporal capital of a group is, the higher is its capacity, e.g., to protect itself from "external agents" (other scientists, research groups, etc.) or to successfully influence their own "environment" (university, political sphere, economic actors, funding agencies, international networks, etc.). Temporal capital can also be used for balancing the lack of scientific capital, but also for defending or exploiting the group's scientific capital.

An experimentation on socialisation of scientific practices

In order to collect information on the social dynamics affecting scientific practices, in the framework of SS-ERC Project, an **experimentation** has been carried out. The experimentation involved a research group of the Tor Vergata University, in Rome, specialised in immunology and infectious diseases (box. 1.1.).

[9] Bourdieu, P. (2001) *Science de la science et réflexivité*. Paris: Editions Raisons d'Agir.

[Box 1.1]
THE EXPERIMENTATION ON THE SCIENTIFIC PRACTICES

Between January 2007 and February 2008, an experimentation focused on the socialisation of scientific practices has been carried out in the framework of the SSERC Project. The experimentation involved a research group based at the Tor Vergata University Department of biology.

The experimentation included **two main phases**.

The goal of the **first phase** was mainly an interpretative one. It aimed to assist an self-evaluation process in order to define the research group's future development plans. In the first phase of the experimentation, all the members of the **research** group as well as some of their institutional counterparts and partners have been interviewed in order to investigate the nature and characters of the research group and to identify the main social, economic, cultural and political factors influencing their scientific practices. Twelve interviews have been held, each one around 75/90 minutes of length. In addition, some information and documentation have been collected in order to explore their research activities.

The goal of the **second phase** was mainly a planning one. It aimed to propose a different method to cope with the research group's risk factors. In this phase, a more **problem-solving oriented activity** was started up and the Tor Vergata University Science Park Office contributed to support the planning process in order to achieve its mission of assisting the research group and evaluating its innovation models.

This included **three main steps**.

- In the **first step**, a research report has been prepared where the main critical points for future developments of the group were identified. The document has been presented to and discussed with the group's members in a meeting.
- In the **second step**, a proposal of an action plan aimed at coping with the critical points previously identified was prepared by the project staff. The proposal was discussed in the framework of two focus groups, involving all the research group's members.
- In the **third step**, the outputs of the focus groups allowed to define, on the basis of the action plan, an agreement among the group's members, about the measures to take for facing the main critical points connected to the group's structure, organisation and daily life as well as about the strategic orientations for expanding and better focalising the group's research activities.

[K] KEY ISSUES

The research activity and the experimentation carried out within the SS-ERC Project allow to single out a set of **key issues** pertaining to scientific practices.

1. Research groups as complex entities

Despite their apparent simplicity, research groups are very complex entities. Their complexity is even increasing because of the transformations affecting research as a whole, which entail a multiplication of functions, roles and activities that research groups have to perform (administrative activities, scientific communication, cooperation with enterprises, devising strategies for competing for public funds, etc.). Therefore, research groups can be usefully understood as "**research micro-systems**", which are to a certain extent similar – in terms of complexity - to the national research systems. For ensuring performances matching the present standards and expectations, research groups are asked to mobilise a **set of specific skills and knowledge** (related to communication, management, administration, networking, etc.) connected and often overlapped to disciplinary competences.

2. Quality of the research group

The success of the research activity is strongly influenced by the **overall quality of the research group**, which is due to different factors such as type of leaderships, inner organisation, size, levels of inner cooperation, presence of a "group culture" or of mechanisms preventing and managing the normal tensions existing among the members' demand for autonomy and the needs for co-ordination. It is unlikely that un-cohesive groups can be successful. They are likely destined to prematurely disappear. Increasing the research group's quality in all its components is therefore a strategic objective to be constantly pursued.

3. Quality of research institutions

The quality of the research groups, in turn, is strongly influenced by the **quality of the research institutions** they are part of. A group working in a low-quality context (e.g., poorly managed, providing scarce resources and support, etc.) is compelled to balance this hindering factor by increasing its own inner quality and by a "hyper-activism", diverting time and resources from other aspects of the research process. Unfortunately, this kind of situation seems not to be rare in Europe, also because tools and techniques of research management are scarcely used and the figure of the research manager is still barely widespread (see box 1.2.).

[Box 1.2] THE VITAL ROLE OF MANAGEMENT

"The *management* of research is (…) critical, wherever that research is done – in universities, public sector research organizations, research and technology organizations, or in industry and the other productive sectors of the economy. While Europe has some research management strengths that it can celebrate and its leading firms are a match to the best worldwide, there is a great deal of room to improve and far too little strength in depth. (…)

The core task in research management is the operational control of individual programs and projects. But there is much more to it than that: other tasks include making strategic choices about topics and directions, informed by good intelligence about technologies, competitors and markets; the effective transfer and commercialization of results; and managing ideas and resources.

These research management tasks are becoming more and more demanding, as those who invest in research expect ever greater accountability and performance. In addition, the growth of research partnering and open innovation is creating fresh challenges, as research managers increasingly have to operate on a truly global basis and deal with teams whose members come from multiple organizations, nationalities and cultures.

Yet Europe's provision for educating research managers, both the professional specialists and researchers in general, is poor. There are examples of excellent courses but these are far from sufficient".

Excerpt from European Research Advisory Board (2007) *Research Management in the European Research Area. Education, communication and exploitation*, Brussels

4. Preparation and training of researchers

Also **researchers' preparation and training** appear to be scarcely **socialised** to the modified ways of production of science and technology and to the newly emerging science-society relation patterns. Obviously, the main worry could be that of ensuring a **high-quality education on scientific knowledge and scientific methods**. However, researchers are asked to have other **skills** and **capacities**, essential to drive the research process, connected to e.g.: designing a research project in such a way that it matches the funding organisations' requirements and selection criteria, expectations and formats; communicating research results out of the group of peers; teaching; leading a team-working process; transferring knowledge and technologies. Unfortunately, these professional skills and competences usually are not included in the university curricula.

5. Relations with the scientific community

As stressed above, research groups are usually part of trans-national, trans-institutional and sometimes trans-disciplinary **research networks**. Thanks to the ICTs, the opportunities for scientific exchange and co-operation as well as for accessing scientific information and data are hugely increasing, accelerating the speed of scientific production. However, developing research networks asks for **time, motivations** and **specific capacities**, which research groups often are not able to or interested in investing. Even **keeping updated** about the advancements in one's own scientific sector is a time and energy consuming activity, because of the growing amount of research results and publications, most of them immediately available on the web. Developing and managing the relations with the scientific community, therefore, can have a strong impact (positive, but also potentially negative) on scientific practices.

6. Resources

As is easy to imagine, the **quality** and **quantity** of human, economic, technical and material **resources** available or accessible is one of the elements particularly influencing research groups' lives. Actually, resources are becoming a key variable assumed by the groups in choosing among alternative research programmes, privileging as far as possible those oriented to issues or sectors where private or public investments are higher. However, this process should be strategically driven. Otherwise, research groups risk not to be able to follow a consistent research program or are forced to reject research strands which are promising in the long run (from the scientific standpoint or in terms of potential technological applications) but scarcely fruitful and highly risky in the short run, or even to reduce the role of the fundamental research.

7. Impacts of public policies

Scientific and technological research represents a sector exposed to a **broad range of public policies** at European, national and local levels. We are referring here not only to research policies. A relevant influence on the life of the research groups can also be exercised by policies devised in sectors such as labour market, high-education, industrial development, urban development, innovation or public administration reform. For example, cuts in public expenditures could affect the generational turnover within research institutions; changes in high-education policies could modify the balance between research and teaching; social policies could influence the career of women scientists; modifications in the salary schemes for research technicians could affect the ways in which laboratories are managed; local policies or urban policies could have an effect on the research strategy devised by universities; and so forth.

Activated by different actors, mostly in an uncoordinated way, these sectoral policies, interacting with each other, might have **unintended systemic effects**, of which researchers and research institutions are not ever fully aware.

8. Contextualisation of scientific and technological research

As already stressed, in the so called "knowledge society", there is a strong tendency toward a **higher social contextualisation of research**: scientists 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. This is a powerful factor of socialisation, since it encourages research actors to become aware of the social and economic usefulness and impact of their own activity. However, **this trend is still uneven in terms of size, features and intensity**. National differentiations are particularly high. Often, the lack of specific institutional places and mechanisms makes contextualisation difficult to manage. Scientists and research institutions are frequently not fully aware of the demands for research arising from different social sectors and sometimes they perceive them as either a mere constraint (for example, when specific application fields are envisaged in the calls for accessing public funds), or as a factor "disturbing" their research routines. Rarely, trends toward contextualisation are properly managed.

[O]

OPERATIONAL INDICATIONS

From the **research activities** and mainly from the **experimentation** (box 1.3.) carried out in the framework of the SS-ERC project, some relevant results for the socialisation of scientific practices have emerged.

[Box 1.3]
THE EXPERIMENTATION: SOME RESULTS

The research group involved with the experimentation, specialised in immunology and infectious diseases, was founded at the end of 80s. In order to increase its growth capacity in terms of visibility, size and resources, the group successfully devised a strategy based on the establishment of "sub-groups" (or "colonies"), linked to each other, but working in different institutional contexts. In this way, the group became a "network" able to enlarge its capacity of research and action. However, in the last years, for different reasons, the degree of cohesion among sub-groups started to decrease, so that the persistence of the research group as a network is not ensured in the long run.

The experimentation was aimed at support the group to prevent a possible crisis by ascertaining the main problems to cope with and paving the way for a new agreement among sub-groups.

Beyond the knowledge-related outputs (which are merged into this handbook), three operational results arising from the experimentation deserve specific attention.

- **Agenda setting**. The experimentation, applying knowledge and methods of social research, allowed the research group to **"put on the agenda"** the main obstacles to face and the decisions to take in order to keep surviving in the long run. Problems and related decisions have been formalised, becoming the subject of a debate involving all the members.

- **Assisted self-evaluation**. The experimentation facilitated the group in progressively identifying the factors (both internal and external) hindering its action and limiting its future development, as well as those which helped it to develop in the past. As a matter of fact, the experimentation appeared to function as an "**assisted self-evaluation**", which helped the group to define new coping strategies.

- **Methodology**. The experimentation provided the group with the opportunity to adopt a new participatory decision making scheme. This has been made possible thanks to an external "counterpart" (the SS-ERC project staff) urging the group not "to slack off" on the process. The adopted approach was based on five main phases: data collection and analysis; draft of an interpretative document; inner debate on the basis of the document; production of a plan for action; implementation of the plan. This cycle, alternating research and action through the use of a participative process, allowed to "objectivise" the situation of the group in all its aspects and to "read" the group's past and future evolution in the light of the macro-changes affecting scientific and technological research as whole.

This complex itinerary made it possible to draw **some operational indications** for the socialisation of scientific practices, which are roughly summarised in the following points.

1. Supporting research groups

Research groups appear to be the primary organisational unit from which the research process originates. For this reason, they have to be adequately supported, in order to increase their capacity of action and to help them in facing critical situations. In this framework, the measures to be taken could be aimed at:

Generating knowledge on existing research groups

- **generating deeper and more systematic knowledge on existing research groups**, both through elementary registration tools (e.g. creation and maintenance of computerised registers of research groups at the university, local, sectoral or national levels) and through more advanced information gathering initiatives (such as periodic meetings, newsletters on the research groups' activities, short studies, etc.);

Promoting the creation of new research groups

- **promoting the creation of new research groups**, through various mechanisms (related to scientific careers, access to new resources, social recognition, etc.) in order to reward the most proactive senior researchers; special attention can be given to developing specific methods for starting up new research groups, even based on the involvement of existing research groups or on tutorship services provided by expert scientists;

Preventing and managing critical life-cycle events

- **preventing and managing critical life-cycle events**, i.e. the events which could put in danger the existence and development of the research group (retirement of the principal investigator, the transfer of members to other institutions or positions, the acquisition of a new important research project, etc.);

Supporting a strategic governance of the research groups

- **supporting a strategic governance of the research groups,** so that each member could be fully involved and motivated in order to provide the group with a steady identity, a specific shared culture and the skills and competences that are necessary to successfully drive it (e.g. competence related to research management, knowledge management, public communication, pedagogy, etc.) as well as to establish fruitful relationships with other actors;

Helping research groups

- **helping research groups in balancing their own scientific capital** (related to scientific recognition and reputation) **and temporal capital** (pertaining to the capain balancing their own scientific capital and temporal capital

city to influence the organisational, economic, financial and political aspects connected with research), avoiding that the dominance of the latter could bring the group to low levels of scientific productivity and the dominance of the former could produce an isolation of the group with respect to the social, economic and institutional context; this problem could be coped with in a public way through public meeting and workshops, allowing principal investigators and research managers within the institution to be in tune about the main choices to be taken;

Feeding the inner cohesion of the research groups

- **feeding the inner cohesion of the research groups,** adopting measures aimed at, e.g., preventing and managing conflicts and arousing a sense of ownership by all the members.

These orientations are mainly addressed to the managers of research institutions (head of research groups, head of departments, university top managers, etc.).

2. Creating an enabling environment for the research groups

Research institutions usually do not pay adequate attention to the needs of their research groups. Often, they also represent a really unfavourable environment for them. Avoiding such situations is a priority objective, to be pursued by creating an "enabling environment" around the research group, which could make their action more effective. From this perspective, specific support can also be given by innovation agencies (such as scientific parks), which can provide researchers with tailored expert advice and opportunities for exchange with other groups or external actors, such as enterprises. The measures to be promoted could be aimed at:

Providing specialist advice

- **providing the research groups with a specialist advice**, to be used on demand, in fields such as research management, public communication, fund raising, small group management, technology transfer, logistic, and the like; advice could be given by personnel of the same university or research institution, even from other departments and faculties or structures such as scientific parks;

Adjusting management and administrative procedures to the research groups

- **adjusting management and administrative procedures** applied by the research institutions **to the needs of research groups;** we are referring to those pertaining to, for example, organisation and maintenance of space and research facilities, accounting, contracts, patenting or technology transfer; from this perspective, the active involvement of research groups' leaders and members could facilitate the identification of solutions that could be acceptable and compatible with the overall regulations that the research institution has to follow;

Facilitating communication

- **facilitating the communication flows among research groups and researchers within the institution**, through flexible, but steady procedures and channels, in order to support scientific cooperation, to identify and solve possible conflicts and tensions and to remove organisational, logistic or economic hindrances;

Monitoring the quality of the institutional context

- **promoting the use of procedures**, even ones very easy to apply, aimed at monitoring and evaluating the **quality of the institutional context** (from any possible perspective, such as decision making processes, short and long term institutional development programs, opening up toward external actors, and the like);

- **making as smooth and rapid as possible the relationships** between research groups and the **other relevant operational units** within the institution such as the technology transfer office, the patenting office, the international relations unit, the offices in charge of public communication, the central administrative offices and the technical services.

Connecting researchers to operational units

These orientations are mainly addressed to the managers of research institutions (principal investigators, heads of departments, university top managers, etc.).

3. Supporting researchers

As we already pointed out, the "profession of scientist" is rapidly changing, enriching with new contents and new functions. This entails developing measures that could support researchers in acquiring new skills and competences, in order to adequately match the needs of a scientific and technological research that is becoming more complex and fragmented. In this domain, some measures can be promoted in order to:

Strengthening the learning paths

- **strengthen the learning paths for scientists**, within both the university curricula, and post-university education, allowing students and young researchers to acquire knowledge and skills about the domains usually not considered in university and post-university courses, such as innovation and technology transfer, team working, organisation and management of research networks, scientific communication and science-related ethical issues;

Making research groups as learning environment

- **reinforce the role of research groups as a learning environment**; this could entail the development of personalised educational and training programs, also based on experiential learning, tailored to younger members, as well as the organisation of updating initiatives on some key aspects of research;

Supporting researchers' mobility

- **support the mobility of researchers** within the research institution (enabling them to experience different roles related to teaching, innovation, research, communication, and management) and among research public and private organisations, in order to come into contact with different dimensions of research production;

Contrasting gender discrimination

- **confront the factors contributing to a discrimination of female scientists in their career paths and in daily activities**, starting from the application of the measures already identified and recommended over and over by European institutions and by some national governments; particularly important is a deep "on-site analysis" on the concrete micro- and macro-mechanisms active within the institution and research groups hindering women in their activities;

Fostering the job stabilisation of researchers

- **foster the job stabilisation of young researchers** contrasting the widespread tendency in many European member states towards precarious and unstable jobs in the research sector; researchers could be supported by research institutions to develop a process aimed at "linking" together their working experiences, avoiding the risk that they could be "trapped" into positions which are at the same time precarious, unconnected with previous jobs and without future perspectives; an effort could be made for developing personalised working insertion plans the steps of which could be verifiable.

These orientations are mainly addressed to a broad range of actors: principal investigators, heads of departments, university top managers, trade unions, governments (e.g. ministry of labour, ministry of high-education, ministry of research), European institutions.

4. Integrating research groups into scientific community

Research groups can attained high-quality research standards only through their strong integration within the international scientific community. This requires growing efforts, due to the increasingly relational nature of scientific production, focused both on individual researchers and research groups. Measures in this field could pursue, for example, the following aims:

Supporting trans-disciplinary research

- **supporting trans-disciplinary research**, e.g. identifying and struggling against the strong resistance to trans-disciplinary work within the different disciplinary groups as well as creating an enabling environment for researchers to become familiar with trans-disciplinary work at different levels (research programmes; university teaching; career paths; inter-faculty communication; sensitisation initiatives; trans-disciplinary exchange evaluation plans; etc.);

Facilitating scientific co-operation

- **facilitating the development of dense trans-institutional and trans-national scientific relationships**, putting in place adequate structures and activities (database, discussion groups, etc.), which could allow mapping the whole scientific networks in which the research institutions, the research groups and the individual researchers are involved, safeguarding the autonomy of each scientist;

Creating responsibility centres on scientific cooperation

- **supporting the establishment of responsibility centres for promoting scientific co-operation** within research institutions or single research units (e.g. departments), acting also on demand of researchers; moreover, research institutions could improve their procedures for evaluating scientific co-operation programmes and could reinforce as far as possible their welcoming structures (temporary board and lodging facilities, transportations means, office space and equipment, etc.) and procedures.

These orientations are addressed to a broad range of actors, but especially to governments and European institutions, being an important aspect related to the construction of the European Research Area.

5. Managing the impacts of public policies

As already pointed out, scientific practices are, not only influenced by research policies, but by other kinds of sectoral policies, related to e.g. education, labour, welfare services, local and urban development, public administration, innovation, and international co-operation. Their impact could be different in size and nature and might influence various components of research production (personal conditions of researchers, access to funds, exploitation of the research results, budgeting plans, etc.). As an example, three main objectives to be pursued can be mentioned:

- **mapping the public policies which directly and indirectly affect research activities**, devised by European institutions, national governments, local authorities and other agencies, in order to evaluate their impacts and to identify the "lacking policies" which could be helpful for boosting high-quality research;

- **promoting exchange and debate**, both within research institutions and with external actors, **on public policies influencing scientific and technological production**, by resorting to a diversified range of tools (periodic meetings, public audits, discussion groups, networking, etc.);

- **identifying and managing hindering factors and opportunities** related to different public policies and their mutual interactions, through specific studies and analysis; specific initiatives could be made for co-ordinating public actors through partnerships and networking, also in order to prevent unintended effects and waste of resources.

Mapping public policies involving research activities

Promoting a debate on public policies

Managing hindering factors and opportunities

Beyond research institutions and governments, these operational indications could be addressed to all the actors involved with the different sectoral policies (such as trade unions, civil society organisations, local authorities, innovation agencies, industrial federations, credit institutes).

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

For different reasons, research groups and research institutions tend to be scarcely open up to their social context, notwithstanding the increasing pressure to link research to economic and societal needs. Often, these trends toward "social contextualisation" of research are more undergone than desired by research institutions, which frequently perceived them as a limitation rather than a propelling factor for research production. Some objectives to be mentioned here can be:

- **consolidating a habit of interacting with social actors** among research institutions and research groups, intended as a "weekday" practice embodied in the research production, rather than as an abstract "weekend" activity; this could mean multiplying the opportunities to open research institutions up to external actors, through the most appropriate and flexible tools (forums, conferences, lectures, presentations of research results, visits to external associations, networking, etc.); particularly interesting could be, in this perspective, the experience of the science shops[10];

- **promoting the involvement of social actors in the lives of research institutes,** by establishing common research programmes, common dissemination initiatives for research results, or other kinds of partnerships and twinning projects; involving stakeholders in teaching activities, evaluation exercises and strategic research planning could be particularly effective in creating bridges between research institutions and social actors; each research group could make efforts to identify the stakeholders

Supporting a habit of interacting with social actors

Involving social actors in the life of research institutes

10 European Commission (2003) *Science Shops. Knowledge for the Community*. Brussels and Luxemburg: Office for Official Publications of the European Communities.

Using impacts as driving criterion for research planning and management

with respect to their own research strand and specific projects;

- **sustaining the inclusion of societal and economic impacts** as one of the driving criteria in planning and managing research; this could entail feeding a debate within research groups, departments and research institutions on what can be realistically done in order to drive social contextualisation processes, starting from the existing research programmes and without limiting researchers' autonomy.

These operational indications are mainly addressed to research managers at all levels and, for some aspects, to social actors.

With reference to this point, other useful recommendations have been made by the European Research Advisory Board (box 1.4).

[Box 1.4]
EURAB'S RECOMMENDATIONS ON RESEARCH AND SOCIETAL ENGAGEMENT

In June 2007, the European Research Advisory Group published a report devoted to the relation between research and societal engagement. The document provides some further recommendations which deserve to be mentioned here.

- **"Expose researchers to other perspectives of research and innovation by integrating engagement with societal actors into the university curriculum.** Universities should try to develop structures that promote a wider dialogue and plant seeds for more open interaction. By training research students to engage with societal actors and see other perspectives, the academe would be encouraging a multi-disciplinary outlook.

- **Encourage engagement as a factor influencing a researcher's career prospects.** Studies have shown that scientists tend to think that public engagement activities can be counterproductive for their careers. The European Commission should act to highlight the value of greater dialogue with societal actors and how this could advance research careers. This would include cataloguing good practices, emphasizing the benefits of dialogue and career mobility, and holding a series of multi-disciplinary events to encourage stakeholder engagement.

- **Develop further mechanisms for societal actors to improve their research capacities.** EURAB encourages the development of mechanisms to bring societal actors to the table as partners in the dialogue on research and innovation. By enabling societal actors (e.g., NGOs, Civil Society Organisations) to develop their own research capacities, the 2007 FP7 Science in Society Work Programme on

Capacity Building pilot appears to be moving in the right direction.

- **Encourage societal actors to be more involved in European Technology Platforms.** The European Technology Platform's multi-stakeholder engagement approach has largely been limited to business, government and the academe. To engage societal actors, EU funding mechanisms like FP7 should provide vehicles that empower these actors to assess issues of concern to certain Technology Platforms. This approach may open the door to further engagement.

- **Encourage structures for partnerships between researchers and societal actors in the research dialogue.** The Commission should assemble a series of good practices to concentrate the researchers' thinking on the overall value of dialogue with other actors. Empowering societal actors helps bring them into the dialogue as engaged and committed partners. These good practices will help generate fresh thinking on the means for further engagement.

- **Integrate societal actors into the various stages of the research evaluation process.** The project evaluation, assessment and post-assessment processes can be strengthened by creating a structural role for societal actors where appropriate. Societal actors should play a larger role on impact assessments".

Excerpt from EURAB (2007) *Research and Societal Engagement. Final Report.* European Research Advisory Board, Brussels

[S]

SOURCES OF INFORMATION AND FURTHER READINGS

A list of possible sources of information in order to deepen the issues dealt with in this section are provided.

Associations

ALLEA – All European Academies. ALLEA is a Federation of National Academies of Sciences and Humanities, aimed at promoting the exchange of information and experience between Academies, offerings European science and society advice from its Member Academies (www.allea.org)

EARMA – European Association of Research Managers. EARMA is a European forum for those engaged in research management and administration. (www.earma.org)

EARTO – European Association of Research and Technology Organisations. EARTO is the European trade association representing over 350 Research and Technology Organisations (RTOs) from across Europe (www.earto.org)

EIRMA - European Industrial Research Management Association. EIRMA is an independent, not-for-profit organisation which deals with the effective global management and organisation of business R&D and innovation within a European perspective (www.eirma.org)

ESMU – European Centre for the Strategic Management of Universities. ESMU is aimed at providing a support to European universities striving to further their strategic developments (www.esmu.be)

EUA - European University Association. EUA represents and supports higher education institutions in 46 countries, providing them with a forum to cooperate and keep abreast of the latest trends in higher education and research policies (www.EUA.be)

EURODOC – European Council of Doctoral Candidates and Junior Researchers. EURODOC is a federation of national associations of Ph.D. candidates and young researchers (www.eurodoc.net)

Websites

SINAPSE - Scientific INformAtion for Policy Support in Europe. SINAPSE is a web-based communication platform that offers a set of essential tools to promote and encourage the effective exchange of information between all stakeholders concerned with the use of science in European governance. SINAPSE is a free public service of the European Commission (europa.eu/sinapse/sinapse/index.cfm)

European Research Advisory Group – It provides useful documents pertaining to different aspects related to science-society relationships (ec.europa.eu/research/eurab/index_en.html)

Science and Society Portal – Established by the European Commission, it allows to follow EC initiatives in this domain (ec.europa.eu/research/science-society)

European Science and Technology Observatory (ESTO) - It is a platform of experts engaged in monitoring and analysing scientific and technological developments and their relation and interaction with society (ipts.jrc.ec.europa.eu);

ERAWATCH - It is a European web-based service managed by ESTO that presents information on national and regional research policies, players, organisations and programs (www.erawatch-network.eu).

CHAPTER TWO

SCIENTIFIC MEDIATION

[*]

The modification of the social environment of researchers

As already pointed out many times in this handbook, scientific and technological research is affected by profound changes modifying its overall structure, such as:

- the tendency towards a strengthening of **trans-disciplinary research** and to **an emergent collaboration of the "three cultures"** (natural sciences, social sciences, and humanities);
- new flows of communication that tend to be increasingly **trans-national and trans-institutional**;
- continuous production of a broad and accessible **stock of scientific information** at a much faster pace than it happened in the past;
- more **extensive** and **direct communication** between researchers and other actors involved in research;
- an **increased demand** for scientific production and technological product, especially in the richest countries.

Therefore, while the contribution of sciences to a rational education and to the economic and technological development of societies has increasingly been recognised, the social conditions for practising and improving scientific research have become more socially complex and have come to involve ever more different social actors.

Consequently, the **social environment** in which research is embedded is becoming a **crucial factor** for the advancement of science and technology. Actually, for doing research under the new conditions and standards, scientists and research groups are required to continuously interact with a larger range of actors. Moreover, research is one of the social sectors in which global, national, local and small-group's dynamics are most intertwined; scientists, therefore, are compelled to continuously jump from one level to another. All these tendencies are making the social environment surrounding research more **dense**, **expanded**, **complex** and **difficult to manage**.

It is in this framework that the question of "**scientific mediation**" can be understood.

Defining scientific mediation

The concept of "scientific mediation" refers to the **relationships that scientists establish with their social environment**. Therefore, in the context described above, scientific mediation can be viewed as a specific dimension of science – the one that is related to the social ties linking scientists with (mostly) non-scientists, such as students, suppliers, funding agencies, managers, enterprises, and the like. Social *ties*, social *mechanisms* of bringing together scientists and (mostly) non-scientists into a social relationship, and the *process* of connecting scientists with people from their environment, are the object of scientific mediation. Due to the fact that **these relationships can be problematic**, knowledge about scientific mediation can be used to provide solutions or alternative ways of behaviour.

Scientific mediation as a mutual and productive cooperation

Usually, mainly in social psychology and peace studies, the term "mediation" basically refers to a **process of conflict resolution**[1]. This implies negotiation and alternative ways of **avoiding legal procedures**. It is usually applied to the **inner** components of a social system, such as families, courts, companies, wars, etc. **Scientific mediation**, rather than to conflict resolution, is primarily directed towards promoting as much as possible a **mutual and productive cooperation** between the parts ("non-zero sum games") for the **sake of collective knowledge**.

Scientists as social producers of knowledge

This need for higher level of cooperation is due to the very nature of knowledge as a **social construction** in which social and institutional factors play a pivotal role[2]. 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[3].

Five domains of scientific mediation

Taking into account the transformations currently affecting science and technology, **five main domains of scientific mediation** can be identified.

Governing

- **Governing**. It includes all the aspects of social environment pertaining to management, administration and planning of research units and institutions, power relationships within research institutions as well as political relations of any kind. Targets of mediation activities can be, e.g.: administration units, specialised offices (for example, patent office, Technology Transfer Offices, scientific parks, International relations units, etc.), local agencies or authorities, research institutions, funding agencies, enterprises. Professional mediators could be, e.g. research managers, consultants specialised in public relations and political lobbying.

Teaching

- **Teaching**. This domain includes any relationships pertaining to teaching activities. Since this is a domain traditionally incorporated within the researchers' life (as their "second mission"), it is usually not perceived as problematic. However, its relationships with research activities are changing, new needs and duties are emerging, and students' attitudes and orientations are also changing. Targets of mediation activities can be, e.g.: students, administration offices, Erasmus offices, secondary schools, higher education institutions, local authorities, enterprises, professional networks. Professional mediators could be, e.g. teaching assistants, tutors, experts in higher education, expert in job placement.

Networking

- **Networking**. This domain, at least theoretically, is in rapid expansion. It includes all the relations linking scientists and research groups to a geographic location. Targets of mediation activities can be, e.g.: economic actors and enterprises, civil society

1 Suares, M. (1996) *Mediación. Conducción de disputas, comunicación y técnicas.* Buenos Aires: Paidós.

2 See, for example, Etzkowitz H., Leydesdorff L. (2000) The Dynamics of Innovation: From National Systems and 'Mode 2' to a Triple Helix of University-Industry-Government Relations. *Research Policy,* 29, and Santos, B. de Sousa (ed.) (2003) *Conhecimento Prudente para uma Vida Decente. 'Um Discurso sobre as Ciências' revisitado.* Porto: Afrontamento

3 Martínez, M. (2008) Complexity and participation: the path of strategic invention. *Interdisciplinary Sciences Reviews,* vol. 33, nº2, pp. 153-177.

organisations, professional organisations, social services, local authorities, science centres, intellectual networks, local media and high schools, as well as scientists belonging to different organisations. Professional mediators could be, e.g., experts in fields such as innovation, university/enterprise relationships, scientific communication, public relations, and Third sector.

Designing and promoting

- **Designing and promoting**. This domain concerns the design and promotion of new research projects and programmes, in a context in which access to funds is becoming increasingly competitive. Actually, designing and promoting new projects entails a large set of mediation activities, addressed to different targets such as: other research institutions, funding agencies, economic actors, professional organisations, local authorities. Professional mediators could be, e.g., professional euro-project designers, experts in project promotion, experts in public relations, fundraisers.

Managing knowledge

- **Managing knowledge**. This domain includes all the relationships pertaining to co-production, exchange, diffusion, manipulation and transfer of scientific knowledge. Targets of mediation activities can be, e.g.: researchers and research institutions, journals, publishing houses, website administrators, libraries. Professional mediators could be, e.g., experts in knowledge management, scientific communication, the publishing sector, data mining.

Each of these domains potentially includes a large set of **different functions**, most of which are still far from being identified or formalised.

Features of scientific mediation activities

Scientific mediation is a domain very close to the **other socialisation areas**, such as scientific practices, scientific communication, innovation or evaluation, in which, to a certain extent, some mediating activities are involved, concerning specific social groups and flows of social exchange. However, mediation appears to be a broader orientation permeating any component of research, **emphasising the productive contribution** to scientific activities played, in "post-academic science", by (mostly) non-scientific groups who are or should be tied to scientists. Scientific mediation, moreover, shows some specific features:

Permanent engagement

- it requires a **permanent engagement** by those who perform the mediating activity (they cannot be sporadic or in a form of "exercises");

Direct interactions

- It is based on **direct** and **immediate** interactions;

Focus on any kind of social relations

- It can be effectively performed if it encompasses as far as possible **any kind of social relationships** that can be potentially useful;

Channels, codes and links

- It tends to systematically establish **channels, codes** and **links** between scientists and other social groups.

Spontaneous and planned mediation

Mediation activities can obviously **occur spontaneously**, without any planning nor specialisation. Scientists can participate actively or, on the other hand, can only take advantage of the opportunities opened by other actors. Their individual enthusiasm, charisma, and dedication, or the specific age and experience composition of the research group, can be crucial[4]. Some actors can play a role in mediation, which is informal and sometimes with a low degree of awareness.

However, due to the rapid transformation of scientific and technological research, **planned professional mediation activities** provided by universities, research organisations and other institutions are increasingly required. This is already occurring in some sectors. For example, in the case of universities, some units are devoted to mediation activities as much as they are to promoting innovation and first-job offers for students. In these cases, therefore, mediators are professionals of mediation.

Social conditions influencing scientific mediation

It should however be stressed that there are many **social conditions that favour or hinder** scientific mediation. Actually, scientific mediation processes coexist along other **relevant social processes** for the production of knowledge such as evaluation, innovation, and communication. All of these processes are variable according, for instance, to the political strength of academic institutions, to the economic resources available for researching, or to the cultural and social debates about the importance of issues that are worth researching. Their influence on planned or unplanned mediation processes is therefore undeniable. Moreover, like science, scientific mediation is socially embedded, and therefore highly dependent on broader factors such as job market dynamics, structure and orientations of mass media, presence and perception of environmental risks or overall political tendencies (for example, narrow-minded neo-liberal approaches strongly privileging the role of private firms and exclusive for-profit-criteria[5] should limit the potential development of scientific mediation programmes aimed at non-profit objectives).

Local environment as priority context of scientific mediation

What we have said above could seem to contrast with the common view of scientists as one of the **most globalised professional** groups and is therefore **less influenced** by the social environment where scientists live. But this is not true. Actually, if information is spatially "disembedded" and can travel everywhere, **knowledge tends to be locally rooted**[6], being produced by physically-located individuals in mutual interaction within a given social context, providing them with resources, information, cultural orientations and support.

In the framework of "academic science", social context was nearly synonymous to the **work environment.** Today, the work environment remains the **primary context** of scientific activities, where **relevant mediation processes** already occur. The organisation of teaching duties, the role of unions and professional associations, the bureaucratic organisation of the departments, or the processes of recruitment of new researchers, are some of the relevant social groups and social phenomena mediating scientific practice.

4 Kalpazidou Schmidt, E., Krogh, E., Langberg K. (2003) Innovation and dynamics in public research environments in Denmark: a research-policy perspective. *Science and Public Policy,* vol. 30.

5 Santos, B. de Sousa (ed.) (2003) *Conhecimento Prudente para uma Vida Decente. 'Um Discurso sobre as Ciências' revisitado.* Porto: Afrontamento.

6 Davenport T.H., Prusak L. (1998) *Working Knowledge: How Organizations Manage What They Know.* Cambridge, MA: Harvard Business School Press.

However, in "post-academic science", research needs the support of individuals, groups, organisations and institutions **external to the work environment,** such as private companies, non-governmental organisations and state and local agencies, local media, services, and so forth. Scientists working in public universities have local, regional or national agencies as important source of social relationships within their immediate environment. Donors, companies and families who fund the private universities are, on the other hand, the immediate references for research groups in those private institutions.

It is mainly at this level - that of the "**local environment**" – where the **need of scientific mediation is high**. It could be unfair saying that most of European research institutions are still the proverbial "ivory-tower" of the past; however, their capacity to interact with external actors, activating effective tools of scientific mediation and fully exploiting the resources these actors can mobilise usually remains very low.

The uncertain definition of local environment

Needless to say that defining the boundaries of the "local environment" is quite an arbitrary exercise, mostly depending on the researchers' perception. **Social proximity** can be determined according to the frequency of contacts, the spatial distance, or the importance given to the influence these social groups and organisations have in the development of scientific activities, of a particular research group or scientific institution, by different actors. Therefore, even **state policies** establishing priorities for funding and criteria for evaluating, could be regarded as the kind of local environments with an influence on science[7]. So that, mediation with these institutional contexts would be more intense, frequent and cohesive. Local or national politicians, academic representatives, consultants, technical staff, exclusive teaching professors (non-researchers), public servants, and so on, would be the *targets* of those mediations.

It is also obvious that the **social** environment of science is **global too**; and, again, it is clear that the boundaries between local and global dimensions are increasingly **blurred boundaries**. For example, scientific journals and international conferences are two of the most typical spheres of that global dimension; and even they require forms of scientific mediation between scientists and all the social groups engaged in organising, funding and managing those spheres in the local dimension. Journals and conferences, then, involve scientists and non-scientists, and produce opportunities, publication proposals, and qualified information about the issues under investigation.

Local environment between scientific practices and global society

Nevertheless, at present, the "**weakest link" of the chain** for the majority of research institutes and researchers is, so to say, the "**meso-level**" between the micro-dynamics of scientific practices and the macro-environment of the global society, that is the **local milieu,** where the most strategic institutional interactions for the advancement of research develop.

A participatory action research on scientific mediation

Most of what we present here stems from a **participatory action-research process** that a team of sociologists developed together with two research groups of natural scien-

[7] Kalpazidou Schmidt, E., Krogh, E., Langberg K., (2003) Innovation and dynamics in public research environments in Denmark: a research-policy perspective. *Science and Public Policy,* vol. 30.

tists (in the field of agriculture and chemistry, at the University of La Rioja, Spain) within the framework of the SS-ERC project (2006-2009) (see boxes 2.1. and the appendix).

[Box 2.1]
A SOCIAL EXPERIMENT ON SCIENTIFIC MEDIATION IN SPAIN

We developed our participatory action-research in the area of scientific mediation looking for natural scientists in the University of La Rioja (Logroño), since a partner of the SS-ERC project is the Foundation of the University of La Rioja. The Spanish city of Logroño is an area surrounded by vineyards and with a good portion of its population and economy dedicated to the world of wine. In September 2007 we started to contact two research groups of the university experts in the field of wine production in particular, and in agriculture in general. After several meetings, a plan divided in two stages was accepted by both natural and social scientists.

The **first stage** was called the "Shadow Project" because natural researchers were submitted to a daily and constant following by a sociologist who literally watched all their daily chores, as if (s)he was a shadow. This sociologist-shadow observed and shared the everyday life of natural scientists focusing his attention on their social relations with the local environment of university setting, management of research and private companies. Four sociologists acted as shadows and around twenty members of the research groups of natural scientists were followed several days each, during six months. At the end of the week, an in-depth interview was conducted with two of them, alternatively. The aim of this research was to get a full understanding of the real problems coming from those social relationships and causing a sub-optimal dedication to scientific research. After analysis and interpretation, it was decided to start up a second period of "experimentation".

For the **second stage**, one of the sociologists would act as a mediator between the two research groups of natural scientists and some groups in their local environment in order to get a practical and productive collaboration. After leaving the option of working within the university institution for coping with the problems of teaching and management of the research, efforts were concentrated on the work with private companies.

The **smaller and completely-female group** of natural scientists is expert in the field of Enology (Wine Studies) and Food Technologies. Due to the great importance of wine in the region, which is reflected in the economy, and in the university's specialised degrees, research about wine is capable of getting a lot of support. In October 2008 this research group was engaged in an ongoing and publicly funded project on the monitoring the presence in air of enological micro-organisms. They needed the facilities of wine producers for taking samples and developing experiments *in situ*, so scientific mediation consisted in helping them to get such collaboration with local companies (cellars) in the region. Different cellars were required in order to compare and verify the research. According to the size of the group, their academic aspirations and familiar constraints we had researched as "shadows" in the previous months, we decided to accelerate the contact with small and medium cellars where some former students were working or those that had made an informal inquiry to the researchers at any moment. Natural scientists, then, successfully selected the companies in the first month. Mediator along with the managers of the Foundation of the University, initiated the contacts, kept everybody informed and prepared the documents for the agreement.

The **second group of natural scientists** is led by two men and has a larger size and track of publications, ongoing big projects and public visibility. They are dedicated to studying the biological control of plagues, but not only at the vineyards. For them, the main problem was about how to get funding for all the lines of research they were already working on. Many PhD candidates and post-doctoral researchers of the group also needed new contracts for maintaining their current affiliation. Public funds achieved by the group were not sufficient, so that, mediation was used to seek private companies that could collaborate with the research group and to provide the funds required. First of all, it was necessary to decide which of the research projects were going to be offered for such collaborations. Depending on them, different options and companies were explored. Secondly, due to the sort of proposals selected (for example, the use of advanced technologies for measuring simultaneously weather changes and micro-organisms evolution) the selection of companies had to be oriented to the national scale -rather than to the local or regional environment- or to entrepreneurial associations of food producers. Social factors like the abundant teaching obligations and a huge burden of management duties over the lead researchers were also disturbing the decision-making process, as a verification of what had been discovered during the "shadow project". The mediator, then, tried to intervene in these factors and to deal with the new difficulties for implementing the collaboration with the providers of private funds. These complexities delayed the process during more than four months before starting a solid collaboration, although many preliminary contacts and project proposals were attempted in the meanwhile

[K]

KEY ISSUES

In this section, some specific aspects of scientific mediation deserving particular attention are briefly presented.

1. Researchers' optimal dedication to different activities

One of the key questions related to scientific mediation concerns the "optimal" dedication (in terms of time, attention, motivation and personal resources) of researchers to activities. In universities where scientists must devote time to **teaching, management** and **research**, there is a very fragile and unstable equilibrium between the three tasks.

Designing and **promoting research projects** able to be selected for funds requires increasing engagement by researchers. **Interacting with social and economic actors** is, for scientists, even more important, but they are highly time-consuming activities. The experimentation carried out in Spain shows that, without strong professional and institutional support, these activities risk to "overwhelm" researchers and to limit their capacity to do research. On the other side, these activities cannot be carried out without a real involvement of researchers. Finding balanced solutions is therefore increasingly important and difficult at once.

2. Changing mindset

As already said, science is produced in a **more flexible, heterogeneous and transdisciplinary way**, requiring stronger links of cooperation and exchange between researchers and between them and other actors. Strong academic structures are increasingly leaving space for a landscape composed of **many places where science is produced** connecting to each other through flexible social networks delivering and allocating essential people, information and goods for improving research activities. Therefore, while individual creativity of the principal investigator was a crucial factor in "academic science", in "post-academic science" the strength of the research group or institution and its capacity to manage these relationships in an effective way become crucial[8]. However, this shift represents a **new challenge of "social reflexivity" for scientists** because they need to deal with the limits of their own research practices instead of dedicating their time and efforts uniquely to producing and publishing the results of their research. **Scientific mediation** is often a "**new world" for researchers**. Different rhythms, routines, rules and expectations are usually at work. Unbalanced contracts with private or public organisations can be a constant source of problems. Frequently, to sign an agreement requires a lot of time, perceived as wasted time by scientists. All that requires a profound **change in the mindset** of scientists, university administrators, technicians and any other actors concerned with research and innovation; a change that not all of them are able or disposed to make.

3. Skills' shortage

Another priority issue connected with scientific mediation is the **shortage of specialised skills**, at both the **individual** and the **institutional** level. **At the individual level**, most of the scientists do not know how to manage the social relationships with their local environment and often lack the **basic skills** in e.g. economy, public administration, science policies, social communication or research management. Conferences, courses or publications addressed to researchers or university students on these issues are rare. **At the institutional level**, different problems can be identified: the often unmet need to define and develop new mediation functions; the parallel need of communication between these separate functions; the shortage of specialised mediators in the different domains of mediation. This overall shortage of skills could produce very negative effects. A typical example thereof can be found in the collaboration of scientists with private companies and NGOs in their local environment. Scientists are usually not **trained** for initiating and implementing that collaboration, as well as for managing their effects. If the institutional mediation services (for example, at university or local level) do not work well (as often happens), the condition of researchers could be even more complicated, producing frustration, extra-work load, and waste of time and resources. However, researchers feel the pressure to

8 Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P., Trow, M. (1994) *The new production of knowledge. The dynamics of science and research in contemporary societies.* London: Sage Publications.

collaborate because of, e.g., the absence of alternative funds or the exclusive resources these organisations can provide; therefore, they cannot stop their engagement, detracting time and attention from research.

4. The relevance of the local public

Connected to the previous point is the risk of interpreting scientific mediation only in an **utilitarian and short-term perspective**. It is true that the five domains of scientific mediation operationally identified above (governing, teaching, networking, designing and promoting, managing knowledge) are prevalently to be viewed as necessary actions for the benefit of research (thus, in a utilitarian perspective, from the point of view of researchers and research institutions). However, also in this perspective, **multiplying the interactions between researchers and the local public at large**, without immediate returns for the former, is equally necessary. Locals can contribute in forming **public opinion about science** and, hence, contribute to the process of **legitimation of science and scientific policies**. Their interest in exhibitions, conferences, public talks, press news and scientific training (even at mature and old ages, attending university courses) constitutes a challenge for scientists. Public funds can be allocated and delivered according to that perceived social interest, so scientists should take into account that context in order to ameliorate their local relationships. Moreover, **an informed public is a basic requirement for civic participation in science**. There are many controversial issues open to public debate so that locals can illuminate possible options for researching, and influence the scientific agendas. More specifically, there are very **local problems** according to the singularities of the regional economy and social groups that can only be understood by scientists in case they are in close contact to locals. In short, promoting mediating action connecting researchers to the public should be understood as a necessary step for **creating an enabling environment**, allowing more narrowly targeted and short-term mediation activities to be really effective.

[O]

OPERATIONAL INDICATIONS

In this section some **practical advices and suggestions** are provided. Even though they cannot be seen as part of a systematic approach to mediation (and therefore they can be taken as isolated from each other), if considered as a whole, they can help researchers, research groups, managers of research institutions or professional mediators to develop consistent programmes aimed at improving and enlarging scientific mediation initiatives and programmes in the five domains mentioned above (governing, teaching, networking, designing and promoting, managing knowledge).

1. Adopting a transdisciplinary and transprofessional perspective

Scientific mediation requires a good method for performing it in a way that major issues and problems we mentioned so far could be adequately dealt with. As we are arguing, scientific mediation is, basically, a matter of **understanding the social environment, the social groups and the different circumstances linked to them**. A social knowledge, thus, is required; and this is a new challenge for natural scientists not so well accustomed to acquiring and using it in a systematic form. In this sense, scientific mediation would be well developed on a **trans-disciplinary basis**, with a meaningful involvement of social scientists. Similarly, planning, activating, implementing and assessing scientific mediation activities in a pro-active perspective requires, to be effective, a **trans-professional methodology**, able to mobilise a wide range of competences and skills (such as those pertaining to public relations, innovation, lobbying, research management, networking, scientific journalism, and so on).

2. Using a participatory action-research approach

For many scholars[9], this sort of trans-disciplinary and trans-professional collaboration relates to **participatory action-research** (PAR) methodologies. Actually, in scientific mediation, no social group or individual can be perceived as 'object' of research and action. Rather, **everybody acts as a 'subject'**, taking part in the important decisions and proposing ways of progress. This does not mean an absolute horizontality because some division of roles can be accepted consensually. Moreover, it is also necessary that someone (and/or professional mediators, if any), assumes the **final responsibility for the whole process of mediation**. Those who accept low degrees of responsibility help the others with their support, key information and contacts, meetings for supervision, and contributions to analyse the data obtained and to decide on ways of intervention. Finally, the uncertain nature of any mediation activity makes a strong and flexible link between analysis and action necessary. In sum, who are involved in mediation activities are to be viewed as part of a **common enterprise**, with its potentials and risks.

3. Distinguishing and mapping social groups

As we already noticed, there are **many factors distorting the perception** of the actors involved in mediation activities. The risk is that entire sectors of the social environment could be ignored, as if they do not exist at all. Hence the need to make an effort aimed at **distinguishing, identifying and mapping** the groups active in local environments on an objective basis (as far as possible). For example, it could be useful to start by dividing the local environment between **'institutional'** and **'non-institutional'** groups.

Institutional groups

An elementary scheme should include, among "**institutional groups**":

- **Work places/organisations** to which the researchers belong: universities, public (or public and private) research institutes, R&D departments in private firms, private foundations / institutes of research, NGOs and civic associations;

- **Funding institutions and donors**: any of the previous organisations and public agencies (local councils, regional governments, national programmes or ministries, European programmes and networks);

- **Research managers**: professional organisations, committees and boards of experts,

[9] Villasante, T. R. (2006) *Desbordes creativos. Estilos y estrategias para la transformación social.* Madrid: La Catarata; Santos, B. de Sousa (ed.) (2003) *Conhecimento Prudente para uma Vida Decente. 'Um Discurso sobre as Ciências' revisitado.* Porto: Afrontamento; Martínez, M. (2008) Complexity and participation: the path of strategic invention. *Interdisciplinary Sciences Reviews,* vol. 33, nº2, pp. 153-177.

and policy-makers within public agencies who organise, establish priorities and assess research projects and results.

Non-Institutional groups

Among the "**non-institutional groups**", examples are:

- **Collectives near to the scientists' life**: students, academic authorities, research assistants, scientists from the same or different fields of research (and from the same or different work place), professors, experts and administrative staff working in the organisation that hosts the research group, friends, and families;

- **Formal organisations with occasional contacts with research groups**: labour unions, professional organisations, public administrations, private companies, civic and non-profit organisations;

- **Public opinion and society at large**: local and mass media, attendants to conferences or exhibitions, former and eventual students.

4. Strategically selecting mediation activities

Making scientific mediation an institutional responsibility, even though it is an indispensable step to take. However, it is particularly **complex to carry out**. Actually, resources are limited while the social environment of researchers and research institutions is huge. Therefore, **selective criteria** are to be adopted. Hence the need of developing a **strategy of scientific mediation** (at the appropriate unit: research group, department, research institutions, local level, etc.). This strategy necessarily has to emerge, at least, from:

- a **critical analysis** of the current formal and informal mediation activities already in place;
- the identification of **weaknesses** and **hindering factors** characterising them;
- the identification of **realistic strategic objectives** to pursue;
- the activation of **experimentations**, in the form of participatory action-research projects, as suggested above.

This strategy can be developed, applying the **five domains of scientific mediation** (governing, teaching, networking, designing and promoting, managing knowledge) as a **possible scheme** for identifying both hindering factors and opportunities, as well as for establishing short- and long-term objectives. Other, similar schemes can obviously be applied.

5. Providing researchers with elementary management tools

As already stressed, a lack of institutional mediation services could produce an **overwhelming burden** for researchers. As our experimentation shows well, there are many factors contributing to creating obstacles and constraints. Three areas of engagement can be mentioned here, as examples.

Managing research work and designing new project proposal

- **Managing research work** as well as **designing new project proposals** are greatly time-consuming activities for scientists. None seems to escape from this task and from the social relationships it involves. On the one hand, it means to read and to search for the calls for funding; to write down a project; to contact other researchers, assistants and organisations who can be incorporated into the project; to verify all the documents asked by the institution who emits the call; to send the application by electronic and postal means; to buy all the material (infrastructure) required; to collect tickets, classify them, write a document and send all to the institution, or to the managers of their own work centre; to hire qualified personal; supervision of the process for contracting personal or students; writing letters for granting students to collaborate, etc.

Family obligations

- **Family obligations are, without doubt, the main constraint for researchers, especially for women.** They feel the typical double-burden of attending with the same dedication to their little children, the domestic work at home, and their professional challenges as a researcher (or as a professor and researcher). A scarcity of public measures to compensate this usual discrimination, directly and negatively affects the optimal dedication of women (and some men) to their research activities (or, on the other hand, personal satisfaction and aspirations can be frustrated in case scientists feel they cannot have children or couples because of their scientific careers).

Teaching activities

- **Teaching is a serious competitor of researching**. Anyway, teaching demands a lot of effort and, therefore, provokes interferences in the research activities: preparation of lessons, visits, experiments, conferences, etc.; attention to students during fixed hours but also at any moment and at any place, even out of the building of work, by telephone and email; time for visiting important places for the training and internships of the students; contacts with the organisations that provide resources for teaching and positions for students to collaborate, etc. **Abundant and unexpected meetings with other professors due to the needs of teaching** are also turbulences in the daily life of researchers-professors. (In our action-research, we could not develop scientific mediation in order to reduce teaching loads of researchers because of the complexity and long duration of the process, and because of the strong resistance showed by academic authorities.)

6. Applying elementary tools of management

Even though scientific mediation increasingly has to be performed by professional figures, researchers and research groups have to play a role in mediation activities anyhow. Therefore, they should be helped to better organise their daily life by applying **elementary tools of management,** on the basis of a **self-reflexive analysis** of their own experience. This is even more important when they are poorly or not at all supported by institutional mediation services.

Some examples

Examples of basic tools for managing daily mediation activities (mostly pertaining to research management and the design of new project proposals) can be:

- To organise a calendar/register **noting all the regular calls for funding** research projects;

- To **collect all the administrative data of the scientists, assistants and collaborative organisations** which were involved in research project in order to facilitate future procedures;

- To ask for the **institutional documents** required in the calls to the work-organisation in time or in advance;

- To elaborate an **agenda of local contacts** for developing the research, in terms of looking for people and organisations to be involved in the fieldwork;

- To **delegate some administrative tasks** to specialised personnel of the work-organisation, and agree on procedures with the chief persons;

- To **prepare alternative research proposals** before calls for funding are open, and to revise them within the research group;

- To be in **contact with other research groups** interested in joining common research proposals;

- To **work regularly with a data-base of scientific journals and articles** close to the field of research and to provide updated information about issues and requirements to all the members of the research group;

- To **update the website and the curricula of the research group**, keeping interested individuals, colleagues and organisations directly informed;

- To **gather news about scientific events**, conferences and discoveries, in order to deliver them to the members of the research group;

- To **plan activities** in the medium term.

Similar lists of possible simple management solutions can be developed for other sectors of activities (like teaching or networking).

7. Identifying and managing the components of scientific mediations initiatives

As already said (see the box 2.1.), the experimentation carried out consisted of realising a concrete scientific mediation activity in support of two research groups. Although specific for its context, contents and aims, the experimentation allowed us to identify **some components** of a mediation programme, which mainly refer to networking activities, but that could probably be common to other kinds of scientific mediation. designing and promoting new research projects, teaching, managing knowledge) as well.

These components are:

- Selection of the relevant actions;
- Preparation and activation;
- Management and implementation;
- Development and maintenance of the bonds;
- Visibility and management of results.

Following a strategic approach, it is of the utmost importance to **select the relevant actors** to be involved in mediation activities. In some cases, scientific mediation should involve categories of actors or, more often, individual organisations. Finding the "right" partners could be a deciding factor for the success of the mediation initiative. Some "lessons learnt" emerging from the experimentation, can be mentioned here:

Selection of the relevant actors

- Privileging actors already known on the basis of past experience or present contacts; this implies **mapping and exploiting the "social capital"** of researchers, research groups, mediators and other actors involved (including the so called "weak ties");

- Renewing contacts with actors who displayed **clear interest in cooperating** in the past, or showing **specific qualities** (such as open-mindedness, enthusiasm, creativity, flexibility, pro-activity, etc.);

- Choosing as much as possible **neighbouring entities,** in order to both reduce costs and to facilitate trust-based interactions (thanks to shared culture, common life context, etc.);

- Ascertaining, through a preliminary negotiation phase, that the actors potentially involved with the scientific mediation initiative recognise a real **strategic weight** to science and technology for their own survival and future development.

Preparing and activating mediation activities represents a particularly important and difficult step to take, since it entails the building up of a common framework of meanings and objectives justifying the initial investments by the concerned actors. Some indications can be singled out in this regard:

Preparation and activation

- making explicit all the **motivations** underlying the collaboration and the **minimum conditions for starting up** (commitments, requirements, quality standards, types of works, personnel involved by each organisation);

- defining the **kind of knowledge produced**, making explicit elements such as material and human conditions for research, the institutional context, the usual routines, and the ways adopted for publishing results;

- taking advantage of **informal contacts** to start up with the mediation activities, not waiting for formal procedures;

- being sure about the real **interest**, **enthusiasm** and **responsibility** of the actors involved with the initiative and facilitating any possible way for reinforcing and communicating a sense of commitment among the stakeholders and partners;

- building up a **shared and clear view** of the **expected results and benefits**, for every actors involved (professional mediators are crucial here for trying to translate these future results into an intelligible language);

- timely providing serious information about **property rights, patents** and **any legal implication** pertaining to scientific mediation activities;

- being ready to **promote the involvement of other research groups**, in order to foster trans-disciplinary cooperation and increase the confidence of non-scientific actors in scientific research.

Management and implementation

It is trivial to state that **implementing and managing** are key components of any mediation activity. A bad management of available resources as well a bad implementation phase produce serious aftermaths (conflicts, waste of time, etc.) which could result in a partial or total failure of the initiative. In this regard, some practical indications can be given:

- ensuring an **accurate** and **transparent estimation** of the resources needed, of any kind (funds, human resources, technical resources, knowledge, know-how, etc.);

- **preventing any dispute** about provision, management and use of the resources (here professional mediation services could provide a key support);

- promoting the **transfer** of **practices, knowledge, know-how and ideas** among the actors involved, using mediation also as a **collective learning process** (this is particularly important when mediation puts into contact actors bearing clearly different cultures, such as researchers and private companies or private companies and NGOs);

- **avoiding to waste time** (through several techniques such as the reduction of unnecessary meetings, travels and documents);

- keeping a regular and shared control over the degree to which **expected goals are being achieved**;

- ensuring **flexibility** and **efficacy** as relevant criteria in order to move forward, as to timely react to unexpected feedbacks, events, obstacles and opportunities;

- using as far as possible **ICTs** and **at distance communication**, both for cutting costs and for fostering rapid, continuous and direct interactions among the concerned actors, preventing any form of "communication isolation";

- keeping a **high level of attention for the** "**invisible dynamics**" involved with the mediation activities, such as those pertaining to trust, prestige, psychological attitudes, levels of personal or institutional mobilisation, levels of commitment, interest and motivation, etc.;

- paying due attention to **cultural bias** and **stereotypes** (typically, stereotypes shared by entrepreneurs on scientists and those of scientists on entrepreneurs) making them explicit when they emerge.

Visibility and results management

Taking care of the **visibility** of the scientific mediation initiative and **managing its results** in appropriate ways is of evident importance for the success of scientific mediation projects. In this regards, some main indication can be mentioned here:

- preventing conflicts about the **publication of the results emerging from the partnership**, by activating an open, sincere and flexible negotiation among the partners (this is important also taking into consideration existing cultural barriers; for example firms' managers do not understand why this is so important for the career of scientists, and fear the risks of being exposed to industrial competition);

- establishing **procedures** shared by all the actors **regulating drafting, revision and publication of texts and articles** pertaining to the scientific mediation initiative and its results (these procedures are also important for avoiding the diffusion of sensible information about some of the partners involved); the right to publish scientific articles should be decided explicitly in common agreement between scientists and the other actors involved;

- activating a **specific programme** (with dedicated personnel) aimed at managing and promoting the visibility of the mediation initiative, both for its scientific and non scientific impacts, naturally including any possible and realistic information tools, such as conferences, workshops, university courses, traditional and new electronic media.

[S]

SOURCES OF INFORMATION AND FURTHER READINGS

Books

Baker, K.A., Branch, K.M. (2002) Concepts underlying organizational effectiveness: trends in the organization and management science literature. In WREN, *Management benchmarking study*, Washington, DC.

Bernal, J. D. (1949) *The Freedom of Necessity*. London: Routledge, Spanish edition quoted: (1975) *La libertad de la necesidad*. Madrid: Ayuso.

Bourdieu, P. (1984) *Homo Academicus*. Paris: Minuit.

Bourdieu, P. (1987) *Choses dites*. Paris: Minuit.

Etzkowitz H., Leydesdorff L. (2000) The Dynamics of Innovation: From National Systems and 'Mode 2' to a Triple Helix of University-Industry-Government Relations. *Research Policy*, 29.

Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P., Trow, M. (1994) *The new production of knowledge. The dynamics of science and research in contemporary societies.* London: Sage Publications.

Gieryn, T.F. Boundaries of Science. In Jasanoff, S. et al. (eds.) (1995) *Handbook of Science and Technology Studies*. Thousand Oaks: Sage Publications.

Gieryn, T.F. (1983) Boundary Work and the Demarcation of Science from Non-Science: Strains and Interests in Professional Ideologies of Scientists. *American Sociological Review*.

Granovetter, M. S. (1973) The strength of weak ties. *American Journal of Sociology,* vol. 78, nº6, pp. 1360-1380.

Kalpazidou Schmidt, E., Krogh, E., Langberg K. (2003) Innovation and dynamics in public research environments in Denmark: a research-policy perspective. *Science and Public Policy*, vol. 30.

Kalpazidou Schmidt, E. (2008) Research management and policy: Incentives and obstacles to a better public-private interaction. *The International Journal of Public Sector Management,* vol. 21, nº6.

Martínez, M. (2008) Complexity and participation: the path of strategic invention. *Interdisciplinary Sciences Reviews*, vol. 33, nº2, pp. 153-177.

Santos, B. de Sousa (ed.) (2003) *Conhecimento Prudente para uma Vida Decente. 'Um Discurso sobre as Ciências' revisitado.* Porto: Afrontamento.

Suares, M. (1996) *Mediación. Conducción de disputas, comunicación y técnicas.* Buenos Aires: Paidós.

Villasante, T. R. (2006) *Desbordes creativos. Estilos y estrategias para la transformación social.* Madrid: La Catarata.

Wilden, A. (1987) *The Rules Are No Game. The Strategy of Communication.* New York: Routledge.

Woolgar, S. (1988) *Science: The Very Idea.* London: Routledge. Spanish translation: (1991) *Ciencia: abriendo la caja negra*, Barcelona: Anthropos.

Associations and website

ProTon Europe - European Knowledge Transfer Association. (www.protoneurope.org)

EARMA - is the European Association of Research Managers & Administrators for networking and sharing best practices in research management. (www.earma.org)

EUA - The European University Association. (www.eua.be/index.php)

AUTUM – Association of University Technology Managers (**www.autm.net**)

TII - Europe's premier independent association of technology transfer and innovation support professionals, informs and encourages networking, and facilitates technology transfer (www.tii.org)

CORDIS - An information space for European Research and Development (R&D) and exploitation of European R&D results (www.cordis.europa.eu/home_es.html)

ERAWATCH - conceived to support policy making in the research field in Europe (www.cordis.europa.eu/erawatch/)

Research research - source of funding opportunities and news on research policy and politics. (www.researchresearch.com/g etPage.cfm)

Science, Technology and Competitiveness key figures report 2008/2009. (http://ec.europa.eu/research/era/pdf/key-figures- report2008-2009_ en.pdf)

APPENDIX TO THE CHAPTER

COLLABORATION OF NATURAL SCIENTISTS AND PRIVATE COMPANIES: SMALL IS BEAUTIFUL, LESS IS MORE

	SUCCESS IN PARTNERSHIPS	COLLABORATIONS IN PROGRESS	FAILED PARTNERSHIPS	EXPLANATORY FACTORS
GROUP 1	Two cellars were rapidly contacted on the basis of previous and personal familiarity. Research requirements did not involve private funds. Collaboration was easily agreed in the local environment.			Although the partnership will begin in 2010, the winery already accepted the requirements of the group in terms of field-work and the scientific publication of results. Mediators helped to perform the collaboration emphasizing the details of mutual needs in the document of agreement. The low-cost of the collaboration and the public funds for researching got by the scientists contributed to free the way. Finally, size and extent of the research was carefully planned according to the time and conditions available for the researchers.
GROUP 2		Contacts with a large private company had been initiated and lasted several months. The company is interested in the scientific contributions of the research group, but wants total control over the results. Negotiations are still focused on the way both parts can use the results in the form of a "patent", industrial exploitation and public dissemination of the results through scientific journals. Scientists also wish to protect their own creation and experimental proposals.	Contacts with an association of enterprises in the sector of food production reached an end because of a lack of agreement with the funding requirements of the research project. The association is interested in the industrial benefits that the research can provide, but this was not a priority in its policy as an association of enterprises. Negotiations were closed for the moment, but conversations opened opportunities for knowing each other better and for possible collaborations in the future.	The two possible collaborations that were attempted implied various difficulties and made the mediation a complex process. On the one hand, the research group is very busy with its ongoing projects and the big size of its membership, with many different economic situations of the researchers. Although they have produced a lot of knowledge which deserves further work in terms of experimentation and application, they lack new public funds for continuing with it. Collaboration with private companies was seen more as a "solution" to that neck of the bottle, rather than a complementary opportunity to strengthen local ties. On the other hand, companies selected had a high technological profile or urgent economic goals, so the research proposals should be integrated according to these singularities. In one case, the company is very interested in the incorporation of the R&D process into their productive stock. This means that, even giving a great priority to the research, they are only concerned with an exclusive and competitive benefit. However, scientists also want to share results with the scientific community and society, since part of their work was previously generated due to public resources. The association of enterprises had a more local-regional profile and liked the collaboration with the university in terms of constituting R&D networks and improving its prestige. However, they considered that the funds requested were to high in comparison to the immediate benefits. Mediation, then, required a lot of time for clarifying the different perceptions and proposals. Finally, it consisted in a search for alternative solutions which could materialise the collaboration in the near future.

CHAPTER THREE

SCIENTIFIC COMMUNICATION

[*]

Changes in society, science and technology

During the last couple of decades we have been witnessing some **major changes in society at large** on the one hand, **and in science and technology** on the other. Even though all of these alterations might not be necessarily mutual or reciprocal, one could still identify a notable cross-section between the two. Adjectives, which are used to describe contemporary society, such as "post-industrial", "post-fordist", "information", "network", "knowledge", "internet", and similar, clearly show the importance of the role that science and technology play in the contemporary world.

Increasing complexity in science-society interactions

The main characteristic underlined by these changes is the **mounting complexity of relations between scientific and technological research and other social spheres**, e.g. government, economy, enterprises, NGOs, and so on. If science in the past was at best described as an autonomous or semi-autonomous sphere within the social totality, then at the end of 20th century the need for new explanations came into sight and some new theoretical models were proposed.

The **Triple Helix**[1] model, for instance, copes with this increasing complexity in terms of a functionally-simplified interaction scheme between academia, government, and industry, showing how bi-lateral interactions are being transformed in the direction of more complex and dynamic **three-way inter-connections**.

The model of the **New Production of Knowledge**, based on the idea of a **transition** from a traditional (modern) way of knowledge production (the so called Mode 1) to a new "post-modern" one (Mode 2)[2], tends to connect this growing complexity to the overall process of **contextualisation** of science and technology. Knowledge is increasingly produced in the **context of a given application**, with the intention of solving specific problems. These "socially contextualised issues", to be effectively dealt with, usually require application-oriented and trans-disciplinary research, private-public co-operation, larger research networks involving researchers working in various and culturally different locations, and more sophisticated forms of division of labour.

Scant awareness of transformations affecting science

As the initial research conducted during the SS-ERC project has shown, this change or transition **is not usually present in the consciousness** of those who participate in it (especially researchers in natural sciences and technology, policy makers, research managers etc.). In short: even though research at large is moving toward Mode 2, most of the stake-

1 Etzkowitz, H., Leydesdorff, L. (1997) *Universities in the Global Economy. A Triple Helix of University, Industry, Government Relations.* London: Cassell Academic Publishers.

2 Gibbons, M., Limoges, C., Nowotny. H., Schwartzman. S., Scott, P., Trow, M. (2005) *The New Production of Knowledge: the dynamics of science and research in contemporary societies.* London: Sage Publications.

holders act as if they were still in Mode 1. The problems that spring from this are obvious: science is not up to its task any more, and it cannot follow the demands set by contemporary society.

The key role of communication in socialising science and technology

In this framework, **communication started playing a pivotal role** as one of the main area where **socialisation of scientific and technological research** can occur. Actually, communication touches on all the main questions at stake: quality of research, use of research results, democratisation of science and technology, access to scientific information, social recognition of science within society, control over science and technology-related risks.

In this regard, it should be stressed that, with the increasing complexity in science-society relationships, the **complexity of scientific communication also increased significantly**. Each scientist meets 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.

Broadening the approach to scientific communication

Dealing with this new picture of communication needs and processes requires a **broader and more flexible approach to scientific communication.** Until the end of the '80's of the 20th century, there were **two separate and unrelated domains**:

- the **communication involved with the scientific research process;** and
- the **communication between science and society at large** aimed at reaching a consensus and ensuring unimpeded performing of work in the scientific domain.

This distinction held until the '90's, when the transition to the "post-academic era"[3] started. Actually, **in the "post-academic" context**[4], **this distinction does not work any longer**.

Scientific and technological production is increasingly incorporated into processes of economic production and organisation of contemporary society. While in the "academic era", decisions concerning research were taken in the scientific community, today, they are increasingly expected to be made in agreement with individuals and interest groups acting in the political and economic system as well as with a broader segment of, primarily civil, society. Given these changes, **knowledge producers** - be they individuals or institutions - **are expected to communicate within the community of knowledge production**, with **many sectors of society** as well as with **society at large**, which is ever more involved in the research processes themselves and in their technological applications.

3 Greco, P. (2002) Communicating in the post-academic era of science. *JCOM, Journal of Science Communication*. http://jcom.sissa.it/archive/01/01/E0101/jcom0101(2002)E.pdf. Accessed 5.1.2009.

4 Ziman, J. (2000) *Real Science. What it is, and what it means*. Cambridge: Cambridge University Press.

Revising the notion of scientific communication

The concept of **scientific communication** should probably be revised. Scientific communication is no longer to be only understood as a matter of communicating the results of scientific and technological research to the public. Rather, it **entails the management of the complex communicational processes connected with research planning, production, use and diffusion of its results**. Each of these phases involves a vast array of actors, at various levels, from researchers through organisations of civil society to government agencies, local entities, development agencies, and companies. This necessarily entails the overcoming of any **one-dimensional** (only the public at large) and **one-directional** (from science to the public) **conception of scientific communication**, as for example in the case of the PUS (Public Understanding of Science) model, which is, simply put, a model of distribution of knowledge to an uninformed and disinterested public

A long-term perspective

Finally, it should be stressed that the majority of the dividends of scientific communication for society are **long-term** and are difficult to discern immediately. It is necessary to bear in mind that scientific communication is not just about hosting spectacular science events and attractive science fairs or articles in popular magazines and daily newspapers. **Scientific communication,** to a certain extent, is a **nervous system,** made up of actors in mutual interaction, underlying scientific research and connecting science and society to each other. Therefore, any approach to scientific communication must necessarily be aimed at enhancing the roles played daily by these different actors - from the general public, scientific, governmental, and entrepreneurial sectors -, empowering them and enabling science to gain interest and support within society at large.

[Box 3.1]
SETTING UP THE EXPERIMENT ON SCIENTIFIC COMMUNICATION (THE CASE OF SLOVENIA)

As a prologue to the experiment, an analysis of the current state of communication between **science & research, business, and civil society** was carried out. The current state was first assessed at the national level and it was then followed by assessment of the current state at the University of Primorska, where the experiment was performed on the basis of these data.

Standard **interviews** with open-ended questions were conducted with professionals working in the field of communication, at universities, research institutes, government ministries, civil society groups and businesses, and they showed the following:

- Slovenian science is not very interesting for the Slovenian public at large. It is only interesting to **restricted circles** of academics;
- There is **no effective communication** between involved parties, viz., actors.

In order to clarify the difficulties thus revealed, **two focus groups** were convened containing actors with most insight and competence in the field of scientific communication. Also invited were representatives from government institutions, universities, those in charge of research and administration of institutes, various organisations, which contribute to fostering the quest for and production of knowledge. Among the insights gained from these focus groups are the following:

- In various **mass media**, natural sciences are over-rated, whereas social sciences and humanities are under-rated;
- A significant role is attributed to science, but, frequently, due to a **lack of understanding** of what science can contribute to the development of a given society;
- **Education** of the general public in science is one of the **basic steps** in socialising practices and research fields.

Research conducted at the national level was followed by an **analysis on the level of University of Primorska** (a micro-level) at which the experiment was to be conducted. Results of survey questionnaires and interviews revealed the following:

- **Improvements in two-way communication** among actors in all three domains are required;
- Mutual cooperation between University, economic sector, political system and civil society should be further advanced;
- A **database** containing all important information (field of research, competences, demands, etc.) pertaining to all the actors from all three domains should be set up.

Based on the data collected from this experiment and research project as a whole, a web site called "The University of Primorska Network of Excellence" (www. mreza-upr.org) was designed and posted to connect the University of Primorska and its research institutions to businesses and civil society. The objective of this portal is **interactive two-way communication** between all three domains thereby promoting the development of effective business and/or research solutions and their implementation in everyday life.

[K]

KEY ISSUES

In this section, some key **issues** pertaining to scientific communication are elaborated.

1. The low awareness of the new scenarios in scientific communication

The first key issue to address is the very low **level of awareness** of the new scenarios in scientific communication opened by the ongoing transformations in science and technology production. Because of socially-distributed production of knowledge, in which nowadays potentially all societal actors – from companies, consulting institutions, politics, non-governmental organisations, institutions of civil society – participate, density of communication flows is increasing, and communication is marked by many-to-many interactions. Consequently, all the actors are facing growing demands to adapt and transform their mode, means and forms of communication rapidly. In this de-centralised and multi-directional communicational context, new problematic issues are emerging, which have rarely been addressed in the past. For coping with these transformations, a widespread leap in awareness and knowledge is required, in order to overcome any forms of rigidity observed in many actors and to improve the overall quality and use of scientific and technological research.

2. The political issues concerned with scientific communication

In the new context of science and technology production, there are many **political issues strongly concerned with scientific communication.** Actually, research is becoming so important for the future of national and international communities that it poses new questions related to rights, duties and responsibilities related to science and technology. Communication is one of the main tools available for making these political issues concretely manageable. This is particularly relevant considering the consequences of the lack of open and democratic communication between different actors. For the production of knowledge, important potential stakeholders remain isolated and without the opportunity to be heard or even invited to participate in decisions concerning science and its role in society. Scientists tend to communicate only with colleagues of their own discipline, leaving the needed cooperation between disciplines intact; political leaders are often inclined to command the field of science authoritatively; frequently private companies are mainly interested in exploiting innovations realised with taxpayers' money; and important sectors of the public seem to be exclusively worried about the risks that science has brought into their daily lives. Scientific communication should play an important role in modifying this state of things.

3. The role of social sciences

Developments presently occurring in science and technology and, consequently, in scientific communication are modifying the **role of social sciences** – and communication sciences in particular. They should surely be engaged in showing the problems of socialisation and democratisation of science and the benefits society may encounter when previously arcane communication processes concerning production of knowledge and its application are made transparent. For that purpose, the most burning problems should be identified and analysed, ranging from communication between scientists of various disciplines to dissemination of research results to the public via mass media, and viable solutions should be suggested.

4.Trans-disciplinary communication: rigidity of institutions and obduracy of scientists

Whereas communication among scientists in a given discipline is almost a routine practice, the new context for knowledge and technology production demands **cooperation of various disciplines**. This poses a problem of how to effectively communicate beyond the same "epistemic community". The communication problem thus has two main prongs:

- The **first one** is the **rigid hierarchical communication structures** of research institutions, which prevent the formation of trans-disciplinary research groups in the first place. Universities and research institutions encounter a distinct lack of social spaces, where researchers - from various fields of both social and natural sciences -

could share their experiences with each other, while the task of these institutions should consist today of "relaxing" hierarchical communication structures and creating open discursive forums in which one could discuss the objectives and direction of research processes, both on-going and future;

- The **second prong** is that researchers are not capable of **understanding discourses of other disciplines** and at the same time underestimate them, respectively. Actually, trans-disciplinary communication requires a special kind of communication, which includes at least **rudimentary knowledge of the relevant fields** that try to cooperate in a trans-disciplinary research setting. Finally, inclination towards cooperation with other disciplines is possible only among researchers who hold various disciplines in high esteem and bestow upon them an important status.

As an addendum, we should also mention the "**communication breakdown**" between natural and social sciences and humanities[5].

5.Clashing communication styles and pace of the involved actors

A great number of changes and problems right in the interactions between universities, political institutions and industrial enterprises can be observed. Whereas changes require fast and open communication, stakeholders from different sectors many times encounter **rigid and/or time consuming communication procedures**, especially when reciprocal cooperation is at stake. One problem pertains to the fact that knowledge production at universities can hardly keep pace with demands that the market is dictating. Decisions about the directions of research at the universities are the outcome of **long negotiation processes**, while companies seek fast turnover of capital and favour results that gain the highest profits. Another problem is the **slow response from the political sector**, which should stimulate research in a direction that gives most advantages to society. Our analysis shows that mechanisms of mediation between political entities (including national and EU funding agencies) and other stakeholders (universities and companies) are quite inefficient in some countries. This, in turn, indicates the absence of any communication system enabling coordinators and advisors at the national level to mediate between political bodies, potential executors of research and those seeking knowledge.

6. Capacity, willingness and possibilities of scientists to communicate

Traditionally, the dissemination of scientific results is viewed as a matter for experts, i.e., news reporters and officials of public research institutions. In the "post-academic" framework, **scientists assume part of the responsibility for effectiveness in communication of science**. However, many scientists lack the skills required for communication with the public. Moreover, often researchers are either uncooperative or they don't have results available in an appropriate and understandable form, or neither want nor know how to communicate with the media and with the public. This is so, because, on the one hand, they often adhere to the ideology or stereotype that any manner of simplification of scientific or technological achievements is impermissible and, on the other hand, because no university-level natural science or technology program provides **training in writing user-friendly professional literature**. Not rarely, scarce engagement of scientists with communication is also caused by lack of time and opportunities. Due to this, scientific achievements, even when presented to the public, are presented in an inappropriate man-

5 See SS-ERC Project (2007) *Final Research Report.* (www.techresp.eu)

ner. This problem should be mitigated if **experts on public relations**, who would function as a link between science, media and other segments of society, were included in the research groups.

7. Civil society organisations as key actors in scientific communication

Role and relevance of **civil society organisations in scientific communication is usually underrated**. It also should be noticed that most of them do not seem to be so interested in getting involved. On the contrary, in a time of heterogeneous growth of research in various sectors of society, involving civil society organisations should be an established practice. Actually, these groups **test and evaluate expert knowledge in practice** in addition to being able to produce knowledge along with its application to specific social problems by themselves. **Information feed-back**, which flows from these groups, is becoming an important part of the information on the basis of which scientists can evaluate the success of their work and correct its course. That is why civil society groups, such as non-governmental organisations, should also be invited to communicate and collaborate with universities, business, and governmental institutions.

8. The heightening of scientific culture and scientific literacy

The heightening of **scientific culture** and **scientific literacy** is a traditional objective of scientific communication; and it still remains a priority issue. However, in the current framework, this objective should no longer be associated only with the need of raising a mere consensus on science and technology (as it was in the framework of the Public Understanding of Science). Rather, increasing people's scientific culture and literacy levels are mainly to be understood as necessary steps for **fostering a direct engagement of people with science** (as in the case of the more recent model named Public Engagement with Science and Technology). In this perspective, it is important here to emphasise three **inter-related dimensions** that contribute to science literacy and consequently scientific culture of each individual:

- the **basic understanding** of the **content** of scientific and technological research;
- the **understanding** of the very **process** of scientific and technological research (including political, organisational, economic and social aspects);
- the **understanding** of the **influence** of science and technology on the lives of individuals and groups in society.

Usually, only the first dimension is really taken into serious consideration. But if these dimensions are not integrated into the scientific communication process, it is highly possible that the public would not be able to communicate with the scientific domain due to a lack of shared concepts and values common to both science and society at large. In other words, the consequence is a **lack of scientific literacy** and **scientific culture** in broader society, resulting in an overall distrust in science and technology.

9. Mass media and science reporting

Mass media are nowadays the entry points for a **public discussion of science.** They foster and are at the same time integrated in social structures and cultural patterns, which determine the mode of production, distribution, and interpretation of mediated content on the part of the public. However, policies, which are designed to accelerate the dissemination of scientific information and research results, often omit the **very contextualisation of media reporting** and of interpretational strategies used by the media workers and audiences, respectively. **Media operate in the free market** and they necessarily serve the interests of media owners and editorial policies that they prescribe, and values and modes of news production are different from those of science. Consequently, news reporters favour sensationalism, drama, conflict and also readily absorbed content, which is just the contrary to how scientific content should be dealt with[6]. Moreover, media often promotes a positivistic image of science[7]. This image is an idealistic one that preserves the myth depicting science as apolitical, unbiased and a rational endeavour of isolated scientists. However, the public is usually well aware of the social nature of science and technology as well as of the interests influencing their development.

10. The "scientific" public sphere

Scientific communication is usually intended also as a tool for building a **"scientific" public sphere**, based on a sort of **agreement between science and the public** at large about the levels of **social accountability** and **moral responsibility** to be expected by those involved in both applied and basic research. This necessarily entails a broader public debate concerning the management of both the effects of research activities on society and the consequences of decisions or actions emerging from society on research activities. In this perspective, two extreme forms of danger can be mentioned here:

- **Fragmentation**: because of unfair access to communication channels and/or bad functioning of communication mechanisms, different separate and unrelated publics can emerge, each one characterised by the dominance of different groups with varying interests and interpretations of facts; this obviously obstructs the establishment of any agreement on science;
- **Democratic deficit**: because of the scarce mobilisation of the public or the lack of effective participatory mechanisms, political and economic leadership can keep or increase their control over the policies regulating scientific and technological production; this results in a democratic deficit, since de facto the public is kept off by the public debate; again, this impedes any possible agreement on science.

[O]

OPERATIONAL INDICATIONS

On the basis of the activities carried out in the framework of the SS-ERC project and mainly of the results of the experimentation carried out (see box 3.2.), some operational indications can be drawn.

6 Treise, D., Weigold, M. F. (2002) Advancing Science Communication: A Survey of Science Communicators. *Science Communication*, p. 313, 23.

7 Lewenstein, B.W. (1995) *Science and the Media*. In Jasanoff, S., Markle, G. E., Petersen, J. C., Pinch, T. (Eds.) *Handbook of Science and Technology Studies*. London: Sage Publications, p. 345.

[Box 3.2] RESULTS OF EXPERIMENTATION IN SCIENTIFIC COMMUNICATION

A specially-assembled "communications unit" developed, implemented, and posted the internet portal called "Network of Excellence", which serves to interconnect University of Primorska along with its research institutions to businesses and civil society in the directions of conducting research, their application to business and to society at large, and fostering scientific culture and scientific literacy among the public.

Analysis of existing communication-related activities of actors revealed that the approach to accelerating individual dimensions of communication requires knowledge of the following:

- The entire **communication network** interconnecting all potential participants in the research process.
- **Modes and forms of internal and external communication** among actors.
- **Critical points** or bottlenecks, which restrict information flows or impede two-way communication within the network.
- Actors that are interested to **collaborate** with each other (institutions, groups, and individuals).
- **Competences and requirements** of participants.

Analysis of communication among participants of research processes confirmed our hypothesis that actors traverse several communication dimensions daily, which requires of actors continual and often demanding **adaptation of modes, forms, and strategies** for communication and **switching of media**. There were, however, actors who weren't amenable to changes, which alter their routine communication procedures, even if the latter were complicated, demanding, and unduly time-consuming. Therefore, **education of users** is needed to accelerate the formation of sets of practices and a common set of meanings to be used by communicators.

By taking into account the approaches listed above, the portal enabled:

- Formation of **publicly-accessible communication channels**.
- Formation of a group of **basic communication norms**.
- Formation of a **value system**, which encourages participants to disseminate their research results and to present their interests.
- A **user-friendly** way of informing and getting involved in a public discussion about the production and application of scientific knowledge.
- Achieving these objectives required from the outset the **cooperation of all the users** of the portal, thereby achieving concurrent monitoring of its operation and of user satisfaction.

This experiment contributed to **bridging the gap between the research commu-**

nity and consumers of knowledge from business and civil society. Various mass media kept the public informed all the while about this new communication tool, which was available to all potential partners in the process of knowledge production. User-friendliness, involvement of users in planning changes and access to current information proved to be key factors in the positive attitude of users toward this new communication tool.

For sake of clarity, we will distinguish between **overall strategic orientations** and more **specific, sectoral measures**.

[A] OVERALL STRATEGIC ORIENTATIONS

1. Adopting a "situational" approach

One of the most interesting results is that scientific communication does not follow "**linear paths**" (e.g. science is made by scientists; they interact with university managers; managers interact with enterprises and policy makers; and so forth), traced by existing regulations, institutional responsibilities or task distribution. Rather, **each communication act** of whatever kind can have unintended effects on other kinds of communication or on other actors. This suggests managing communication problems in science and technology using a "**situational approach**". Rather than designing prescriptive schemes of communication flows to be adopted (defining who has to communicate with whom, what, when and through which means), it appears more appropriate to **map the existing "situations**" in which science and technology are subject of communication, naturally at the appropriate level (e.g. department, faculty, research institution, university, local level, etc.). This mapping exercise should allow an analysis of who are the concrete actors involved, which are the contents transferred and, mainly, how these situations can be improved, enlarged, standardised, supported and, when particularly effective, replicated elsewhere.

2. Overcoming the distinction between lay people and experts

Experimentation results seem to suggest that **dividing communication participants into scientists/experts and lay public community** is scarcely productive and risks to be misleading. Actually, this distinction countervails a "situational" approach, since it risks typifying the individuals involved in scientific communication on the basis of a model. For example, examination of practices of popularisation of science and of dissemination of scientific results – the most frequently used practices followed in PUS (Public Understanding of Science) and PAS (Public Awareness of Science) models – reveals that the public was addressed as scientifically illiterate, unaware of the importance of science, that it neither harbours nor fosters a positive attitude toward science, and is facing a lack of scientific culture. Such practices assume from the outset that the public has too little knowledge, intelligence, or even ability to understand, whereas science has all the required knowledge and ability to disseminate scientific results. Finally, they assume that an increase in scientific literacy necessarily brings about an increase in a positive attitude towards science. **All these assumptions are proven to be partial or simply false**. Moreover, these practices have been criticised also from other points of view: they have been based on questionable methods of investigating, measuring, and assessing scientific literacy and understanding of science; they used an uni-directional communication of science; they ignored that ways and contents of communication depend on particular interests in a hierarchically-organised social structure, which stimulates a given direction of research; and, last, but not least, these practices mistakably ignored that the public is usually aware of the fact that knowledge is socially constructed.

3. Pointing to the development of scientific culture

Any action in support of scientific communication, beyond its specific aims, has also to be aimed **at developing a broader scientific culture**. In its broad sense, scientific culture can be understood as a value system, which promotes science and scientific literacy as achievements in themselves and represents "means by which any member of society may access science and technology"[8]. Scientific culture should concern, not only history of science, scientific achievements or benefits that scientific activity provides to a society, but also **problematic aspects of research** (controversial issues, current organisation of research systems, research policies, funding strategies, obstacles to research activities and the like) which, exactly because they are problematic, require the involvement of the public to be effectively dealt with. Moreover, raising the level of **scientific culture to the level of a prevailing atmosphere** motivates inclusion both in production and in dissemination of knowledge on the part of experts and the public alike. In this sense, scientists should also be required to increase their own scientific culture, beyond their specialised knowledge, in terms of a broader engagement for a more socialised scientific and technological research, really opened to the contribution of other relevant actors and the public at large.

4. Involving educational institutions and science centres

Any action in support of scientific communication should also be aimed, as far as possible, at **involving educational institutions and science centres** (including science museums) **in socialisation initiatives**. As a matter of fact, education is one of the basic steps to socialising practices and domains of research as well as to remove the aura of secrecy and "unattainability" from science. Any component and institution of the education system at the elementary, secondary, and collegiate/university levels (including scientific faculties) should find their role to play.

5. Promoting a two-way communication process

As already stated, **mono-directional models of scientific communication are ineffective** for socialising scientific and technological research in the current transition toward new advanced context-driven mode of knowledge production. 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 of discussion; the public to "absorb" science and cooperate with it. In this context, media should serve as platforms that constitute **discursive forums** for debating scientific and public issues. Effective two-way communication process assumes the form of **widespread routine practices of interaction and information exchange**, able to develop into dense and flexible communication networks underlying different aspects and dimensions of science and technology mobilising relevant stakeholders and sectors of public for coping with specific needs, problems or situations.

8 Burns, T. W., O'Connor, D.J., Stocklmayer, S.M. (2003) Science Communication: A Contemporary Definition. *Public Understanding of Science*, p. 183-202, 12.

The last overall strategic orientation is that of **mapping and opening** as far as possible (but ever according to a realistic assessment of the situations and needs) **the existing scientific communication channels.** Research groups continually undergo transformations depending on the need for division of scientific labour. All of this contributes to the increase in communication flows and to the need for reaching agreements to ensure the highest degree of efficiency of the research process itself. Opening scientific communicational channels is therefore important in order to include all potentially relevant participants, which don't necessarily come from academia. Even more often, stakeholders' insights into potential contexts of application are necessary to drive research and technological development toward **socially effective outputs** and can contribute to application-context-dependent definitions of "good science," or rather, science which serves the common good[9]. Actually, scientists could have their own ideas of what is important in science and what are or should be the applicative effects of knowledge on society; but only information feedback enables them to discover interests, conflicts, demands, required skills, and moral standards of users related to a given set of knowledge or a given technology. Finally, **inclusion and participation** increases both confidence among a society at large in scientific work, and the social status or esteem of science, which engenders more clout with decisive institutions.

6. Mapping and opening the existing scientific communication channels

[B] SPECIFIC SECTORAL MEASURES

Besides the overall strategic lines, a **set of more specific measures** can be given, on the basis of the research and experimentations made within the SS-ERC project. The proposed measures are presented using as a frame a **seven-component model of scientific communication**[10]. This model – or other similar approaches equally reflecting the complexity of current scientific communication - can be used at different levels (departments, research institutions, universities, local level, etc.) as a support scheme for, e.g.:

- Mapping **existing communication flows** (and therefore the actors involved, the procedures adopted, the channels used, etc.);
- Identifying **obstacles, hindering factors** and **resistances** to a more advanced scientific communication;
- Identifying **success stories** and **best practices**;
- Facilitating the definition of new overall or sectoral **scientific communication strategies;**
- Establishing **monitoring systems** or developing specific **assessment procedures** in order to improve scientific communication activities;
- Identifying **professional figures** and **skills** to be employed for improving the quality of scientific communication activities.

9 Wynn, B. (1995) *Public Understanding of Science*. In Jasanoff, S., Markle, G. E., Petersen, J. C., Pinch, T. (Eds.) *Handbook of Science and Technology Studies*. London: Sage Publications, p.382.

10 d'Andrea, L., Declich, A. The sociological nature of science communication. *JCOM, Journal of Science Communication*. http://jcom.sissa.it/archive/04/02/A040202/jcom0402(2005)A02.pdf. Accessed 5.1.2009; authors identified the first six components, while the last one has been added on the basis of the experimentation results carried out in Slovenia.

7. Intra-epistemic communication

Promoting communication structures within research institutions

Encouraging researchers to publish

Fostering informal interactions and promoting science groups, clubs or societies

8. Trans-epistemic communication

Promoting trans-disciplinary publication and co-autorship

Establishing managerial mechanisms

Organising trans-disciplinary conferences

Promoting trans-disciplinary informal interactions

Introducing new web

In the following points, for each component, a short description of the component and some examples of possible measures to be taken are provided.

Intra-epistemic communication – This includes all forms of communication involved in relations of researchers with their peers, i.e., those belonging to the same "epistemic community" because they work within the same discipline or in the same area of research. In this framework, the measures to be taken could be aimed at:

- **Supporting the creation of internal formal and informal communication structures within research institutions**. The effectiveness and efficiency of communication can be improved by introducing new tools, which are continually becoming available through the advancement of information technology;
- **Encouraging researchers to publish** their own work, e.g., through financial incentives and proper encouragement as well as offering assistance with administrative aspects of publication;
- **Building spaces devoted to informal interactions** among researchers in certain institutions: common areas for rest, eating and drinking, socialising, etc., and **promoting the establishment of science groups, clubs, or societies** in which researchers in a specific scientific discipline meet and organise various events.

Trans-epistemic communication - This includes all forms of communication related to subjects with diverse disciplinary affiliations, which are more or less inter-related, which often represent non-academic institutions. As example, the following measures can be mentioned:

- **Promoting the publication of scientific articles** in journals devoted to various scientific disciplines, involving either **co-authorship** with researchers from other scientific disciplines or treating a problem from a point of view that is different from established views in a given discipline;
- **Establishing managerial mechanisms** in support of a larger involvement of researchers in transdisciplinary research and communication, such as the introduction of informal rules and certain forms of rewards;
- **Organising trans-disciplinary scientific conferences**, colloquia, and meetings at which participants discuss certain problems from the point of view of various disciplines;
- **Building structures for informal interactions** between colleges and institutes, which offer researchers, lecturers, and students from various disciplines, to presence, meeting, and socialising opportunities alike;
- **Introducing new web applications and services**, such as forums, virtual groups,

and wiki-portals, in which certain scientific topics/problems can be discussed and examined from trans-disciplinary points of view.

application and services

Network communication - This includes all forms of communication related to "collateral" activities required for the development of research and those that involve actors such as research managers, technical and administrative personnel, suppliers and consultants, experts (who analyse and interpret processes of scientific and technological research) and all those actors, who are involved for various reasons in the implementation of research and research-based innovation policies. In this domain, some measures can be promoted in order to, e.g.:

9. NETWORK COMMUNICATION

- **Map and assess network communication flows** with non-scientific actors that are involved in research activities, in order to increase researchers' awareness of the quality and quantity of communicational interactions of this kind; this should allow developing more effective and planned communication strategies with some key support actors, such as suppliers, service agencies or external consultants;

Mapping and assessing network communication flows

- **Experiment with new communication models** allowing an increased cooperation between researchers and support (both business and administrative) staff of research institutions; this should include a shared and critical assessment of the situation, the development of new procedures, the organisation of training initiatives for support staff members, and the launch of new communication models;

Experimenting new communication models with support staff

- **Introduce effective two-way communication channels with funding institutions** (EU, national funding agencies, etc.), in order to give them quality and continuity and to overcome a sporadic approach exclusively depending on the dynamics of the "call for proposals"; this could entail the development of both periodic at-distance communication (such as newsletters, policy brief, etc.) and personal informal interactions.

Introducing two-way communication channels with funding institutions

Social communication - This includes all upstream involvement in the process of scientific and technological production by social groups, social parties, the business community, civil society organisations, and numerous actors, who are involved in various ways in specialised sectors of research, e.g., associations for the chronically ill, business associations, etc.. The measures to be promoted could be aimed at, e.g.:

10. SOCIAL COMMUNICATION

- **Promoting the involvement of researchers with public life** at the local, national, and international levels, in order to allow researchers to acquaint themselves with specific problems related to their own research and to facilitate the collection of feedback information about their own work from the public;

Promoting the involvement of researchers with public life

- **Designing and promoting two-way communication plans** involving researchers and interested members of the public. It is necessary to take advantage of all communication channels and forms of current information-communication technology

Designing and promoting communication plans addressed to the public

(ICT), which become available and gain sufficiently-wide-spread usage, for example, virtual groups and wiki-portals;

Providing technical and professional support to the public

- **Providing technical and professional support to interested members of the public** (professional societies, civil and technological initiatives, non-governmental organisations, etc.) in the form of consulting, advising, explaining, and active involvement in the scientific sphere;

Reinforcing scientists' orientation to science dissemination

- **Reinforcing scientists' orientation to disseminate information on their scientific activities** in terms meaningful to a wider audience. These activities can take the form of lectures, contributions to forums, publications in various mass media, educational TV shows and webcasts, etc. Different tools can be used for enhancing this orientation, such as recognising higher value to dissemination activities for scientific careers, introducing scientific communication in the university curricula, or establishing specific prizes or awards for who promote scientific dissemination initiatives.

11. Political communication

Political communication – This includes all communication involving relations between the scientific community and policy making bodies, e.g., political institutions, public administrations, political organisations, etc. Among the possible measures, we can mention here:

Supporting researchers to cooperate with political bodies

- **Providing researchers** (including young researchers) **with opportunities to collaborate with political bodies**, at various levels of a given administrative political complex (usually, only senior scientists are involved in this kind of activities);

Fostering the involvement of researchers to public debate

- **Fostering the involvement of researchers in public debates,** giving them the opportunity to contribute in improving their quality and to clarify to the public possible critical points of the issues at stake, by using different tools such as traditional mass media, new media or public lectures;

Preparing researchers to be experts

- **Improving professional capacities and skills of researchers in order to allow them to contribute as experts in decision making process;** this could include short courses or specific training initiatives (for example, on legal issues, use of language and rhetoric, data presentation styles, reporting styles, etc.), thematic workshops, organisation of meetings and public initiatives with the involvement of policy makers within universities and research institutions, defining codes of conduct, handbooks and guidelines;

Supporting policy makers to use expert knowledge

- **Promoting initiatives addressed to policy makers at different levels** (local, national, European levels), **to help them in using expert knowledge**; this could include the development of specific information tools (newsletters, specialised websites, etc.) updating them on research and data resources pertaining to politically sensitive issues, the diffusion of professional figures managing the relationships between research institutions and political institutions or the carrying out of analyses aimed at understanding how policy makers use expert knowledge.

General communication - This is the dominant component relating the scientific community with public opinion, in other words, the form of communication aimed at the general public. In this domain, some measures can be promoted in order to, for example:

- **Broaden the reach of dissemination of research results**, in order to reach larger segments of society. This can be achieved, for example, by publishing popular science magazines targeting readerships different from both those of scientific journals or lectures and those of TV and webcast shows intended for the "general public," i.e., the public outside of both the scientific and technological communities thereby promoting scientific literacy and culture;

- **Develop tools facilitating interactive, two-way communication** between researchers and the general public, e.g., through websites, internet forums, informative radio and television talk shows, etc.;

- **Supporting research institutions in being accountable to the public for the discoveries made and the ongoing research;** this implies an increase to the number of "public spaces" devoted to scientific discoveries, both physical (in the "brick-and-mortar" sense) and virtual (in new media), such as specialised exhibitions and science centres, web-based virtual museums, etc.;

- **Fostering scientists' engagement with scientific communication**, at any level, such as: drafting popular science books, where scientific breakthroughs and technological advancements are explained; initiatives of science literacy through workshops, articles in the popular scientific press, in magazines and daily newspapers, web forums, popular lectures, in radio talk shows, etc; participation in forming virtual groups or forums addressing scientific topics; involvement in science shows, competitions, exhibitions or university "open house" day for the interested general public. This action can be made by resorting to different tools such as: social and academic recognition of scientists' engagement with scientific communication, also in terms of career paths and salaries; economic incentives; establishment of prizes and awards; diffusion of courses on scientific communication within the scientific faculties; devising of specific policies and action plans on scientific communication at department or university levels;

- **Feeding as far as possible a community involvement in research activities,** mainly when issues of public interest are at stake. In such a way, the public gains insight into the workings of scientists and has opportunities to collaborate with them. Such involvement fosters a favourable view of science among the general public.

Educational communication - This includes all communication between researchers (as producers of knowledge) and educational institutions, e.g. schools, museums, science centres, etc. Possible measures to take could be, for example:

- **Encouraging the collaboration of researchers and research institutions with**

12. General communication

Broadening the reach of dissemination of research results

Developing interactive communication tools

Accounting for the discoveries made and ongoing research

Fostering scient-ists' engagement with scientific communication

Feeding community involvement in research activities

13. Educational communication

Encouraging

collaboration between research institutions and educational institutions

educational institutions in creating lesson plans, courses, and programmes. Active engagement of researchers is more than just their serving as *a posteriori* reviewers. Rather, engaging researchers and research institutes in all level of the educational process enables the formation of curricula that are both updated and more interesting;

Developing programs promoting scientific culture in schools

- **Developing programmes aimed at promoting scientific culture in schools**, in the form of lectures, tutorials, workshops, laboratory sessions, and other learning activities. These activities can take place not only in schools, but also in museums, science centres, etc.;

Developing tools for addressing youth

- **Developing tools of science communication specifically addressed to youth**. This could include: the creation of "science parks" for young people, through which they can have pleasant and fun experiences in the form of amusement, which increases motivation for learning and becoming acquainted with work in scientific fields; university "open house" days specifically for youth, i.e., the pre-collegiate-age population, emphasising what they can do in science and what studying science at the collegiate and university level entails and how profoundly enjoyable it can really be; science shows, competitions, or exhibitions designed for a younger population; increasing diffusion of scientific articles, written by or in cooperation with researchers, on youth magazines; development of new toys and experimentation sets for the youth market, establishing stable forms of cooperation between research institutions and scientific toys manufacturers.

[S]

SOURCES OF INFORMATION AND FURTHER READINGS

Books

Wilson, A. (1998) *Handbook of Science Communication*. London: Taylor & Francis, Institute of Physics Publishing.

Burns, T. W., O'Connor, D.J., Stocklmayer, S.M. (2003) Science Communication: A Contemporary Definition. *Public Understanding of Science*, p. 183-202,12

Treise, D., Weigold, M. F. (2002) Advancing Science Communication: A Survey of Science Communicators. *Science Communication*, p. 313. 23.

Scanlon, E., Whitelegg, E., Yates, S. (2006) *Communicating science. Contexts and channels*. London: Routledge.

Longino, H.E. (1990) *Science as social knowledge. Values and objectivity in scientific inquiry*. Princeton: Princeton University Press.

Gregory, J., Miller, S. (2000) *Science in public: communication, culture, and credibility*. Cambridge: Basic Books.

Bucchi, M. (1998) *Science and the media. Alternative routes in scientific communica-*

tion. Routledge studies in science, technology and communication. London: Routledge.

Websites

European Science Foundation: www.esf.org/
Science in Society Portal: http://ec.europa.eu/research/science-society/
Science Media Centre: www.sciencemediacentre.org/
Communicating Science and Technology: uit.no/cst
Science Communication: www.sciencecommunication.org/
Science in Society: www.sci-soc.net/SciSoc/
International Association of Science parks: www.iasp.ws-/publico/intro.jsp
Science News: http://www.sciencenews.org/

CHAPTER FOUR

EVALUATION

[*]

Increased attention to science and technology evaluation

The attention given to science and technology and the continuous evolution of policies, has spurred an increased interest in evaluation of research, science and technology policies and strategies. **Evaluation of science and technology** has gained importance and has become an instrument in policymaking at different levels and within varied contexts.

This development has its origin in the recognition that closer links between science and technology policy and evaluation are required, as new challenges emerge following changes in the European scene, where efforts to enhance socio-economic systems and integrate research systems are intensified. Focus is in particular on the contribution of science and technology to addressing the challenges of the emerging knowledge society and finding solutions to urgent problems. Evaluation, in combination with other instruments, could support these processes.

Evaluations are increasingly used to demonstrate the **societal relevance of public science and technology** and prove that policy implementation and investments are worthwhile pursuing. Evidently, the key question is how science and technology policy is evolving in the context of growing societal demands for transparency and accountability, on the one side, and greater participation in decision making, on the other. Evaluation could address the question by offering tools to analyse the transformations.

Socialising science and technology through evaluation

Demands are larger than ever, as knowledge production processes are nowadays negotiated among a growing number of stakeholders, each with their own interests. In this context, the issue of **socialisation of science and technology through evaluation is central**. Evaluators are increasingly engaged in providing assessments of implemented policies, in offering feedback and advice for policy and strategy formulation. As a consequence, in a time of great socio-economic and epistemological transformations, the role of evaluation in supporting science and technology policy has gained importance.

The full potential of evaluation is still under-exploited

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**.

The following sections discuss the socialisation of evaluation in science and technology policy based on the research conducted within the SS-ERC project, which also involves an experiment on evaluation (see Box 4.1.). The discussion focuses on the conceptual apparatus of evaluation as a socialising instrument, identifies the key challenges science and technology policy evaluation faces in the socialisation process and offers a number of operational indications.

[A] THE CONCEPT OF EVALUATION

Evaluation emerges at a point in time when **society becomes reflective** and acknowledges that not all efforts to shape the future are by design successful, but some have unintended effects. Society, thus, uses evaluation to make improvements based on science-based feedback. Actually, evaluation was established in a period with great expectations on the capacity of social sciences to contribute to societal progress. Evaluation has hence been intensively discussed as a means to transform scientific knowledge to decision making but also criticised for its emphasis on social engineering and its certainty that scientific methods could produce indisputable results[1].

Evaluation emerged when society became reflective

Nonetheless, there are many good reasons to consider the **concept of evaluation**. The main reason is that a well-described evaluation concept can be as useful in the socialisation process as larger empirical descriptions. **What is evaluation then**? There is no simple answer to the question. Evaluation is an umbrella term, an apparatus for assessments, conducted within a variety of contexts and using a range of different techniques and methods. Given that evaluation is a dynamic process with multiple faces, there are varying definitions of the concept. It is obvious, though, that the **perception of the concept has implications for the evaluation process and impact** and ultimately on the **degree of its socialisation**.

There is no right way to define evaluation

Some definitions of evaluation focus on the **function of evaluation**, involving judgements of value, worth or significance of subjects for evaluation. Others go one step further and define evaluation as a careful, retrospective assessment of merit, worth, and value of the administration, output and outcome of government interventions. Interventions are obviously made with the clear intention to influence future actions.

Other definitions again have as a point of departure **the purpose of or mandate for evaluation**, which usually involves provision of information for policy making or for improvement of an activity. A **broader definition** of evaluation involves a systematic collection of knowledge on implementation and effects of public efforts based on explicit criteria. Efforts may comprise all the activities, in public and semi-public regimes, such as public organisations, management, projects, programmes, policy areas, development activities, innovation systems, etc..

Evaluation could also be defined by placing it in a wider context and considering **the social nature** of the process. Evaluation may hence be seen as a much broader concept, not limited to past and ongoing actions or governmental interventions but one that embraces prospective assessments as well and could be targeted at other kind of activities than public and semi-public. In this perspective, evaluation is a systematic process designed to assess the quality, relevance, efficiency, effectiveness and impact of systems, policies, programmes, institutions and projects in attaining their initially stated objectives. Evaluation is both a theory- and practice-driven approach that can provide feedback into policy and as such is part of a **continuous learning and socialising process**.

Evaluation is an efficient socialisation instrument

Evaluation has hence a **socialisation function** due to its contribution to smoothen the

[1] Dahler-Larsen, P. (2006) Evaluation after Disenchantment? Five Issues Shaping the Role of Evaluation in Society. In Shaw, I. F., Greene, J. C., Mark, M. M. (eds), *The Sage Handbook of Evaluation*. London: Sage Publications.

Evaluations do not take place in a vacuum

interfaces between stakeholders with different interests, involved in a negotiation process. With the concept of interest or **stakeholder evaluations** gaining ground, more actors are given the opportunity to make their voice heard early in the process of designing the evaluation. In such practices and aiming at consensus building, evaluators function as mediators between different interests. As a result, the implementation of evaluation focuses at last only on issues where consensus has been achieved. The socialisation function of evaluation is hence the point of attention in these practices.

Yet, perceived as a **social process**, evaluation has its boundaries in what is practicing and what is implicitly acknowledged within the evaluation community. **Evaluations do not take place in a vacuum** but within complex socio-economic and cultural environments. This implies that contextual issues and limitations of deployed theories and models, but also of available data, have to be taken into consideration in real evaluations. This complexity makes the importance of better socialisation of evaluation even more vital.

[B] THE ROLE AND FUNCTION OF EVALUATION IN SCIENCE AND TECHNOLOGY POLICY

Evaluation of science and technology policy is under-developed

Science and technology policy consists of complex settings that incorporate all public initiatives regarding science, technology and innovation, entailing public policies, strategies, regulations and programmes, but also the institutions and organisations, which perform research. The uncertain impact of science policy in a landscape with increasing global competition and intense pace of change puts new demands to science and technology policies. A growing number of researchers in Europe are specialised in science and technology evaluation. However, although the reservoir of evaluators is expanding, evaluation is **still under-developed** in terms of capability to be part of the policy setting. Moreover, as regards the study of the link between evaluation and improved policy making, the evaluation field is still at an early stage of development. **Socialising the actors** of science and technology evaluation and the policy makers is hence a necessity in order to generate synergies by activating the relevant networks.

Science and technology policy makers need to demonstrate that they initiate meaningful investments with high socio-economic impact. It is a fact that evaluations have traditionally been, and are still in many cases, used to demonstrate control and accountability, and legitimise past actions. Focus has usually been on quality assessments, allocation of resources, efficiency and effectiveness. However, combined with other methods such as strategic and foresight approaches, evaluations can strengthen their **strategic and analytical potential** and attain a role that goes beyond traditional activities. The importance of this particular function of evaluation for the socialisation of science and technology has probably not been acknowledged in its full capacity yet.

[C] TYPES OF EVALUATIONS

Traditional approaches are challenged

Traditional evaluation has been challenged by a concept that is wider and embraces understanding of processes and their implications. Evaluation as a socialisation instrument is accordingly broadened, incorporating learning, strategy development and impact assessments. As a result there is a shift from **summative** (measuring performance, providing legitimisation or controlling) to **formative** approaches, where evaluators are perceived as advisers and mediators in learning processes that involve several stakeholders.

Formative evaluation

A typical formative approach could be a strategy or policy evaluation **before the implementation** of an initiative. Such approaches have developed partly as a supplement to summative and partly in competition. Evaluators in formative approaches focus more on the process of a particular activity and provide not only analyses and recommendations but also an **agenda for negotiation** between the different interests. This type of evaluations has a number of limitations, linked to advice on future policy and strategies, in particular as regards important investments where many stakeholders are involved. However, it may be a strong tool in managing social dynamics and preventing conflicts.

Summative evaluation

Evaluations conducted **at the end of an intervention**, to assess to which extent expected outcomes of science and technology interventions have been produced, are summative in character. This type of evaluations provides information on the worth of an intervention and is usually conducted for the benefit of external actors who are not directly involved in the implementation of the evaluated activity. Summative evaluations, although with many limitations due to the fact that they do not pay attention to the process but only to the outcome, have been widely used in science policy.

Monitoring

Finally, **monitoring** is an approach that aims mainly at providing key stakeholders and managers with continuous feedback on the progress, or lack of progress, in achieving intended results. It is an assessment of ongoing activities where actual results are compared to planned or expected results according to objectives set in the launching of activities. However, monitoring can also support policy requirements for the accountability of funding bodies and the transparency of funding allocation. With regard to the last point, evaluations used strategically can assist funding processes and manage the social environment.

[D] FUNCTIONS OF EVALUATIONS

Evaluations have different functions that depend on the aim of the evaluation and on the need for knowledge the initiators have in a certain process. Evaluations are accordingly adopted when:

- Central actors have a need for **control and steering;**
- Concrete **problems need solving** and the evaluation is perceived as an instrument to uncover responsibilities for these problems and find solutions;
- Evaluation is perceived as a **strategic tool** that can be used in a political setting;
- There is a need to use evaluation as a **justification or legitimisation** instrument as initiation of an evaluation signals that something is being done;
- Central actors have a need for **learning and development;**
- There is a need for **opinion making** within a certain area;
- There is a need for **development of an identity** in an area; evaluation gives an opportunity for interaction and dialogue between stakeholders and diverse interests.

Choosing the right function or mix of functions

It goes without saying that the different functions can be combined in complicated and – in some cases – even in contradictory practices. **Choosing the appropriate function or mix of functions** influences the degree of acceptance of the evaluation among the stakeholders and accordingly the degree of its socialisation. Evaluation is nonetheless only **one of several instruments** used in a policy setting. When evaluations are used as inputs in science policy, this is often done in an indirect, not always obvious way, since evaluations are one of many different components of policy making. What's more, uptake and use of results is also a social process. As the results of the experimentation among the Members of the Danish Parliament show, the users combine evaluation results with results from other actions to generate new combinations relevant for their activities. That is why socialising evaluation and demonstrating its potential in supporting policy is important.

[E] THE ROLE OF THE EVALUATOR

Stakeholders involved in an evaluation as a rule have different interests and objectives with the implementation and therefore different knowledge needs. Their interests depend on the various ways that activities are managed and controlled. In the case of science and technology, there are multiple control mechanisms, such as the political system, the market, the organisation, the professionals and the users. Some designs and methods of evaluation are accordingly more appropriate for some actors and their need for knowledge than for others. As a consequence, the **role of the evaluator varies** with the mode evaluations control and manage processes. There are hence different evaluator functions:

- Evaluator as a **controller** to keep implementation bodies responsible for their dispositions;
- Evaluator as a neutral, **problem solving social engineer** in decision making processes;
- Evaluator as an **adviser** in practices in order to build up or adjust public initiatives or implemented activities;
- Evaluator as a **mediator** between divergent knowledge interests;
- Evaluator as an **opinion maker** within a particular political setting:
- Evaluator as an **identity shaper/developer** within a certain area:
- Evaluator as a **midwife or therapist** for disadvantaged groups in society (often used in action research).

Evaluators should be aware of their role as socialisation actors

Different evaluator functions can evidently be combined, as was the case in the SS-ERC experimentation; an evaluator can for example act as an adviser, mediator and identity developer at the same time. It is not possible, though, to meaningfully outline the pros and cons of the different roles without having insight in the context of a concrete practice and its social setting. However, it is important to point out that the evaluator as a socialisation actor should be aware of his/her role and the strengths and weaknesses of it. Moreover, all the relevant stakeholders should be aware of the role of the evaluator.

[K] KEY ISSUES

Based on the literature and the research conducted during the initial phases of the SS-ERC project as well as the evaluation experimentation among Members of the Danish Parliament (see Box 4.1.), some key challenges for science and technology policy evaluation have been identified, which are discussed below.

An experimentation on socialisation of evaluation

[Box 4.1] THE EXPERIMENTATION ON THE EVALUATION

The overall objective of the experimentation was to collect information on the socialisation of social sciences and evaluation in policy making. Focus was specifically on the relationship between science and technology evaluation and decision making processes among Members of the Danish Parliament. Central questions were the extent of interest and information on science and technology among politicians, the use of science and technology in policy, the use of the social sciences and evaluation in policy making, the type of knowledge required in policy and the politicians perception of the role of sciences in society.

The specific objectives of the experimentation were (a) to **evaluate the role and influence of science and technology evaluation on policy making**, (b) to map the perception of the **relationship between science and society** among Members of Parliament, and (c) to **increase awareness** among parliamentarians of the capacity of science, in particular social science and evaluation, to support policy making.

The experimentation started in January 2008 and was concluded in December 2008. It consisted of **four phases**:

- A description of the **State of the Art** in science and technology policy evaluation as the basis for a meta-evaluation;
- A **meta-evaluation** of science and technology socialisation in relation to policy making processes. A questionnaire was distributed to all the Members of Parliament, to map perceptions of, interest in and practical use of science. A total of 124 parliamentarians (69%) responded to the survey. In the end, 72 parliamentarians answered the questionnaire;
- An identification and description of **models of socialisation of science in policy making**. Models were developed from the questionnaire responses. Rather distinct response patterns were identified, and a **typology** attributed to particular paradigms was generated on the perception of science and technology and

social sciences and their role and contribution in policy making;

- An **experimentation** of the models was made in order to assess the validity and reliability of the typology on the one hand, and confront a selected sample of representatives with the socialisation models, on the other. This component of the experimentation was organised as a "confrontation" of chairmen of the research committees of parties in Parliament with the different paradigms. This was done in an attempt to offer stimulus and obtain a response in terms of reflections on the relationship science and society and the role science, particularly social sciences and evaluation can play in policy making. Changes in viewpoints during the process were registered.

1. Challenges in socialising evaluation of science and technology policy

Taking into account that science and technology policy formulation and implementation is not straightforward, the **expectations** on evaluation to support the process of socialising science and technology are high, in particular among policy makers. It is nonetheless a fact that evaluation as a socialisation instrument is nowadays influenced by broader political and socio-economic factors, as the Danish experimentation illustrates. Hence, there is a movement towards engagement with a range of economic, social and other important issues. As a result, there is a **growing pressure** on evaluators to:

- Acknowledge, understand and analyse the **complexity of science and technology systems** with divergent interests and more stakeholders, levels, themes and aspects;
- Give attention to changes in the **focus of science and technology policies**, which is shifting from focusing exclusively on national, to centring on regional and supranational issues;
- Consider science and technology initiatives in a **broader socio-economic perspective**, where other issues such as the environment, energy, etc. are of significance;
- Analyse how to **improve governance of science and technology**, in particular as regards strategic issues and allocation of resources.

Higher expectations and growing pressures

Higher expectations and growing pressures create new challenges but also new opportunities to increased socialisation of evaluation. The key challenges for science and technology evaluation in this framework are manifold [2].

Improving research systems

One of the main challenges for evaluation to address is **how to improve research systems by strategic decision making**. The issue has been on the agenda for some time and relevant competencies have been developed to some degree. Improvement of national, regional and other research systems is evidently the intention of many governments but also supranational organisations. As providers of funds, but also having the responsibility for science and its role in society, governments are interested in the **productivity and relevance** of science, and the establishment of a robust system capable to generate quality results. The pro-

[2] Rip, A. (2003) Societal challenges for R&D evaluation. In Shapira, Ph., Kuhlmann, S. (eds) *Learning from Science and Technology policy Evaluation. Experiences from the United States and Europe*. Cheltenham UK, Northampton, MA, USA: Edward Elgar.

blem is (as illustrated through the experimentation among Members of the Danish Parliament, which reveals a great differentiation on the perception of governance of research) to find the right mix of strategic research and research initiated bottom-up. Evaluation together with other tools could prove an effective policy instrument in addressing these issues.

Managing impacts contributes to increased socialisation

Another main challenge is to address **expected and unexpected impacts of science and technology.** Although evaluations have provided several insights to the problems, many areas are still unexplored. Given that science is not a routine activity with predictable outcomes, tracing expected and unexpected impacts of science and technology is a complicated task. Managing impacts of science and technology could provide evaluation a higher degree of legitimacy and justification and contribute to increased socialisation of both evaluation and science and technology. The challenge is therefore to develop appropriate **approaches and competences** as current instruments and skills are not geared to handle this type of problems.

Addressing the opening-up of science to society through evaluation

The third challenge considers the increasing number of **old and new stakeholders and dimensions** in evaluation, which is one of the newer territories for exploration. The entrance of new stakeholders to the evaluation scene and new dimensions in practices, is a result of **new production of knowledge processes** and the opening up of science to society; the last not least in terms of actors. Policy makers nowadays have to coordinate and orchestrate their interventions with a range of actors in mind. Opening up of science is important for reasons of democracy, legitimacy and diffusion of knowledge. This exposes science and evaluation to new challenges (greater involvement of all types of stakeholders), bringing new dimensions to evaluation practices where evaluators function as mediators and advisers. These practices strengthen the process of socialisation of evaluation and provide new opportunities to evaluation in relation to policy making.

Exploiting the new production patterns in strengthening evaluation

Simultaneously with changing science and technology processes, demands on science to produce goods and solutions to complex problems, necessitating inter-, trans- and multidisciplinary research, are growing. Traditional disciplinary-based research evaluation and peer review systems are tested by the increasing non mono-disciplinary character of science. The **new patterns** of production, interactions, communications and interfaces should be recognised by the evaluators and exploited to strengthening the science and technology socialisation role of evaluation.

2. 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. Public sector reforms and policy interventions have resulted in what can best be described as an **evaluation boom**.

Socialisation of evaluation is still an open question

However, the question is to which extent existing evaluation practice and methodology is capable of grasping - besides immediate outcomes - the underlying procedures for impacts of policy interventions or support of strategic decisions. The answer to this question is of significance for the socialisation of evaluation.

Theory and practice have

Over the last decades, evaluation practice and theory have undergone important changes and new insights have been gained. This has led to **more experimental practices**, resul-

undergone important changes

ting in demands for better organised evaluations to provide feedback into policy. In order for science and technology systems to function more effectively, a better insight in the research system as a whole is needed. Evaluation can help deepen the understanding of the dynamics of science and technology and thus function as an important socialisation mechanism.

Towards a central role in the policy cycle

In fact, the development of the rationale in this area, from demonstrating accountability and control and legitimating past initiatives, to improving the understanding of processes and advising policy has resulted in a **broadening of the focus of evaluations**. The focus has thus shifted from a narrow economic and efficiency orientation to a more encompassing concept, with issues such as appropriateness of policy instrumentation and strategy development. This is a sign of a move towards a more **central role for evaluation in the policy cycle**.

Evaluation as a participatory and deliberative notion of democracy

Another noteworthy change is the shift from evaluations producing evidence and argument towards formative approaches. In the new wider understanding of evaluation, focus is on the genuine **social process of negotiation** between stakeholders, where evaluators have a central role to play. Negotiations imply participation and taking responsibility. In this process, the function of evaluation as a participatory and deliberative notion of democracy is of vital importance in contemporary societies.

These developments indicate that evaluation has more to offer to policy and to the socialisation of science and technology.

3. Managing the relationship 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. Matching the demands of policy makers with the expertise and experience of evaluators can reveal differences in viewpoints and distort the organisation of the evaluation. One such element is **conflicting expectations** that may influence the implementation process and delivery of results. **Bridging the gap between evaluators and policy makers** could increase **socialisation of evaluation** and of science and technology.

The differences, which highlight the difficulties in matching available tools and user needs, are often referred to in the literature[3] as the **delivery gap** on the one hand, and the **user/customer gap** on the other.

The delivery gap

To analyse the relationship, the **delivery gap** describes what policymakers ideally expect from evaluators. It further illustrates how evaluators perceive a certain evaluation process and what they believe is feasible. Policy makers require information in time for decisions, while evaluators might argue that production and dissemination of knowledge is a complex process, rarely linear and can take years to have effects. There is always a trade-off between users requirements of evaluation results to fit their timing and policy cycles and evaluators scientific interest.

Policy makers demand independent evidence of excellence, which might be difficult to

[3] Georghiou, L. (2001) *The Impact and Utility of Evaluation*. Conference on international best practices in evaluation of research in public institutes and universities, Brussels, 16.10.01

achieve considering the loyalty of peers to their field and colleagues. Policy makers require clear attribution of effects to investments, but a linear perspective on funding and outcome is often not realistic. In addition, while adequate indicators to monitor and benchmark are wanted, crude evaluation design may distort performance and open up for manipulation of practices.

The user gap

The **user gap** refers to how evaluators perceive evaluations, what they wish and require from the process and how policymakers respond to such request. Evaluators should ideally have a comprehensive understanding of the evaluation object, clearly defined and hierarchically presented objectives, independence and adequate resources. Policy making is also a complex process, often characterised by limited resources, time restrictions, deadlines and conflicting interests, and compromises. Such constraints, let alone the fact that stakeholders are not always willing to give access to information and data, constitute a genuine risk in evaluations. Another long standing problem in evaluations is their tendency to be method-oriented; evaluators committed to their methodology favour particular approaches. In those cases, practices are determined by how to proceed instead of by the aim of the activity. This may create problems in the relationship between evaluators and policy makers in designing the evaluation.

Experiments may bridge the gap

In conclusion, a key question to be addressed in the context of the science and technology evaluation, in order to bridge the differences in perspectives, is how to overcome the user and delivery gap. Evaluators could offer **tools that enable policymakers to better understand the evaluation process**. On the other hand, and depending on the circumstances, **the evaluators' awareness of the conditions for decision and policy making** should be increased for evaluations to be a relevant socialisation instrument. Approaches as the one carried out in the SS-ERC framework among the Members of the Danish Parliament is one way to bridge this gap.

4. Challenges at national level

No common evaluation ground

Evaluation is gaining ground as a consequence of the substantial funds being allocated to science and technology. However, despite more than 40 years of efforts in science and technology evaluation, practices are poorly coordinated and studies reveal that a **common evaluation ground is not yet seen in Europe**[4]. This implies a fragmented evaluation landscape where the socialisation of evaluation in some countries is limited to assessments of efficiency of research and development investments.

Nevertheless, efforts to socialise evaluation have increased. National evaluation networks and associations have been established, which promote exchange of experiences and contribute to the development of evaluation cultures by organising meetings, workshops and conferences.

Enhancing national socialisation of evaluation policies

Addressing the challenges for science and technology evaluation discussed in the previous section, would undoubtedly benefit from valid evaluations at country level. Development of advanced skills and competencies at country level would contribute to a deeper understanding of national systems, which could be the basis for a European-wide effort to boost the socialisation of evaluation.

4 Kalpazidou Schmidt, E. (2003) Evaluation and science policy. In Siune, K., Kalpazidou Schmidt E. (eds) *The use of evaluations in Europe*. Report from the European RTD Evaluation Network meeting, Report 2003/2, Aarhus: Danish Institute for Studies in Research and Research Policy.

5. Challenges at European level

Evaluation as an integral part of the policy cycle

The European Commission (EC) has no doubt played a key role in the socialisation of evaluation by promoting exchange of information and experiences among evaluation experts and users, initiating studies and commissioning evaluations of its own programmes.

Evaluation practices used by the EC have been developed over time, from in depth evaluations to measurement-oriented approaches, to policy and ex ante evaluations. There are, at the European level, consolidated experiences in the evaluation of the FPs. Experiences from the evaluation of the previous programmes have been used in the creation of the FP7 and for the first time an ex ante evaluation of an entire FP was conducted in 2006 to assess strategies and policies for the coming programme. At this level, evaluations form an **integral part of the policy cycle**; a practice not prevalent to the same degree at the national level, where monitoring is used more often. European level evaluations are characterised by adoption of several approaches and combinations of methodologies, and have a systems view. Evidently, the degree of socialisation of evaluation at supranational level is higher compared to the national level.

New instruments generate new challenges

However, the policy of integrating research in the European Research Area (ERA) through **new instruments has generated challenges for evaluation** and otherwise. New approaches to assess integration impacts should be considered.

No single European body of evaluation practice

Based on studies of the European landscape, Luukkonen[5] concludes that "there is no single way of doing research evaluation in Europe". Given the challenges that European research faces and taking into consideration the fact that there is no single European body of evaluation practice, Georghiou and Kuhlmann[6] go one step further and suggest: "…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 that allows members to accept and validate each other's findings".

A plethora of policies aiming at socialisation of science and technology

There are nonetheless indications that the fabric of European science and technology is changing as a result of new policies in the ERA, and despite signs that there are still barriers to full integration of research systems. During recent years, national funding bodies and research organisations are in the process of building up their European and international strategies. This development with its various implications for evaluation involves, besides the FPs, components such as the European Research Council[7] and the European Institute of Innovation and Technology.

New European instruments require a new breed of evaluation methods

European policy making and funding bodies have intensified their cooperation using

[5] Luukkonen, T. (2002) Research evaluation in Europe: state of the art. *Research Evaluation,* vol 11, no 2, pp 81-4.

[6] Georghiou, L., Kuhlmann, S. (2002) Future policy instruments: evaluation of the socioeconomic effects in the European Research Area. In Fahrenkrog,G., Polt, W., Rojo, J., Tübke, A., Zinöcker, K. (eds*) RTD evaluation toolbox: Assessing the socioeconomic impact of RTD policies, EUR 20382*, Seville: Joint Research Centre, Institute for Prospective Technological Studies, pp 232-42 (www.epub.jrc.es/docs/EUR-20382-EN.pdf).

[7] A recent example of the ERCs evaluation socialisation effect on European research is the launch of national initiatives in France, Italy, Spain and Switzerland and Sweden to offer the possibility for financial support to finalists of the first ERC Starting Grant competition, whose proposals have not been funded by the European body due to budgetary limits.

joint actions and funding schemes to benefit from knowledge exchange and best practice. The plethora of policies and instruments involved implies the complexity of the activities. For upcoming activities, it is essential to evaluate the instruments that are utilised. The policy of integrating science and technology through combinations of different new instruments generates particular challenges for evaluation. A **new breed of evaluation methods** is required in order to **study the interplay and synergies between the instruments** taking into consideration the following features:

- Interdependence and complexity of socio-economic phenomena;
- Limitations of theories and methods;
- Accessibility and limitations of available data;
- Discrepancy between resources allocated and expected results.

In conclusion, despite attempts at European level to augment the socialisation of evaluation, the amount, range and pace of the initiated policies and instruments demand more concentrated efforts and systematic approaches to socialisation of science and technology evaluation.

[O]

OPERATIONAL INDICATIONS

Science and technology policy in complex systems ought to be based on **systematic approaches of informed actors**. Systematic approaches in policy require **methodical use of evaluations**. The following features characterising current practices indicate some preconditions for increased socialisation and thus productive use of evaluation in research policy:

Systematic approaches of informed actors

- The implications of **stakeholders' interests and values** (an example is the influence of values of different stakeholders in biotechnology research);
- The **need for mediation and facilitation of processes** taking place between competitive interests;
- The requirements for **forums for negotiation and formulation of policy among stakeholders** (consensus conferences are one example of such forums - a tool often referred to in the Danish experimentation).

Taking into account those features, evaluation could be a valuable socialisation instrument, not only in non controversial questions but in particular addressing **high-risk areas** or issues where strategic decisions on research priorities and technological choices have to be made. These are the areas where Danish Parliamentarians explicitly ask for information in making strategic decisions.

Addressing high-risk areas and strategic decisions on technological choices

Operational indications and systematic approaches are offered in the following section, based partly on the SS-ERC experimentation results (see Box 4.2.), and partly on the existing reservoir of knowledge and future requirements within the field, and aiming at strengthening evaluation as a science and technology socialisation tool.

[Box 4.2]
EXPERIMENTATION RESULTS

The main results of the **first two phases** of the experimentation reveal in brief that among Danish Members of Parliament (MPs), there is:

- a high degree of **trust in researchers and science as a foundation for policy making** compared to other factors, such as moral and ethical judgments or public opinion;
- a positive assessment of the **contribution of research results,** specially medical and interdisciplinary sciences but also social sciences, to the **political decision making process**. Reports from social sciences are the most frequently used to get information on scientific results;
- a differentiation in perceptions of the **impact of different scientific fields on policy**. Accordingly, the impact of medical, technical, agricultural and interdisciplinary sciences is high. Those perceptions are in contrast to widespread views on the limited impact of natural and social sciences, and in particular the humanities;
- a ranking of the **key functions of social sciences** as follows: the most significant role of social sciences is to **identify socio-economic** and other relevant problems, analyse **socio-economic and technological development**, **contribute to policy making**, and analyse and inform on **opportunities/risks linked to science and technology**.

In the **last two phases** of the experimentation, a typology on the perception of sciences and their role in society among politicians, was created and tested. The typology identified two distinct perspectives, reflecting the two main socialisation paradigms, internalism and externalism, developed within the philosophy of science on how science is organised, controlled and influenced. According to the MPs in favour of the **internalist** perspective, the development of science is determined first and foremost by structures and processes within the scientific community, reflected in the valuation of all disciplines as similarly useful; science should only to a limited degree be controlled by external factors. MPs in favour of the **externalist** perspective see the development of science as influenced mainly by processes in society as a whole and thus value the usefulness of some disciplines much higher than others. As a consequence, science should be controlled and managed by external actors. In the typology, MPs who are not explicitly advocating for the one or the other perspective (taking a standpoint somewhere in the middle) are characterised as **"neutral"**, which in fact does not imply neutrality but rather a middle position.

During the experimentation, the positions in the Danish Parliament were quite polarised, with the externalists comprising the majority of the MPs, and almost all the parliamentarians from the parties in the Government coalition, while the internalists were identified among the opposition parties. The number of MPs with a "neutral" position was limited.

The chairmen of the research committees of parties in Parliament, involved in the experimental "confrontation", represented each a distinct socialisation perspective. This phase of the experiment was used to raise the awareness on the capacity of science to support policy and actively promote the social sciences as a policy instrument. The experimentation contributed thus to create a more favourable environment for social sciences that might possibly enable an increased socialisation of science in relation to policy making.

The orientations are organised in three areas:

- Orientations aimed at improving socialisation through **actual use** of evaluation results;
- Orientations pertaining to **future actions** in socialising science and technology policy evaluation;
- Orientations aimed at **strengthening evaluation** as a tool for science and technology socialisation.

[A] ORIENTATIONS AIMED AT IMPROVING SOCIALISATION THROUGH ACTUAL USE OF EVALUATION RESULTS

1. MAKING ACTUAL USE OF EVALUATION RESULTS

As the SS-ERC experimentation results show, policy makers assess the contribution of research results positively even though social sciences and evaluation are still **hypo-socialised** compared to other scientific areas. On the other hand, the experimentation shows that the **impact of social sciences** on policy is perceived by policy makers as **being limited**, despite statements that one of the key functions of social sciences is to contribute to policy making.

Increased socialisation of evaluation is closely related to two fundamental questions. First, it is connected to the extent evaluations are used to inform about developments, implementations and impacts of policies. Secondly, it is linked to the **extent that evaluation results are actually used** to support scientific and technological developments. Evaluation results are not always implemented, nor have they always the expected impact, which implies the hypo-socialisation of evaluation. This is the case despite the fact that the SS-ERC experimentation shows that reference to research results makes the argumentation stronger in a political setting and that policy makers state that results should be included in the decision process.

2. GIVING ATTENTION BOTH TO THE PROCESS AND THE OUTCOME

Concerning the **use of evaluation**, a distinction has to be made between the significance of the **process** and the **use** of outcomes. The evaluation process in itself has a value, namely to clarify actors' viewpoints through exchange of information. Increased use of evaluation outcomes depends on the credibility of evaluators, and the absorbability and steerability of results[8].

[8] Boden, M., Stern, E. (2002) User Perspectives. In Fahrenkrog,G., Polt, W., Rojo, J., Tübke, A., Zinöcker, K. (eds) *RTD evaluation toolbox: Assessing the socioeconomic impact of RTD policies, EUR 20382*, Seville: Joint Research Centre, Institute for Prospective Technological Studies, pp 232-42 (www.epub.jrc.es/docs/EUR-20382-EN.pdf).

Increasing socialisation levels through credible, absorbable and steerable evaluations

The **credibility** of the evaluators is related, not only to their technical ability but also to their reputation, independence and fairness. The results must thus be based on solid data and adequate depth and coverage. Sufficient **absorbability** of results requires a high degree of stakeholders' awareness of the process. It is therefore important to **mobilise all the relevant actors**. In addition, the results must be presented in an easily absorbable way, be timely and target recommendations at a proper level, it should not be too specific, or too general. As to **steerability**, the degree of being steered by evaluation results varies considerably. In some policy areas for example, implementation of results is placed with the policy makers while in other areas with other stakeholders. The task for the evaluator is to follow up the implementation process in order for the evaluation results to have an impact in society. Practices without impacts undermine the reputation of evaluation.

Keeping high level of transparency

Nonetheless, it is important to pay attention to the fact that the use of evaluations as an effective socialisation tool in science policy is dependent on the **transparency of the process**; the more transparent the evaluation process, the better the chances for implementation of results and the stronger the impact of evaluation.

[B] ORIENTATIONS PERTAINING TO FUTURE ACTIONS IN SOCIALISING SCIENCE AND TECHNOLOGY POLICY EVALUATION

A second set of operational orientations concerns the need to enhance mechanisms and practices of evaluation, in order to make them adequate to the emerging dynamics, both in the production of scientific and technological research and in the science-society relationships. When defining future actions in increasing the socialisation of evaluation, some **key attributes** are important to consider.

3. Rethinking evaluation concepts and practices to increase socialisation

The first is linked to the **evolution of European science and technology**. With the shaping of the European Research Area, involving all levels of intervention, mobilising critical mass and intensifying the use of integration mechanisms, the requirements for enhanced evaluation have grown to a level where **rethinking of evaluation concepts and practices** is called for.

Aiming at synergy between different levels

The current evaluation system is **not optimally equipped** to take up this challenge, as each level of policy intervention carries out evaluations separately from other levels, which is an important obstacle to further socialisation of evaluation. When the impact of policies implemented at other levels is unknown, learning from similar interventions becomes difficult. As a result, users only have access to a small share of the relevant information needed to make adequate decisions (the Danish experimentation shows that only a limited part of the parliamentarians have access to science-based information despite a relatively high degree of interest to use it in decision making).

Better linking evaluation and policy

The success of the ERA is linked to the availability of accurate analyses of its dynamics, and the effectiveness and impact of research activities and policies. For this reason, knowledge on how to enhance coherence of national policies with European objectives is required, in order to strengthen science and technology and promote impact. This could be done through **closer links between evaluation and policy**, which could provide better transparency in practices and address demands for increased involvement of relevant actors. Closer links could contribute to effectively managing the dynamics of integration. Moreover, in analysing ERA dynamics, evaluators and policy makers ought to consider the wider framework namely the political, socio-economic and cultural context within which research activities are carried out. This could reinforce the socialisation potential of evaluation and create a favourable environment for science and technology.

4. Evaluating integrative activities for a European wide socialisation effort

The **second feature**, closely related to the first, is the establishment of a more **systematic approach to evaluate integrative science and technology activities**. The Danish experimentation results show a high degree of interest among policy makers in a broader integration of science in society.

A systematic approach will enhance the production of inputs about needs at the national and regional level, draw attention to best practices and thus support policy on integrative activities. A systematic approach can improve data collection and dissemination systems. Open coordination of evaluation in terms of data collection could enhance comparability of results at supranational level, a precondition for European-wide socialisation of evaluation and research.

5. Strengthening the linkages between different levels

The **third feature** is the **strengthening of linkages** between the different policy levels, using national expertise and experiences at the EU level and vice versa. Evaluation practice has been strengthened in some member states with the establishment of evaluation agencies or specific evaluation units. Still, further attention could be given to networking of evaluation between relevant actors[9].

Learning from better socialised traditions

European evaluation capabilities need further development, and knowledge exchanges with other evaluation traditions (such as the United States), where evaluation is better socialised and more often used in addressing societal issues, could be intensified to learn from different experiences.

6. Making better use of existing experiences and lessons learned

The **fourth feature** is how to **make better use of the experiences and lessons** already learned from evaluation practices in order to mobilise and coordinate the competences and skills necessary for increased levels of socialisation. A comparative study[10] of 22 European countries' concepts of public evaluations and their impact on policy suggests striving towards a higher degree of coordination and systematisation of science and technology evaluations, and including additional issues of significance for research integration.

Using evaluation as a strategic tool

Additional issues involve evaluation of national policies and strategies, studies of socioeconomic impacts and improvement of evaluation methodologies. Evaluations could be further developed as effective instruments by increasing the use of evaluation as a **strategic tool** in policy. Fostering an environment fertile for evaluation, in particular at natio-

9 The European RTD Evaluation Network focusing on the ERA is one such forum.

10 Kalpazidou Schmidt, E. (2006) RTD Evaluation and Policy in the European Research Area. *Evidence & Policy, a Journal of Research, Debate and Practice,* May 2006, vol. 2, issue 2, pp 185-209.

nal level, will promote stronger communication links between different social actors and create forums for networking and interactions.

7. Promoting a co-development of policy and evaluation to avoid marginalisation

Finally, in accordance with the new rationales and instruments agreed upon in European research policy, **evaluation practices should co-develop**. The flow of policy instrumentation is likely to further stimulate science and technology. It is a challenge for evaluators to develop tools to assess upcoming issues and impacts of recent initiatives. Studies on the interplay between initiatives at different levels are required to better manage the social dynamics of integration. Effects of member states science and technology policies on European research should be analysed in relation to the impact of EU programmes on national and regional systems. As no strong foundation is presently in place to develop a European evaluation culture fully capable of addressing integration challenges, evaluators ought to focus on building evaluation competences geared for the ERA. It is obvious that without such competencies, there is a high risk that evaluation will be marginalised.

[C] ORIENTATIONS AIMED AT STRENGTHENING EVALUATION AS A TOOL FOR SCIENCE AND TECHNOLOGY SOCIALISATION

In a socialisation perspective, a key argument is that growing successful involvement increases the chances for evaluation to gradually be more used; an argument compelling both at national and supranational level.

8. Creating a common conceptual framework as a socialisation platform

In a differentiated context such as the European, it is of outmost importance that national evaluations provide correlating data for comparative studies. A harmonisation and standardisation of processes could provide considerable advantages (high standards, an integrated structure for data collection and analysis) but also involve the risk of creating a uniform system that does not reflect contextual and other differences. The answer might therefore be to create a **conceptual framework** that enables actors to perceive concepts, instruments and standards in similar ways without putting constraints to practices.

Such a framework could certainly be a platform for increased socialisation efforts. It requires the engagement of all relevant stakeholders to become widely recognised, achieve the most promising concept and limit disadvantages of convergence, though. Some concrete suggestions to develop such a conceptual framework are presented below.

Putting evaluation in a system through an open method of coordination

Better coordination and systematisation of evaluation activities, based on an **open method**, may assist in achieving comparable results and developing common high standards. This could improve practices in countries with less deep-rooted traditions. It may equally support the creation of an evaluation culture capable of better managing science socialisation issues.

A common framework could be the basis for a European approach to evaluation and could smoothen the process of developing and implementing policies. A common evaluation platform could offer tools that allow countries to validate each other's results and learn from each other. A precondition for the establishment of such a platform is the building of capabilities enabling them to undertake complex data collection and analysis. An effective joint conceptual framework could for example be based on a network of country correspondents.

Enhancing visibility of the socialising potential of evaluation

Further development of interfaces to **improve visibility and accessibility of existing knowledge and expertise** and expose the **socialising potential of evaluation** is likewise required. This might involve (i) the raising of awareness among actors in order to actively engage in a socialising dialogue, (ii) the activating of bodies of science and technology at different levels (facilitate communication between actors), (iii) the creation of a networking structure and a common tank of evaluation expertise, and finally (iv) the setting up of an Evaluation Observatory that smoothens the flow of information on evaluation.

Limiting the risks of uniformity

It is important to point out that in a field where diversification and contextualisation are vital concepts, the **risks** involved in developing conceptual and methodological uniformity are substantial. The answer could be an improvement of methods and coordination of activities based on common standards, rather than on standardisation of practices, which involve the risk of marginalising evaluation.

9. Paying attention to differentiation and context to avoid marginalisation

Science and technology activities have different needs, are carried out under different conditions and within different frameworks. As a consequence, **evaluators and policy makers should take contextual factors into consideration** such as the characteristics of national settings, institutions and research fields. A precondition for higher socialisation levels is to understand the dynamics of each national and institutional context in order to be able to use experiences and adapt best practices to concrete frameworks.

Considering the increased amount of research in new and emerging fields of science and the expansion of inter-, trans- and multidisciplinary approaches, a combination of different evaluation expertise and methods may be required to meet future demands. The SS-ERC experimentation shows that Danish parliamentarians value in particular knowledge gained through these approaches and point out the importance of evaluations of inter-, trans- and multidisciplinarity.

High skilled capabilities, interfaces between different policy levels as well as science areas and genuinely socialised processes are crucial in addressing contextual complexity. It requires capabilities at the national level able to improve the access of evaluative activities to a wider audience. It involves also establishing or, where already in place, strengthening of capabilities able to map the complexities of science and technology on the one side, and on the other able to analyse and synthesise the findings in a European perspective. The challenge for evaluation is thus to **address the increasing contextual complexity and great diversity** among stakeholders, and at the same time **develop a common framework that facilitates coordinated activities**. Successfully addressing this challenge may prove to be one of the most important socialising mechanisms for evaluation in Europe.

10. Widening the scope of evaluations

New understanding gained at the theoretical level and through evaluations in different contexts, will constantly add new issues to the agenda. **Broadening the evaluation agenda** is hence required in an environment with an increased number of stakeholders, a variety of new institutions and an expansion of research policy issues. It is therefore a paradox that current evaluation methods still have as point of departure the practices and instruments that were established during a different science and technology era. It is vital for the socialisation of evaluation and research to develop existing instruments. Without adequate, high quality instrumentation, the credibility of evaluators and hence the socialising function of evaluation is at risk.

11. Creating comprehensive instruments

Over the last four decades, considerable efforts have been made to improve evaluation design and methodology. Combinations of methods and instruments have also been used to some extent. It has increasingly been acknowledged both by policy makers and evaluators that **there is a need to use the instruments in more flexible ways** that provide opportunities to exploit synergies of interventions in different areas and levels.

What is more important, a system with enhanced methodology for evaluating integrative dynamics in the ERA should be put in place. At the same time national evaluations should take into consideration elements that are significant in the integration process, namely their participation in the Framework Programmes, networking, cross-border collaboration and mobility issues.

In principle, there are two complementary approaches to proceed in order to develop the evaluation instrumentation.

Improving and deploying existing instruments

- The **first** is to improve and deploy **existing instruments**. Much could be achieved through the development of existing instruments and their use in new combinations or by comparing results produced through the same instruments but at different levels, in different scientific areas or countries.

Combining analytical and process oriented tools

- The **second** approach is to **combine analytical and more process oriented tools** fit to address the complexity of science. In this way evaluations could help actors to gain insights into the conditions for science production and identify opportunities and risks linked to technological progress (highly required by policy makers as the experimentation on evaluation reveals).

12. Combining different approaches

Evaluation aiming to support policy would be strengthened if it was **combined with other tools in a broader system of data collection and analysis**. Evaluation of the interplay between different instruments or the right mix of instruments requires input from a variety of methodologies. It also requires inputs from tools such as benchmarking, foresight, technology assessments and other analytical tools. The combined use of such instruments is in the literature described as strategic intelligence[11]. Strategic intelligence, together with a system for distribution of its outcomes, could be a valuable instrument in the socialisation of, among others, evaluation.

The new instruments used in European science and technology policy put forward an **infrastructure for strategic intelligence**. This is mainly done by establishing linkages between different sources and actors. This infrastructure is still in an early stage and needs improvement to provide a better understanding of the growing interconnection between science and technology, policy makers and other stakeholders. Given the European diversity, further attention has to be given to the question of (i) how the combination of different tools should be designed and (ii) how the strategic intelligence should be distributed

[11] Kuhlmann, S., Boekholt, P., Georghiou, L., Guy, L., Héraud, J-A., Laredo, P., Lemola, T., Loveridge, D., Luukkonen, T., Polt, W., Rip, A., Sanz-Menendez, L., Smits, R. (1999) *Improving Distributed Intelligence in Complex Innovation Systems.* Brussels and Luxembourg: Office for Official Publications of the European Communities.

and utilised to achieve the best socialising effect. There is no formula, though, on how tools can be combined to achieve higher socialisation levels. The composition should be considered from case to case depending on the objectives of the activity.

Finally, increased socialisation of evaluation is feasible only **with committed and coordinated efforts** and if successful practices are carried out based on enhanced capacities and methods. By giving special attention to socialisation of evaluation, operational indications as these offered above, may help decrease the uncertainty in science policy and bridge the gap between science and society.

[S]

SOURCES OF INFORMATION AND FURTHER READINGS

Books

Fahrenkrog, G., Polt, W., Rojo, J., Tübke, A., Zinöcker, K. (eds) (2002) *RTD Evaluation toolbox: assessing the socioeconomic impact of RTD policies.* EUR 20382, Seville: Joint Research Centre, Institute for Prospective Technological Studies.

Guba, E.G., Lincoln, Y. S. (1989) *Fourth Generation Evaluation.* Newbury Park, CA: Publications

Jasanoff, S. (1990) *The Fifth Branch: Science Advisers as Policy Makers.* Cambridge, MA: Harvard University Press.

Patton, M.Q. (1997) *Utilization-Focused Evaluation: The new century text.* Thousand Oaks, CA: Sage.

Plattform Forschungs- und Technologieevaluierung 2006. Special Edition, nr 28, New Frontiers in Evaluation. Vienna, Austria.

Rossi, P. H., Lipsey, M. W., Freeman, H. E. (2004) *Evaluation: A Systematic Approach.* Thousand Oaks, CA: Sage Publications

Science and Public Policy (2005). Special Issue on Evaluation of European Union Framework Programmes: the 2004 Five-Year Assessment, vol. 32, no 5, October 2005.

Scriven, M. (1991) *Evaluation Thesaurus*. Fourth edition. Thousand Oaks, CA: Sage Publications.

Shadish, W.R., Cook, T.D., Leviton, L.C. (1991) *Foundations of Program Evaluation.* Newbury Park: Sage Publications.

Shaw, I.F., Greene, J.C., Mark, M.M. (eds) (2006) *The Sage Handbook of Evaluation.* London: Sage Publications.

Spaapen, J., Dijstelbloem, H., Wamelink, F. (2007) *Evaluating Research in Context. A method for comprehensive assessment.* Second edition. Consultative Committee of Sector Councils for Research and Development (COS), the Netherlands, the Hague.

Weiss, C. (1998) *Evaluation.* 2nd edition. Upper Saddle River: Prentice Hall.

Vedung, E. (1997) *Public Policy and Program Evaluation*. New Brunswick, NJ: Transaction Publishers.

CHAPTER FIVE

GOVERNANCE

[*]

Science and technology governance as a new issue

Governance can be defined as "the structures and processes for collective decision-making involving governmental and non-governmental actors"[1]. **In relation to science and technology, governance is a relatively new issue,** but 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.

Changes in science, technology and society

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[2]. 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.

The notion of the "**triple-helix**" has been used to illustrate this integration[3]. It stresses the dynamic and unstable, yet highly interwoven, configuration of the three helices, science – industry – politics that interact and form provisional networks and organisations of innovation.

Overcoming the "triple-helix" model

Increasingly, though, **the idea of these three constitutive helices seems inadequate** with respect to taking the participation of "the public" as a part of innovation systems – or knowledge societies more broadly - into account. Knowledge production within the **context of application** is - in turn - knowledge production within a **context of implication**[4]. Knowledge produced with the intention to meet societal demands or solve economic, political, and social problems will arguably affect the lives of lay citizens. New and emerging technologies are considered primary vehicles for wealth production, with crucial importance to welfare and labour market conditions; yet at the same time these technologies fundamentally challenge ethical values, cause environmental damage, and force societies to reconsider basic perceptions of human nature and social interactions.

1 Nye, J.S., Donahue J.D. (2000) *Governance in a globalizing world.* Washington: Brookings Institution Press.

2 Gibbons, M. et al. (1994) *The new production of knowledge – the dynamics of science and research in contemporary societies*. London: Sage Publications.

3 Etzkowitz, H., Leydesdorff L. (2000) The Dynamics of Innovation: from National Systems and 'mode 2' to a triple helix of university – industry – government relations. *Research Policy*, 29. p. 109-123.

4 Nowotny, H. et al. (2001) *Re-Thinking Science - Knowledge and the Public in an Age of Uncertainty*. Cambridge: Polity Press.

Hence, **citizens** are increasingly being considered a relevant "**stakeholder**" or discussed as a fourth component in the triple helix model of innovation systems[5]. In contemporary societies, **a new mode of knowledge production** is advancing, and within this new mode the role of citizens – not least the way in which citizens can make their voices heard and affect the developmental course of science and new technologies - is becoming an issue of pressing societal importance and academic interest.

It is against the backdrop of these changes that the issue of governance is gaining an increasingly important place on national and international agendas. The interplay between science and society as defined during FP6 was - and still is - an interaction going both from society to science and from science to society. The concentration in FP7 upon **Science *in* Society** puts focus on the functional integration of science and society, and it necessarily raises the **fundamental issue of governance** in relation to science.

Citizens as relevant stakeholder

[K]

KEY ISSUES

Destabilisation of the traditional governing mechanisms and the advancement of new arrangements of governance is said to be one of the most remarkable developments in modern societies in the past few decades[6] and therefore governance is in itself an object for studies, also in the context of European research capacity (SS-ERC).

1. Innovation and democratic governance

Science and governance in a new light was the issue for "Taking the European Knowledge Society Seriously"[7]. In this European report from the expert committee on science and governance, the main point is that **policy making should address the complex issue of science and governance "seriously"**, and more than anything take the concept of the **knowledge society** seriously. The report argues that "there are pressing and apparently contradictory demands placed on European science and governance. 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**" (op.cit. p.12). We have to be aware of the **contextualisation in its global perspective**, which is one of the very important emerging issues concerning governance.

5 Leydesdorff, L., Etzkowitz, H. (2003) Can 'the public' be considered as a fourth helix in university-industry-government relations? Report on the Fourth Triple Helix Conference, 2002. *Science and Public Policy*, Vol. 30, No. 1, p. 55-61(7).

6 van Kersbergen, K., van Waarden F. (2001) *Shift in Governance: Problems of Legitimacy and Accountability*. Haag: Social Science Research Council.

7 European Commission (2007) *Taking the European Knowledge Society Seriously* (Working document from an expert group on Science and Governance in relation to Science, Economy and Society). Brussels: European Commission.

2. Commercialisaton and privatisation of research

Another emerging issue has to do with **commercialisation and privatisation of research**. "The decentring of the state involves a move from the public ownership and centralised control to privatised institutions and the encouragement of market competition"[8]. This aspect has extreme relevance for changing ownership of scientific results, since it is no longer primarily the state that funds scientific work. **Demand on governance and regulation from private market** actors is becoming more and more relevant as an object of study. One major change today is the sheer volume and scale of investment in research and the shift toward an increase from private sources. Shareholder values have increasingly been passed on to science, or at least shareholders have tried to pass on their values, and the hot fields of investment are those scientific fields in which advances are most rapid and promising for their potential applications. **Shareholders** today are clearly recognised by many political parties and governments across Europe 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[9].

3. Civic deliberation

While science has always spoken to society now society increasingly "speaks back"[10]. And it happens in many different forms involving stakeholders of all kinds and the public in all forms. This is one of the reasons that society might be thought of as an enlarged laboratory for social sciences[11]. **Civic deliberation** is something else than expert opinions and usually perceived as something else and broader than shareholders. Recent years have witnessed an increasing interest in **deliberative democracy**[12], sometimes referred to as discursive democracy, which is essentially a discourse on 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 - communication without compulsion, which generates consensus when certain validity claims are met - have become highly influential.

4. Participatory exercises

The deliberative democracy model has become central to science communication activities. Among agents of science – society interaction the notion of deliberative democracy plays a lead role in guiding the processes and defining the format for participatory exercises. 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. Local as well as national and international networks of "deliberation practitioners" have emerged, and experiences and reflections on specific cases are exchanged and discussed intensively. Good practices in deliberation exercises are systema-

8 Hutter, B.M. (2006) Risk regulation and management. In Taylor-Gooby, P., Zinn, J. (eds.), *Risk in Social Science*. Oxford, UK: Oxford University Press, pp. 202-227.

9 *Public Debate on Research Policy in the Nordic Countries*, to be published by NordForsk 2009

10 Gibbons, M. et al. (1994) *The new production of knowledge – the dynamics of science and research in contemporary societies*. London: Sage Publications.

11 Felt, U. (2008) Speech at the European conference "Science en Societé - Dialogues et Responsabilité Scientifique". Paris, November 2008.

12 Dryzek, J. S. (2000) *Deliberative democracy and beyond: Liberals, critics, contestations*. Oxford: Oxford University Press.

tically being identified and collected in "practitioners' handbooks" on strategies for civic engagement[13] and public participation[14].

The most important **points of discussion** are briefly outlined below:

Compulsion-free and symmetrical exercises

- **Are the participatory, deliberative exercises in fact free from compulsion and symmetrical?** It has been argued that problems arise in connection with framing the debate and that certain biases in recruiting or selecting participants can be detected. In "Constructing the scientific citizen: science and democracy in the biosciences" Alan Irwin[15] examines a particular science-citizen interface – the Public Consultation on Developments in the Biosciences – which was carried out in 1998-1999 in the UK. Irwin questions the participatory and citizens-led character of the exercise by showing that the **citizen role in a number of ways is socially contingent**, a construction rather than a normative model. In the specific exercise in question, the institutional location (the Office of Science and Technology), the balance of information and consultation, the preframing of the questions for discussion (Lord Sainsbury's initial questions led the whole exercise), the degree of **activity vs. passivity** that was accorded to the citizens, and the underlying scientific assumptions (the coherence of the 'biosciences') were all elements that challenged the normative ideals of democratic governance. Practical issues about the format of the participatory activities, ranging from problems in ensuring random selection of citizens[16], over framing issues, to considerations about how institutions affect the output[17] thus have significant influence on the democratic legitimacy of the exercises.

Impact of deliberative governance

- What is the **impact of deliberative governance**? There is only limited evaluation of the deliberative exercises. One systematic, comparative research project, however, studied "public participation and environmental science and technology policy options", and concluded that the sites and institutions for public participation are highly fragile and effectively detached from policy making processes[18]. Public participation, in other words, is not necessarily politically influential.

Participatory exercises and real policy making

- Is the focus on governance just a transition from "the more you know it, the more you love it" to "the more you participate in it, the more you love it"? Considering the lack of evidence that **participatory exercises really feed into policy making**, it

13 Gastil, J., Levine, P. (eds.), (2005) *The Deliberative Democracy Handbook: Strategies for Effective Civic Engagement*. San Francisco: Jossey-Bass.

14 Creighton, J. L. (2005) *The Public Participation Handbook: Making Better Decisions Through Citizen Involvement*. San Francisco: Jossey-Bass.

15 Irwin, A. (2001) Constructing the scientific citizen: science and democracy in the biosciences. *Public Understanding of Science*, vol. 10, no. 1.

16 Carson, L., Martin, B. (2002) Citizen participation – Random selection of citizens for technological decision making. *Science and Public Policy*, Vol. 29, No. 2.

17 Kass, G. (2000) Science and citizens – Public debate on science and technology: issues for legislators. *Science and Public Policy*, Vol. 27, No. 5.

18 Jamison, A., Ostby, P. (eds.), (1997) *Public Participation and Sustainable Development – Comparing European Experiences*. Aalborg: Aalborg Universitetsforlag,

is relevant to ask, whether the shift from science dissemination to dialogue and participation is just another strategy to make citizens accept or appropriate new technologies. According to Levidow & Marris[19] emerging models of risk assessment and regulation, which aim at invoking a more democratic governance of science and technology, are only superficially committed to citizen influence. Rather, **rhetorics of openness and transparency** have been tagged onto dominant models rather than superseding them. In order to re-legitimise decision making, institutional frameworks must also be re-evaluated in order to avoid this problem. Politicians, industrialists, and science and technology administrators, it is argued, have identified *a new "deficit model"*, according to which the public discontent with science and technology is not so much a question of competence deficit, as it is a question of "**participation deficit**". Increased participation is expected to enhance increased appreciation of science and technology, and – at the end of the day – industrialists and decision-makers are more enthusiastic about public appreciation than about democratic governance.

The political out of politics

- By insisting on rational dialogue and "natural" consensus, **does deliberative governance abstract the political out of politics?** Elam & Bertilsson[20] argue from a radical democracy perspective that the consensus-orientation of many participatory settings leaves no room for conflict, dissent, passions, struggles over power, and confrontation, which are fundamental elements of politics[21] . They continue to raise a need for competing or complementary institutions, which can better handle residual participatory practices. The current field of science communication does not satisfactorily provide a framework for the citizen – science – technology interaction and for policy making within this area. There may be grounds for advancing an Alternative Public Understanding of Science, or APUS, they argue.

The role of professional moderators, facilitators, and brokers

- **Do the facilitators of governance monopolise the debate over science and technology issues?** With some irony, Martin Bauer has called the range of consultancy companies, professional moderators, facilitators, and brokers, who take on the well-paid job of managing the considerable organisational work in connection with consensus conferences, citizen juries, national debates, and other deliberative exercises, the 'angels' of the knowledge society. These angels intermediate, ".. not between heaven and earth, but between a disenchanted public and the institutions of science, industry, and policy making"[22]. The angels create an infrastructure for dialogue, but it is worth considering, whether they in fact simultaneously take away the responsibility and initiative from citizens. Intermediation has become a lucrative niche that the "angels" have some interest in preserving as a professional activity

19 Levidow, L., Marris C. (2001) Science and governance – Science and governance in Europe: lessons from the case of agricultural biotechnology. *Science and Public Policy*, Vol. 28, No. 5.

20 Elam, M., Bertilsson M. (2003) Consuming, Engaging and Confronting Science – The Emerging Dimensions of Scientific Citizenship. *European Journal of Social Theory*, 6(2): 233-51.

21 Mouffe, C. (1999) Deliberative Democracy or Agonistic Pluralism? *Social Research*, 66(3): 745-58.

22 Bauer, M. (2003) The vicissitudes of 'Public Understanding of Science': from 'literacy' to 'science in society'. *Science meets Society*. Lisbon: Fundacâo Calouste Gulbenkian.

and presenting as the only legitimate model of citizen – science interaction. It is reasonable to believe that the extensive activity of the angels may implicate that some people would be more inclined to think, that the public debate on new technologies is "being taken care of" and accordingly the perceived need for individual involvement would seem less urgent. Thus, the institutionalisation of public debate may in fact cause de-mobilisation or non-participation on the side of citizens.

[O]

OPERATIONAL INDICATIONS

The list of discussion points evolving around **deliberative, democratic governance** goes to show that this approach **is not unquestioned**, even if it is gaining momentum in recent policies on science and society and among science communication practitioners. However, it is not public participation as such, which is being questioned. It is rather the ways in which participation is being done. There is widespread acceptance, even among scientists, that public participation in issues of science and technology is a legitimate consideration in modern knowledge societies.

1. Understand-ing the dimensions of governance

These considerations also point towards the need for discussing **different models or types of governance**. In the SS-ERC, the Danish team presented the members of Parliament with questions that were meant to tap into different perceptions of science and technology governance.

Based on Gaskell and colleagues[23], we can identify **two important dimensions** when it comes to the issue of governance.

The **first dimension** is concerned with **who should decide**; and the **second** has to do with the basis or **criteria on which decisions should be made**. In terms of who decides, it is relevant to ask whether decisions about science and new technologies should be made by experts or the broader public; i.e. based on **delegation** of authority to a group of particularly qualified persons or based on **deliberation** in a broader, public context. In terms of criteria, we can distinguish between making decisions on the basis of stringent **scientific evidence** about risks and benefits or making decisions on the basis of **moral and ethical issues** involved.

The figure presents a typology of governance based on these two dimensions. Those in favour of delegation would be inclined to rely on the advice of expert bodies, for example food safety authorities or others involved in risk analysis (in the case of scientific dele-

23 Gaskell, G. et al. (2005) Social values and the governance of science. *Science,* (310); Gaskell, G. et al. (2006) *Europeans and Biotechnology in 2005: Patterns and Trends – A report to the European Commission*. Brussels: European Commission.

gation) or ethical councils or others concerned with moral and ethical issues (in the case of moral delegation). Those in favour of deliberation would be more interested in public opinions and sentiments, either based on assessment of risks and benefits (in the case of scientific deliberation) or based on moral and ethical values (in the case of moral deliberation).

Four types of governance

Four types of science and technology governance: Decisions about science and new technology should be based primarily on:

	Scientific evidence about the risks and benefits involved	The moral and ethical issues involved
The advice of experts	**Scientific Delegation**	**Moral Delegation**
The general public's view	**Scientific Deliberation**	**Moral Deliberation**

The **typology of governance** is intimately connected with the discussions about technological responsibility, the role of citizens vis-à-vis science and technology, and the wider science and technology socialisation processes.

2. Making citizens real decision-takers

The SS-ERC project as a whole has pointed to the fundamental importance of socialisation policies that enhance and invoke a broad sense of technological responsibility distributed across actors and institutions in knowledge societies. The particular relevance of public mobilisation in this regard has been stressed throughout the SS-ERC work. **Technological responsibility requires citizens to actively make an effort to understand the societal and political complexities** nested in science and technology as a prerequisite for taking a stand, forming opinions, or expressing concerns. However, **if citizen voices are ultimately not heard in decision-making**, i.e. if citizens are neither direct nor indirect decision-takers, the value of technological responsibility as well as the motivation for mobilisation is in jeopardy. If citizens are effectively marginalised from decision-making, any ambition or idea of enhancing 'scientific citizenship' is obscured. If, on the other hand, citizens themselves choose to delegate decisions-making power to people with particular skills, experts, the implications may be different.

Scientific delegation as the main type of governance

The idea of technological responsibility implies that citizens need to take responsibility for acquiring knowledge; not only technical knowledge, but no less important knowledge about the social implications and contingencies of science and technology. But should citizens, based on this information, decide to delegate decision power to a confined segment of the population, it might actually not be in conflict with the idea of technological responsibility. Based on the interviews with the members of the Danish parliament that we conducted as the element of the Danish SS-ERC experiment, it is possible to estimate the distribution across the governance typology described in the figure above. **Scientific delegation** dominates among the Danish parliamentarians; the majority wish to base their decisions on expert advice and scientific evidence about the risks and benefits involved.

Confidence in scientific deliberation is not in any way strong, while the idea of moral delegation is expressed among more than a quarter of the parliamentarians as the ideal way decisions about science and new technology should be taken.

Distribution across the typology: scientific delegation, scientific deliberation, moral delegation and moral deliberation.
Responses from politicians (2008) and citizens (2005); pct.

	Politicians	Citizens
Scientific delegation	67	57
Scientific deliberation	6	6
Moral delegation	27	29
Moral deliberation	0	8
Total	100	100

In the table above, results from citizen surveys (as part of a Eurobarometer study from 2005) show that Danish citizens are more or less of the same opinion as their elected representatives. In a governance context, it is in itself interesting to compare public opinion to that of politicians. The results appear to support the ideal model of representative democracy, in the sense that politicians' and citizens' opinions are almost congruent. There is some indication of a positive attitude to moral deliberations among citizens in contrast to the total lack of this attitude among parliamentarians. Moral deliberation refers to some citizens' ideal to be more involved as decision takers who would focus on the moral and ethical issues connected with science and new technologies.

Policy makers' lack of concern about citizens and citizens' lack of ambition to be involved

The Danish data show that there is a **widespread lack of concern among members of parliament about citizens' viewpoints**, as well as a lack of **ambition to be involved on the side of a majority of the Danish public**. This is one of the main results of the Danish SS-ERC experiment and has to be discussed in the context of socialisation. Are parliamentarians in general socialised not to be concerned about citizens as such but only about interest groups central for the party? And particularly, when it comes to science and technology, is there a tradition to rely on expert advice and technocratic processes rather than inclusive, deliberative models? Are citizens socialised to become involved or engaged 'scientific citizens' or are they socialised to leave decisions with others? How can we understand these results in relation to ideas about technological responsibility and scientific citizenship?

Among recent initiatives in terms of governance of science and technology in Denmark is an attempt to invite citizens to tell the government about their wishes, needs and fears in this area. Invitations from the Danish Ministry of Science, Technology and Innovation to engage in science for the future can be taken as an example. A recent initiative from the Danish Strategic Research Council inviting citizens to tell about their needs and wishes in relation to science and innovation, as part of the so called 'Forsk2015' initiative, could also be mentioned as a new way of inviting citizens to participate, to be part of science governance.

Consensus conferences and the increased dominance of economic logic

The organisation of **consensus conferences** was for years a Danish brand, run by the Danish Board of Technology, but now new forms of consensus conferences are planned, based on direct input from citizens based on general invitations. Quantity has come to prevail over quality. At the new type, initiated by Bjorn Lomborg, supported by the government, and called Copenhagen Consensus, high level economists including several Nobel prize winners will discuss and prioritise based on the wishes put forward by lay citizens. Basically, authority is taken away from citizens and left with experts. In terms of Arnstein's "ladder of participation"[24], governance appears to be based increasingly on citizen consultation rather than real participation in decision-taking. The **narrowing down of decision power in this new type of consensus conferences** just to participation of economists runs contrary to the old format for Danish Consensus Conferences, where experts from a variety of scientific fields met a selection of concerned citizens, with the citizens in a position to formulate the overall consensus statement. This **change shows the increased dominance of economic logics**, a dominance which is very outspoken in Denmark, but definitely not solely seen in Denmark.

But it also strongly contributes to understanding the distribution across the four types of governance in our model above. It is a clear result from the survey that politicians in Denmark are very reluctant to leave decisions concerning science and technology with the broader public. Instead, politicians – and citizens to a high extent – support technocratic decision making in which expertise is required.

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

The national level is one level of action, another level is the **European**. Key emerging questions are then: How will the creation and implementation of science policies within complex supranational systems like EU and the broader European or even global level give citizens an option for being part of the structures and processes that we refer to as governance? Will citizens have a greater chance to be heard as part of an established consultation and involvement practise or programme at the European level than at the national or local levels?

The trans-European interest groups

Some **trans-European interest groups**, primarily raising from within professional science organisations, have been formed specifically directed towards science and technology policy, and a variety of European formations and networks now exists[25] . Ethical councils should also be mentioned as strong groups trying to influence European science.

24 Arnstein, S. R. (1969) A Ladder of Citizen Participation, *JAIP*, Vol. 35, No. 4, pp. 216-224.

Groups of patients (as described at some length in "Taking the European Knowledge Society Seriously") are another type of groupings of citizens that seek and also increasingly have influence. The rather well established environmentalist and consumer organisations are also exercising pressure on science policies and in this way try to practise their own perception of "right to governance". Many of these groups and organisations are cross-national.

Mass media and citizens' attitudes toward science and technology

The **mass media coverage** of science and innovation has played a **great role in the forming of attitudes among citizens**. Several studies have referred to the interaction between citizens and scientists primarily to take place through the media[26]. While the educational system remains the main source of scientific information for most people, many citizens also get general, basic "knowledge" about science from the mass media. Since the broad media coverage still is so significant for setting the public agenda, the question about *who sets the agenda* in the mass media is still highly relevant.

Limited range of actors involved in the mass media

Content analyses - like the ongoing Nordic analyses of science policy debates over the last ten years (from 1998 to 2007) in the main newspapers in five Nordic countries - show the **limited range of actors in the debates in the mass media,** even though the media project included letters to the editor. For decades television has been the prime source of information about new developments within science, but in relation to television the access for ordinary people to become producers of messages is more restricted than access to the print media, so this way of exercising governance is very limited, although the number of talk-, quiz-, and science-shows with ordinary citizens have grown enormously in number all over Europe. Increasingly, the internet has taken over a part of the mass media's role in dissemination but that form in itself limits the broadness as a result of users' search on selected science fields. The search is primarily for health information, since health is one of the prime themes where people accept and are interested in almost all new scientific developments, as long as they believe it is for the good of their lives. But also in this area a growing uncertainty exists, more than anything else due to developments in the life sciences.

4. Preparing citizens to be policy makers

Constantly there are new issues and new challenges of which fewer exclusively are national; increasingly news about science brought to citizens is at the European or global level. **Are citizens socialised to cope with all this**? **Are policy makers?** Is the basic trust greater or smaller? Does news coverage lead to greater involvement in governance? Or should we just leave it to experts to make decisions about science and technology, as it appears to be the case in Denmark?

At the European level Ortwin Renns book "Risk Governance – Coping with Uncertainty in a Complex World"[27] from 2008 concludes that "modern societies are in urgent need for a new inclusive and integrative framework promising to promote good risk

25 Banthien, H., Jaspers, M., Renner, A. (2003) *Governance of the European Research Area: The Role of Civil Society*. Brussels: European Commission.

26 Vinther, T., Siune, K. (2000) *Danske TV-nyheders dækning af forskning og udviklingsarbejde,* Rapport 2000/2 udg. Aarhus: Analyseinstitut for Forskning; Nowotny, H. et al. (2005) *The Public Nature of Science under Assault*. Berlin: Springer.

Three components of good governance:

legally prescribed procedures...

knowledge....

...and social values

Socialising actors to be scientific citizens

governance, establish a more stringent approach to deal with complex, uncertain and ambiguous risks, develop a more suited structure to cope with emerging systemic and global threats and provide a convincing and acceptable format for involving civil society in the decision-making process".

And the book continues to say that "**good governance** seems to rest on the **three components**: Knowledge, legally prescribed procedures and social values" (op. cit p. 362). The main point here is that **governance is something else and more than mere regulation**.

Legally prescribed procedures do exist in many areas, more than in any other scientific area in medicine, but as we see in the case of for example nanotechnology, demands on regulatory adjustments are certainly not trivial.

In terms of **knowledge** – the second parameter – it is paramount to stress that the emerging awareness of public engagement (as opposed to public understanding) should not entail neglecting the issue of sharing, disseminating, discussing, and confronting scientific knowledge. **Basic knowledge of science**, i.e. scientific results, scientific practices, the organisation of science and so on, should still be considered a very important part of the opportunity structure for public participation in science governance. As Mejlgaard & Stares have recently shown[28], public competence in matters of science and public engagement with science are strongly interrelated, and should be considered mutually stimulating dimensions of scientific citizenship.

Social values are extremely relevant in establishing new forms of governance; indeed, democratic governance of science is in itself more than anything a value-based, normative model of science in society.

The issue of **socialisation**, which holds a prominent position in the SS-ERC project, is important in this context. 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 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 of science governance.

27 Renn, O. (2008) *Risk Governance – Coping with Uncertainty in a Complex World*. Earthscan.

28 Mejlgaard, N., Stares S. (2009) Participation and Competence as Joint Components in a Cross-national Analysis of Scientific Citizenship. Forthcoming, *Public Understanding of Science*

[S]

SOURCES OF INFORMATION AND FURTHER READINGS

Banthien, H., Jaspers, M., Renner, A. (2003) *Governance of the European Research Area: The Role of Civil Society*. Brussels: European Commission.

Creighton, J. L. (2005) *The Public Participation Handbook: Making Better Decisions Through Citizen Involvement*. San Francisco: Jossey-Bass.

Dryzek, J. S. (2000) *Deliberative democracy and beyond: Liberals, critics, contestations*. Oxford: Oxford University Press.

Elam, M., Bertilsson M. (2003) Consuming, Engaging and Confronting Science – The Emerging Dimensions of Scientific Citizenship. *European Journal of Social Theory*, 6(2): 233-51.

European Commission (2007) *Taking the European Knowledge Society Seriously* (Working document from an expert group on Science and Governance in relation to Science, Economy and Society). Brussels: European Commission.

Gaskell, G. et al. (2005) Social values and the governance of science. *Science* (310).

Gastil, J., Levine, P. (eds), (2005) *The Deliberative Democracy Handbook: Strategies for Effective Civic Engagement*. San Francisco: Jossey-Bass.

Gibbons, M. et al. (1994) *The new production of knowledge – the dynamics of science and research in contemporary societies*. London: Sage PuPublications.

Nowotny, H. et al. (2001) *Re-Thinking Science - Knowledge and the Public in an Age of Uncertainty*. Cambridge: Polity Press.

Nye, J.S., Donahue J.D. (2000) *Governance in a globalizing world.* Washington: Brookings Institution Press.

Renn, O. (2008) *Risk Governance – Coping with Uncertainty in a Complex World*. Earthscan.

van Kersbergen, K., van Waarden, F. (2001) *Shift in Governance: Problems of Legitimacy and Accountability*. Haag: Social Science Research Council.

CHAPTER SIX

INNOVATION

[*]

Linking research with innovation: a well-established tendency

Linking research with innovation and economic growth is a **well-established tendency**. Actually, since the Second World War, in different ways and with accelerated pace, governments have been pursuing the objective to **strengthen the role of science within innovation processes,** devising a broad range of policies and measures.

In particular, the attempt has been that of passing from an innovation grounded on unpredictable individual discoveries, to be economically exploited afterwards, to 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 technological applications. The attempt is that of planning as far as possible what by its very nature is not plannable, i.e. a discovery or an invention.

Innovation as a collective process

In this perspective, innovation has been increasingly viewed as the final output of a **collective action**, involving a growing number of individuals and organisations in a movement spiralling upwards. Consequently, the social shape of the innovation processes has been no longer that of a machine-like hierarchically structured system, but rather that of "**innovation clusters**" or "**innovation networks**", i.e. horizontally structured networks made up of highly diversified and specialised actors (research institutes, enterprises, local authorities, government agencies, suppliers, financial institutions, and other kinds of actors).

Therefore, **interaction** started playing a **pivotal role** in innovation, at least for two good reasons. On the one side, it has been recognised that new ideas and new solutions are more likely to emerge in the "boundary areas", that is where more disciplines, corpuses of knowledge, points of view, cultures, languages and representations of reality come into contact and overlap. On the other side, in complex societies like ours, interaction increasingly appears indispensable to mobilise and co-ordinate the diversified set of skills, competences, roles and functions necessary for innovation to occur.

In Europe, innovation still meets many obstacles

Also in Europe, governments and European institutions, since the 60s, started devising specific innovation policies aimed at **linking the "innovation actors"**. Today, after three decades or so of innovation policies, there are important **stocks of knowledge and know-how available** (formalised in thousands of books, handbooks, websites, evaluation protocols, etc.) about how to support innovation through networks and co-operation. More recently, the focus has increasingly been on science-based innovation and therefore on the relationships between the "research systems" and the "innovation systems", progressively more viewed as a unitary system or at least two faces of the same coin.

Notwithstanding the efforts made and the past successful outputs (allowing Europe to keep the pace of innovation up), connecting research and innovation **remains highly problematic**.

The crucial point is the interaction between the actors of innovation and the actors of research or – using a classic, but too schematic distinction – the match between **supply** and **demand for knowledge for innovation**.

The supply of knowledge for innovation

As for the **supply side**, in the academic environment, the **orientation towards innovation seems to be still very weak**. Certainly, this is a trend which is unevenly diffused in Europe. In countries such as Denmark, Finland and UK, research institutions are on average more oriented to innovation than in other national contexts. However, the number of researchers investing times and "brain resources" in innovation and putting innovation – at least for a limited period - at the very centre of their own interests and passions is relatively low. Lacking such an orientation, a great amount of science-based knowledge is **wasted**, not from the angle of scientific advancement, but in the perspective of their social and economic potential benefits. This knowledge simply does not enter in the composition of the supply.

The attention devoted to supply of knowledge **aimed at social innovation** is even lower. University and research institutions are establishing structures (such as Industrial Liaison Offices or Technology Transfer Offices) to have stable relations with enterprises, while little or nothing is being done in support of using scientific knowledge for social aims or for direct benefit of people (such as in the case of science shops).

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 produced without meaningful interactions with enterprises or other key economic actors. Therefore, their "**presumed demand**" is likely to be scarcely coincident or overlapped with the "**actual demand**" of knowledge for innovation.

The demand of knowledge for innovation

However, many problems also arise on the **demand side**. Among **firms**, the level of awareness about their own needs for scientific knowledge is often dramatically low. In Europe, enterprises engaged in innovation activities are estimated to be around 38/40% of the total number of firms[1]. Among them, only around 3.5% of them identify universities and higher education institutions as highly important sources of information for their own innovation activities and only around 2.5% of them identify as such public research institutes[2]. This means that an **overwhelming majority of innovative enterprises do not address any demand to research institutions** and act without significant information about the actual and potential supply of exploitable knowledge generated within the closest university. Most of them use sources of information within the enterprise (50%) or use as sources of information their clients (27%) or their suppliers (24%); less than 8 out of 100 use scientific journals or technical publications.

The attention devoted to scientific and technological research is **even lower among small and medium-sized enterprises**. Most of them seem not to include at all universi-

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

2 Parvan, S.V, Weak link between innovative enterprises and public research institutes/universities, Eurostat Community Innovation Statistics, *Statistics in Focus, Science and Technology*, 81/2007

A double socialisation

ties and research centres as their potential interlocutors and partners and not to connect their own growth with science-based innovation.

These considerations help in better understanding the question of "**socialisation of innovation**", or, better, the question of **double socialisation**; research institutions are asked to be socialised to innovation and the enterprises and civil society organisations to be socialised to research

The main effect of this situation is that research institutions, enterprises, civil society organisations and intermediate entities, despite their increasing interaction, **are still strongly separated entities.** There is a gap among them to be removed which manifests itself at different levels (micro-level, meso-level, macro-level) and in different perspectives (such as strategic, political, cognitive, cultural, communicational, ethical, societal or psychological one). Many of these levels and perspectives are often not considered or barely influenced by innovation policies.

Innovation is not something that can be done in the spare time, nor can it be imposed by law. Innovation is made not by impersonal systems (university systems, industrial systems, etc.), but by concrete individuals and collective actors, bearing their own stories, traditions, mindsets, cultural and professional models and feelings. Also for this reason, cooperation between them is often hindered by personal or institutional conflicts, diverging interests, silent professional confrontations, forms of social stigma or lack of common languages. In this framework, sometimes there are not even the most elementary conditions to generate trust, which is often cited as a deciding factor for activating successful innovation networks.

Socialising the actors of innovation to scientific and technological research and the actors of research to innovation is therefore a necessary step for overcoming these constraints and for freeing social energies to be channelled on innovation.

An experimenttation on the socialisation of innovation

In order to better understand socialisation dynamics related to innovation, in the SS-ERC project experimentation has been conducted, involving a research group of the Tor Vergata University Department of Mechanical Engineering (box 6.1.).

[Box 6.1]
THE EXPERIMENTATION ON INNOVATION

The experimentation on the socialisation of innovation involved a research group based at the Tor Vergata University Department of mechanical engineering.

The **first step** of the experimentation allowed us to collect information and opinions among the group's members and other actors about the history and development of the group. Specific attention was devoted to the group's inner organisation and its relationships with enterprises.

The **second step** was aimed at supporting the group in facing the main problems met in organising its research activity and in promoting and carrying out its innovation programs. Using a strongly interactive approach (based on meetings and focus groups with the group's members), the SSERC staff supported the group in developing the idea and in practically planning the establishment of an intermediate entity, working closely with the group, completely devoted to industrially develop and commercialise the group's research outputs and to keep and deepen the interaction with the industry sector.

[K]

KEY ISSUES

The research and experimentation carried out in the framework of the SS-ERC project allows us to identify a set of "key issues" on the socialisation of innovation deserving specific attention.

1. The lack of social dialogue on science-based innovation

Social dialogue is perhaps the keystone for bridging the existing gap between supply and demand of knowledge for innovation. However, social dialogue is not to be understood as a discontinuous and occasional activity (to be carried out only through consensus conferences or deliberative tools), rather as a "daily habit" of interaction and exchange among the different actors involved. Unfortunately, at least in this broader and deeper meaning, **social dialogue on innovation, in many national contexts, is still at an embryonic level**. Actually, interface and co-operation practices among actors, if any, are sporadic. The institutional or informal "places" where a social dialogue on regular basis can be conducted are very few and usually they have a poor impact. There is also the risk that initiatives of social dialogues were promoted for tokenism, without mobilising a real strategy to attack the barriers limiting a free-flowing communication among the actors involved.

2. Low social recognition of innovation among research institutions

In many research institutions, **innovation still has a low social recognition within many research institutions**. Many researchers all over Europe see innovation as an activity which is out of their tasks or at least of lesser importance and less attractive than research. In the context of a scientific career, publications are much more valuable than patenting or leading a project of technology transfer. In the academic environment, sometimes there is a social stigma surrounding those who, as researcher, carries out activities related to technological transfer or application research, which still appear to be less "noble" activities in comparison with theoretical-experimental research or teaching,

3. The social pressure

There is an increasing **pressure on research institutions** by governments and enterprises **to drive research activities towards the production of economic outputs**.

on research towards the production of economic outputs

Sometimes, this pressure has **problematic** and even **counterproductive effects**. Actually, present tendencies to "industrialise" research processes, i.e. to shape them by applying cultural and organisational models drawn from the industrial world, could alter some core mechanisms of research (pertaining to e.g. peer reviewing or research network's structure and prestige). Another risk is that research is increasingly driven toward short-run application-related objectives, penalising fundamental research, which is able to produce economically valuable results only in the long run. Finally, in the national contexts where governments are particularly proactive in promoting science-based innovation policies, this pressure on researchers could negatively affect the working environment, inducing stress, tensions, silent resistance, and reactions.

4. The difficult interaction between research institutions and enterprises

Even when there exists a common willingness to co-operate, the **relations between research institutions and enterprises usually meet many difficulties** (see also the box 6.2.). Research organisations and enterprises operate at different paces and apply dissimilar organisational and operation models; they have different expectations and interests; often they distrust each other; their languages and communication habits are different and, sometimes, even clashing, systematically producing misunderstandings. Similar problems arise within "mixed organisations" such as university spin-offs, scientific and technological parks and technology transfer offices. These difficulties tend to further increase when SMEs are concerned, since they usually act within short-term horizons and have not much time and resources to invest on building relationships with research and academic institutions.

[Box 6.2]
THE DIFFICULT INTERACTION BETWEEN RESEARCH INSTITUTIONS AND ENTERPRISES

In 2003, the European Commission organised a brainstorming workshop on university-industry relations, with the participation of 21 external participants from associations representing universities, industry and knowledge transfer specialists equally. Some of the outputs of the workshop, after 6 years, still deserve to be mentioned here.

"…forcing a public institution to engage in "innovation-related activities" is unlikely to result in successful results, since such activities require **commitment** and **professionalism**. Moreover, the huge diversity of European institutions, even within a single country, makes a "one-size-fits-all" approach inadequate (…) "

"… The **cultural gap** between industry and universities is a major problem, which prevents trust building, although this is a pre-requisite for long-term balanced relationships benefiting all partners. (…) There is also a strong need to develop **professionalism** among university staff involved in the management of knowledge and relations with industry, because this, in addition to scientific excellence, is what industry is looking for. It was stressed that very specific skills are required in this area, and that these skills are usually not included in standard researchers' curricula (…)

"…Developing innovation-related professionalism in universities requires that, in the first place, there is sufficient **awareness** (at the top level of PROs) and **commitment** in that area, and that the relevance of innovation is properly recognised. Alternatively, a bottom-up approach can be used, e.g. with activities aimed at convincing researchers of the relevance of patent information, etc. "

The problem of the **assessment/appraisal criteria** is a real one, as the reliance on purely academic criteria (publications, …) and the exclusion of "innovation-related" criteria (patenting/licensing activity, etc.) acts as a disincentive for researchers to engage in such activities".

Excerpt from: European Commission (2003) *Brainstorming Workshop on University-Industry Relations*, K1/DD D, Brussels.

5. Skills and competences

As already stressed, promoting, managing and developing science-based innovation processes needs the involvement of **a broad range of professional skills and competences** (related to e.g. marketing, communication, administration, law, management, and the like) to be added to the technical and scientific ones. These skills and competences should be widespread enough among the concerned actors, enabling them to interact and effectively co-operate. Unfortunately, they seem to be scarcely diffused among research institutions and even among enterprises or other actors. One of the hindering factors is that many innovation-related skills and competences are not embodied in formal professional figures or in well-defined professional corpuses of knowledge, neither included in standard university curricula of scientific faculties. Moreover, service agencies providing high-quality advice and training in this sector are very few.

6. The diffusion of policies aimed at the "university third mission"

A real positive change to be pointed out is the diffusion among universities and research institutions of policies and measures **aimed at developing their so called "third mission**". "Third mission" is referred to as the direct engagement of research institutions in support of economic and social development, to be added to their traditional missions of research and teaching. In this perspective, in many universities, offices devoted to technology transfer have been established, patenting procedures have been enhanced, university spin-offs and high-tech incubators have been promoted, more effective ways to link university and the surrounding social and economic environment have been introduced and the relations with the private sector have been fostered. Impacts of these policies can be recorded in all European countries, even though with variable intensity. Anyhow, it is important to stress that the concept of "third mission" provides universities and research institutions with a "cultural place" and a strategic domain where to concentrate and coordinate their own effort towards innovation and social engagement.

7. The scarce involvement of civil

Almost everywhere in Europe, a scarce involvement of **civil society organisations** and **Third sector enterprises** in research can be noticed (with some remarkable exceptions, such as associations of disabled people or chronically ill persons as well as many environmental groups) while they often seem to express distrust in scientific and technological research. 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**.

[O]

OPERATIONAL INDICATIONS

On the basis of the research activity carried out within SS-ERC and the experimentation's results (box 6.3.), some **operational indications** can be drawn.

[Box 6.3]
THE EXPERIMENTATION: SOME RESULTS

As already said, the experimentation on the socialisation of innovation concerned a research group specialised in mechanical engineering based at the Tor Vergata University in Rome. Established at the end of the 90s, the group has always shown a strong orientation towards innovation.

This orientation has had an influence on all the aspects of the group's life (culture, organisation, procedures, research activities, resources), making the group particularly proactive and able to keep trust-based relationships with the economic world.

However, in the last years, the growing demands for assistance by enterprises have been met by the research group with increasing difficulty.

Therefore, it was decided to use the experimentation for identifying the main obstacles affecting the group's life and for designing and activating, through the full involvement of all the group's members, a new organisational structure enabling the group to better exploit the research results and to keep the main efforts concentrated on high-profile research programs.

The experimentation allowed us to show some important aspects involved in the university-enterprise interaction. Most of them are dealt with in this chapter. However, three of them deserve to be mentioned here.

- **Focusing on innovation**. Innovation required the mobilisation of high levels of motivation, passion, interest, curiosity and personal engagement. This is not in opposition to research activity and it is compatible with it. In many case, research and innovation are fully merged in the identity of the research groups. However, when one of the two dimensions – research or innovation – starts to be perceived as a by-product of the other or to be instrumentally used for the benefit of the other, there is the risk that the non-dominant dimension is carried out with decreasing level of commitment and quality.

- **Innovation and fundamental research**. The focus on application of research results is also not in opposition to fundamental research. Certainly, the balance among them could vary widely. However, matching the knowledge demands expressed by enterprises, in many cases, could boost the fundamental research carried out by a research group. During the experimentation, this fact clearly emerged; some lines of theoretical enquiry were triggered by the demands for practical solutions advanced by some firms and continued also after these demands were accomplished.

- **Innovation and a research group's style.** Each research group seems to be characterised by a specific "style", i.e. an approach to research and innovation, based on e.g. specific representations, routines, procedures, professional habits and languages shared by the group's members. The group's style tends to embed tacit and informal knowledge and know-how generated by the group itself. This style often concern key aspects of innovation, such as how to manage the relationships with enterprises, how to organise the work in order to match the expectations of the firms or how to speak to companies' managers. Being more aware of, making explicit and better sharing this "style" could be particularly important for enhancing the group's performances and for transferring it to younger researchers.

1. Strengthening the orientation towards innovation among research institutions

Overall, the action of research institutions towards innovation is still weak and asystematic. In many cases, what is lacking is the capacity of research institutions to mobilise for innovation all the components of the organisation (researchers, research managers, heads of departments, technical personnel, administration, etc.). In this framework, creating organisational units specialised in technology transfer is not enough; it is equally important to shape and diffuse within the research institutions an overall orientation towards innovation permeating its core strategies and structures. Among the possible measures to be taken, we can mention here, as examples:

Evaluating the capacity of innovation

- **adopting mechanisms and procedures allowing research institutions to evaluate their own capacity of innovation**, singling out the hindering factors within the organisations and in the social and economic context, in order to take appropriate measures;

Increasing the social and academic value of innovation

- **fostering an increase in the social and academic value of innovation**, through measures such as higher recognition of innovation-related activities in the scientific careers, sensitisation activities on innovation among researches and students, economic incentives to innovation projects, promotion of thesis on innovation, the establishment of awards or other highly symbolic initiatives;

Developing capacities and know-how

- **developing and diffusing within research institutions capacities and know-how necessary to promote research-industry links**, pertaining e.g. legal aspects, communication with enterprises, organisational aspects related to technology transfer; in this perspective, it seems to be particularly effective to include innovation-focused teaching within scientific faculties;

Promoting the innovation scouting

- **promoting within research institutions actions aimed at the innovation scouting**, i.e. a context related and focused search for new ideas, solutions, products, processes or technologies; this should include a stronger communication between natural sciences and social sciences; one of the main first objectives to be pursued is that of "drawing research results out of the researchers' drawers", allowing their assessment in terms of innovation potentials, both in economic and social terms;

Reinforcing the orientation towards the "third mission"

- **reinforcing the orientation of research institutions toward the "third mission",** by promoting a co-ordinated use of all the tools available for the social and economic exploitation of research results (Industrial Liaison office, Technology Transfer Offices, framework agreement with private enterprises and civil society organisations, communication of research results, science-shops, scientific parks, incubators, etc.), sensitising researchers and students on these issues and creating opportunities for debating them.

The majority of these orientations are addressed to research institutions. For some aspects, national governmental institutions should play an important role.

2. Attracting enterprises to scientific and technological research

A big effort should be made for **attracting the 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. Among the possible measures, we can mention here:

Generating new knowledge on the enterprises' orientation towards research

- **generating new knowledge on enterprises' orientation towards research,** both through specific research projects at local or national levels and through a second-tier exploitation of the knowledge already available; this could help research institutions and intermediate innovation agencies to devise more targeted strategies;

Sensitising enterprises on research and innovation

- **promoting co-ordinated sensitisation initiatives on research and innovation** involving enterprises and other economic actors; this could also entail an open debate on tools, strategies and procedures presently adopted in connecting enterprises to research institutions, in order to develop new ones;

Providing enterprises with advice in research and innovation

- **facilitating the access of enterprises to advice services specialised in research and innovation,** with special reference to university-enterprise links, science-based innovation, assessment of technological needs, innovation clusters, access to public funds for innovation; a proactive role could be performed by industrial federations;

Promoting specific

- **promoting specific initiatives addressed to SMEs and micro-enterprises**, which seem to meet major problems in co-operating with research institutions and even to understand the pivotal role played by research in innovation; this is particularly important, taking into account the weight of SMEs and micro-enterprises in the European national economies; the main aspect to cope with is that of supporting SMEs and micro-enterprises to "create a demand for knowledge" having a sufficient "critical mass" to justify investments on university-industry partnerships; again, an important role could be played by industrial federations.

actions addressed to SMEs and micro-enterprises

These orientations are mainly addressed to enterprises, enterprises' networks, industrial federations and university-industry intermediate agencies. For some aspects, the managers of research institutions could be concerned as well.

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 (an important example is provided in box 6.4.). However, as already pointed out, this relation still appears to be **weak and of low quality**. Therefore, some initiatives might be taken specifically aimed at improving the interactions between research institutions and the private sector. Among the possible measures, the following can be cited:

Opening up research institutions to enterprises

- **opening up research institutions to enterprises,** involving entrepreneurs and firms' managers e.g. in teaching activities, in planning research projects, in the placement of young researchers, in hosting Phd students, and using the broad range of existing tools (workshops, agreements, training stages, research partnerships, etc.);

Developing specific professional figures

- **developing specific professional figures in the domain of university-enterprise relationships**, creating new specific posts within research institutions, research and innovation networks, "hybrid" entities or enterprises' associations; this process entails a detailed analysis of the complex links connecting university and private sector and the roles, functions and tasks really involved with them;

Developing context-driven science-based innovation policies

- **developing context-driven science-based innovation policies**, which could take into account the specific features of the research institutions, enterprises and other actors involved in that specific context, avoiding tokenism, abstract recipes, fully imitative models and unrealistic solutions;

Promoting informal interactions

- **feeding informal interactions among researchers and enterprise managers**, based on trust and face-to-face relations, which appear to be sensibly more effective than formal and merely institutional ones; in this perspective, the establishment of physical and virtual places where researchers and managers could informally meet each other should be promoted (e.g. creating mixed associations and networks, placing university institutions within industrial areas and industries close to research institutions; promoting the participation of researchers to industrial and trade fairs and meetings and vice-versa);

Mapping obstacles and success factors

- **mapping, assessing and monitoring the success factors and the hindrances** in the domain of university-industry links, developing specific procedures and criteria well tailored to the specific context;

Promoting experimental initiatives

- **promoting experimental initiatives** aimed at continually improving approaches and tools to university-enterprise co-operation, applying a European perspective, using benchmarking strategies and supporting institutional learning processes.

These orientations are addressed both to research institutions and to economic actors, including innovation agencies and industrial federations.

[Box 6.4] RESPONSIBLE PARTNERING

"Responsible Partnering is a voluntary code of conduct for innovative companies and public research institutions to enable them to collaborate more effectively (...) developed by experienced practitioners of collaborative research from 4 European associations representing the needs of Industry (EIRMA), Research & Technology Organisations (EARTO), Universities (EUA) and Knowledge Transfer Organisations (ProTon Europe), with the support of the European Commission.

Two principles underpin Responsible Partnering: the principle of Maximum Beneficial Use of Public Research (benefits appear only when knowledge is disseminated and put to productive use) and the principle of Responsible Use of Public Research (with respect both to the relations among partners and to the relation of the partners towards the public at large).

In order to develop these principles into action, ten guidelines are identified.

Aligning interests - Effective knowledge and skills transfer depends upon being able to align the partners' interests. (…)

Treat collaboration strategically - It is important to make a strategic decision about the part that collaborative R&D and knowledge transfer will play in meeting the PRO's or company's objectives. Explicit policies are required and steps have to be taken to ensure that these policies are communicated, understood and acted upon.

Organise for lasting relationships - There is strong evidence that effective collaborative programmes happen within long-lasting relationships. (…) Responsible Partners organise themselves in ways that make likely the emergence of these lasting relationships.

Provide the right professional skills - Effective management of collaborative R&D and knowledge transfer requires high quality professional supporting skills. Responsible Partnership requires commitment to establish these resources and to train people to an appropriate level.

Establish clear intent – (...) Responsible Partnership requires the early adoption of open processes that establish clear intent and eliminate hidden agendas and abuse of bargaining power.

Use standard practices and communicate regularly - (…) Responsible Partners share good practices and interact regularly, at a high enough level and as part of professional management development.

Achieve effective Intellectual Property – (…) Responsible Partners protect their Intellectual Property in ways that facilitate value creation in a context of Open Innovation, and use (and contribute to improving) public IP systems in ways that encourage future investment in public and private research.

Provide relevant training – (...) Responsible Partners develop appropriate programmes and safe learning environments to learn the skills and common language appropriate for the world of open innovation.

View innovation as a trans-disciplinary activity – (...) Responsible Partners recognise this transdisciplinary nature of innovation and organise themselves accordingly".

Excerpt from EU, EIRMA, EUA, EARTO, ProTon (2005) *Responsible Partnering. Joining Forces in a World of Open Innovation. A Guide to Better Practices for Collaborative Research and Knowledge Transfer between Science and Industry*, Brussels.

For a long time now, European institutions (mainly through the Regional Development Funds), national governments and local authorities have been promoting local development initiatives relying upon the full actualisation of local tangible and intangible potentials. However, the **involvement of research institutions in 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:

Establishing territorial coalitions pivoted on research

- **promoting the establishment of local development territorial coalitions** interested in supporting and orienting research and pivoted on science-based innovation initiatives; these coalitions could recognise to research institutions a leading role, in co-operation with the other stakeholders; this could entail a specific effort aimed at creating around research institutions a network of concerned actors;

Inserting research institutions in the existing development initiatives

- **encouraging the participation of research institutions in the existing local development initiatives** (technological districts, innovation networks, etc.) directly involving research groups and research departments, applying flexible but well defined strategies;

Enhancing the capacity of local authorities

- **enhancing the capacity of local authorities** in designing, managing and evaluating science-based local development programs; this necessitates an increasing capacity of local authorities in connecting research with other territorial policies (such as those pertaining to infrastructures, social development, environmental protection, education, or urban development);

Providing information on local research institutions

- **promoting a broad and continuous information** about the research institutions (university, public research agencies, private research structures, non-profit research centres, etc.) operating in the local environment, with special attention to their research activities, the problems they are coping with, their actual and potential involvement with local development initiatives.

These operational indications are addressed to a wide range of actors, i.e. all those having an impact or playing a role on local development. An important role could be assumed by local authorities.

5. Broadening social dialogue on science and technology

As already stressed, social dialogue is not only to be understood as a tool for a necessary democratisation of the decision making processes involving research. More practically, social dialogue should also be viewed as a necessary step for creating the "social environment" allowing enterprises, stakeholders and research institutions to develop a "habit of interaction", to learn to communicate with each other and to share and exchange ideas, representations and points of view about innovation, research and local development. Among the main measures to be taken, the following ones can be suggested:

Involving civil society organisations with science-based innovation

- **promoting initiatives aimed at a stronger and more diffused engagement of civil society organisations with science-based innovation**; in this perspective, joint cooperation initiatives mobilising research institutions, enterprises and civil society organisations are to be promoted, creating ad-hoc procedures or using and modifying the existing ones (e.g. for example, those usually applied for technology transfer such as spin-off, Industrial Liaison Offices or Technology Transfer Offices);

Diffusing the already tested tools of social dialogue

- **facilitating the diffusion at national and local levels of the already tested tools of social dialogue on science and technology** such as deliberative opinion polls, citizens' juries and panels, standing consultative panels, consensus conferences, internet dialogues and focus groups, which are still applied in a very small number of cases and social or institutional contexts; a larger and more targeted diffusion on data and information on them therefore seems to be necessary;

Enlarging the use of ICTs for social dialogue

- **enlarging the use of ICTs in support of social dialogue for innovation**, creating a virtual environment allowing enterprises, research institutions, civil society organisations, local authorities and other stakeholders as well as the public at large to be part of the process, according to a principle of scaling-up the usual social dialogue instruments and procedures;

Promoting sensitisation on social dialogue

- **promoting sensitisation initiatives on social dialogue** among all the relevant actors, as a necessary step to be taken for boosting and qualitatively improving science-based innovation programs at the local or regional levels; specific professional figures specialised in designing and managing social dialogue and innovation programs could also be identified and developed;

- **increasing the diffusion of technological forecasting exercises**, as one of the primary tools providing possible frames for both orienting science-based innovation programs and promoting new innovation-oriented partnerships and networks;

- **favouring the development of forms of "technological responsibility"**, i.e. a voluntary orientation by research actors, stakeholders or individuals to "play their own part" in support of scientific and technological development, in helping research institutions to drive their own actions, in encouraging a responsible use of research results and in fostering a larger involvement of people in decision and policy making activities pertaining to science, technology and innovation; the tools to be used vary very much, according to the context, the objectives pursued and the actors involved; possible tools to mention can be, as examples, the creation of new voluntary organisations, umbrella organisations, forums and networks, the promotion of sensitisation campaigns, the implementation of action-research projects on social dialogue on science; the launch of participative assessment exercises addressing the problems met in scientific and technological research and innovation, at the local or national levels.

Diffusing technological forecasting

Developing forms of technological responsibility

These operational indications are addressed to a wide range of actors both at the local level (research institutions, civil society organisations, local administrations, local enterprises associations, etc.) and at national level (ministries, national agencies, national research councils, etc.).

[S]

SOURCES OF INFORMATION AND FURTHER READINGS

A list of possible sources of information in order to elaborate the issues dealt with in this section is provided.

Associations

EARTO – European Association of Research and Technology Organisations. EARTO is the European trade association representing over 350 Research and Technology Organisations (RTOs) from across Europe (www.earto.org).

EIRMA - European Industrial Research Management Association. EIRMA is an independent, not-for-profit organisation which deals with the effective global management and organisation of business R&D and innovation within a European perspective (www.eirma.org)

IASP - International Association of Research Parks. The IASP is the worldwide network of Science and Technology Parks, connecting Science Park professionals from across the globe and providing services that drive growth and effectiveness for their members (www.iasp.ws)

IAMOT - International Association for Management of Technology. IAMOT is an international association of professionals in the field of Management of Technology from all over the world (www.iamot.org)

ISPIM - International Society for Professional Innovation Management. ISPIM is a worldwide network of academics, business leaders, consultants (and other professionals involved in Innovation Management. ISPIM's goals are to create a worldwide network of excellence in the field of innovation management, to enhance collaboration between its members and to be at the forefront of research on innovation (www.ispim.org/)

ISSNET - International Science Shops Network. ISSNET promotes the diffusion of Science Shops, e.g. small entities within research institutions and universities that carry out scientific research in a wide range of disciplines – usually free of charge – on behalf of citizens and local civil society (www.scienceshops.org)

TII - European Association for the Transfer of Technologies, Innovation and Industrial Information. Europe's premier independent association of technology transfer and innovation support professionals, involving firms, universities and individual professionals (www.tii.org)

Websites

FORERA (Foresight for the European Research Area) Action website. Provides information and material on science and technology foresight (forera.jrc.ec.europa.eu)

Innovations Report. Forum on Science, Industry and Business. Innovation report is a research, industry and business platform that promotes dynamic innovation and networking. It offers up-to-date R&D results and information on leading-edge technologies, processes, products and services. (www.innovations-report.com/home.php)

Industrial Research and Innovation website. Managed by European Commission's Joint Research Centre, offers information on industrial research, development (R&D) and innovation and of the relation between R&D, innovation and economic performance (ri.jrc.ec.europa.eu/)

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

A NEW SETTING FOR DEALING WITH SCIENCE AND TECHNOLOGY

As an effect of the overall shift from industrial to knowledge society, the **ways in which scientific and technological research** is produced are profoundly changing: boundaries among disciplines are weakening; application fields are multiplying; research is required to be more effective, fast, accountable, trans-disciplinary, result-oriented and able to generate benefits for people and firms. Moreover, a strong intensification of science-society relationships is also occurring, at multiple levels: an increasing number of actors and stakeholders are involved in research production; pervasiveness of technology tends to render users an active part in technological development; new democratic and ethical issues are emerging.

These transformations have taken place in a very short time span and often in a chaotic and contradictory way. While traditional social and institutional mechanisms to orient research and regulate science-society relationships appear to be increasingly ineffective, new ones find it hard to emerge. As a consequence, research seems to be less embedded into society than in the past, while its social recognition and acceptance remains unstable and uncertain.

All this can be viewed in the perspective of the **socialisation of scientific and technological research**, that is, the capacity of science and innovation systems to adapt to a changing society and to manage and steer the transformations affecting them. Poorly socialised scientific and technological research is destined to decrease as regards quality and significance of results or to remain a foreign body with respect to the rest of society. Similarly, a society where science is poorly socialised runs the risk of lagging behind.

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 to each other. On the contrary, the perspective of science and technology socialisation could provide a support in analysing and facing them as a whole, as expressions of a single overall profile of science-society relations.

ORIENTATIONS FOR INTERPRETING

Besides being a **descriptive** concept of the overall approach and the interconnectedness between S&T at all levels, socialisation has a **prescriptive** meaning too. In fact, socialisation can be viewed as an **objective for the European research systems**, implying strengthening science-society relationships as well as better addressing and exploiting social dynamics increasingly involved in the research process.

In this perspective, **specific socialisation policies** should be devised at national and European levels in support of the current science and innovation policies, capable of, on the one hand, assessing science and technology socialisation and, on the other, developing new measures to improve the average socialisation levels within the European Research Area as well as coordinate and improve existing ones. This entails stronger and more open **co-operation** between **social sciences** and **natural sciences,** which should be promoted, by dealing with the multiple cultural, professional and organisational barriers presently hindering this cooperation.

In order to develop effective socialisation policies, European research is required, not to copy other socialisation models (such as those adopted in United States or Asian countries) but to invest in its own **specific 'high-quality' socialisation** of science and technology, which takes into account values embedded in European culture such as sustainability, solidarity, fairness and democracy. In this perspective, an effort is required to identify the relevant **actors**, especially those already engaged in science and technology socialisation, the **arenas** where socialisation issues can be addressed, and the most effective **mechanisms** to find the right solutions.

Developing socialisations policies, however, cannot be done without strengthening a broad public attitude of **technological responsibility**, i.e. a widespread social and individual engagement to guide both how science affects society and how society affects science. Everyone, at different levels, is potentially concerned, from scientific professionals to different public sectors, 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 in support of science and technology.

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

In Part C of the Handbook, some strategic and practical orientations for devising policies, measures and projects aimed at socialising science and technology are provided. These orientations pertain to six main socialisation areas.

Scientific Practices

Socialisation policies, in this area, should be aimed at supporting research groups in coping with research processes which are becoming increasingly difficult to manage. 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). In this framework, improving the quality of research groups and research institutions (in terms of e.g. organisation, conflict prevention, capacity of inner co-operation, etc.), heightening preparation and training of researchers, reinforcing their links with scientific community and the social environment, become priority issues to deal with.

Scientific mediation

This area refers to all researchers' activities, "hooking" research to social environment (mainly at local level). Five main domains of mediation activities can be identified: governance (management, administration, planning, etc.); teaching; networking (with enterprises, civic society organisations, professional organisations, social services, local authorities, science centres, etc.); designing and promoting new projects; managing knowledge (publishing, exchanging knowledge, etc.). Each mediation activity necessarily implies establishing contacts and cooperation with other actors, developing new skills and establishing a broad range of mediation services within research institutions in support of researchers as well as promoting a profound change in the mindset of the key actors.

Scientific communication

Increasing complexity in S&T production and in science-society relations makes scientific communication a pivotal element in socialising science and technology. In this perspective, broadening the approach to scientific communication is necessary, in order to encompass both the communication between science and society and the communication involved with the research process. Some emerging questions are: the rigid hierarchical communication structures of research institutions; the clashing communication styles of different actors; the low capacity, willingness and possibilities of scientists to communicate; the need to create a public "sphere"; the involvement of civil society; the development of a widespread scientific culture.

Evaluation

Evaluation is a powerful science and technology socialisation tool, which is still under-exploited. Evaluation is to be seen as a composite social process, performing multiple functions of a different nature and presently broadening its scope. Consequently, evaluators are also playing multiple roles. There are a set of challenges for evaluation: how to use evaluation effectively to improve research systems; how to enlarge evaluation approaches and competences; how to apply evaluation to support the growing opening up of science to society. These challenges can be successfully met by giving evaluation a central position in policy making, by creating a common evaluation ground in Europe and by developing a new breed of evaluation methods.

Governance

Changing relations between science, technology and society require forms of governance of science and technology that are more responsive to the new mode of knowledge production and open to the involvement of citizens as real stakeholders. Governance mechanisms are expected to balance the need to reinforce science-led innovation with the increasing demands of democracy in science-related policy making, to regulate tendencies toward the commercialisation and privatisation of research, to promote public debate and civic deliberation about scientific and technological research, and to disseminate intelligent and realistic participatory exercises.

Innovation

Linking research to social and economic innovation is a well-established tendency. However, in Europe, it meets many obstacles. In the academic environment, the orientation towards innovation seems to be still very weak, while among firms and civil society organisations, levels of awareness about their own needs for scientific knowledge is often dramatically low. Therefore, a double socialisation process is required: research institutions are asked to be socialised to innovation and enterprises and civil society organisations are required to be socialised to research. Social dialogue on science and technology, understood as a daily habit of interaction, should be the basis for creating research-innovation links. Other key points are: increasing academic recognition of innovation-oriented activities; breaking cultural, linguistic and organisational barriers in university-industry relationships; overcoming the present shortage of specific skills on innovation; increasing the engagement of the third sector in research-based innovation.

REFERENCES

REFERENCES

Arnstein, S. R. (1969) A Ladder of Citizen Participation. *JAIP*, Vol. 35, No. 4, pp. 216-224.

Baker, K.A., Branch, K.M. (2002) Concepts underlying organizational effectiveness: trends in the organization and management science literature. In WREN, *Management benchmarking study*. Washington, DC.: Department of Energy, Office of Science.

Banthien, H, Jaspers, M., Renner, A. (2003) *Governance of the European Research Area: The Role of Civil Society*. Brussels: European Commission.

Bauer, M. (2003) The vicissitudes of 'Public Understanding of Science': from 'literacy' to 'science in society'. *Science meets Society*. Lisbon: Fundacâo Calouste Gulbenkian.

Baumann, Z. (2000) *Liquid Society*. Cambridge: Polity Press.

Beck, U. (1992) *Risk Society: Towards a New Modernity*. London: Sage Publications.

Bell, D. (1974) *The Coming of Post-Industrial Society.* New York: Harper Colophon Books.

Bernal, J. D. (1949) *The Freedom of Necessity*. London: Routledge

Bijker, W. (2003) The Need for Public Intellectuals. A Space for STS. *Science, Technology, and Human Values,* 28 (4); 443-450.

Bijker, W. (2007) American and Dutch Coastal Engineering. Differences in Risk Conception and Differences in Technological Culture. *Social Studies of Science,* 37, 143-151.

Bloor, D. (1991 [1976]) *Knowledge and Social Imagery*. Chicago: University of Chicago Press.

Bourdieu, P. (1984) *Homo Academicus*. Paris: Minuit.

Bourdieu, P. (1987) *Choses dites*. Paris: Minuit.

Bourdieu, P. (2001) *Science de la science et réflexivité*. Paris: Editions Raisons d'Agir.

Bucchi, M. (1998) *Science and the media. Alternative routes in scientific communication*. London: Routledge.

Burns, T. W., O'Connor, D.J., Stocklmayer, S.M. (2003) Science Communication: A Contemporary Definition. *Public Understanding of Science*. p. 183-202,12

Carson, L., Martin, B. (2002) Citizen participation – Random selection of citizens for technological decision making. S*cience and Public Policy*, Vol. 29, No. 2

Castells, M. (2000) *The Rise of the Network Society: The Information Age: Economy, Society and Culture*, Volume I (2nd revised edition). Oxford: Blackwell.

Creighton, J. L. (2005) *The Public Participation Handbook: Making Better Decisions Through Citizen Involvement*. San Francisco: Jossey-Bass.

Dahler-Larsen, P. (2006) Evaluation after Disenchantment? Five Issues Shaping the Role of Evaluation in Society. In Shaw, I. F., Greene, J. C., Mark, M. M. (eds), *The Sage Handbook of Evaluation*. London: Sage Publications.

d'Andrea L., Declich A. (2005) The sociological nature of science communication. *JCOM,* 4(2).

d'Andrea L., Quaranta G., Quinti, G. (2005) *Manuale sui processi di socializzazione della ricerca scientifica e tecnologica*. Roma: CERFE.

Davenport, T.H., Prusak, L. (1998) *Working Knowledge*. Boston: Harvard Business School Press.

de Solla Price, D. J. (1963) *Little Science, Big Science*. New York: Columbia University Press.

Dryzek, J. S. (2000) *Deliberative democracy and beyond: Liberals, critics, contestations*. Oxford: Oxford University Press.

Elam, M., Bertilsson M. (2003) Consuming, Engaging and Confronting Science – The Emerging Dimensions of Scientific Citizenship. *European Journal of Social Theory*, 6(2): 233-51.

Etzkowitz, H., Leydesdorff, L. (1998) The Endless Transition: A 'Triple Helix' of University - Industry – Government Relations. *Minerva*, 36

Etzkowitz, H., Leydesdorff, L. (2000) The dynamics of innovation: From National Systems and 'Mode 2' to a triple helix of university–industry–government relations. *Research Policy,* 29.

European Commission (2002) *Science and Society Action Plan.* Brussels: European Commission.

European Commission (2003) *Brainstorming Workshop on University-Industry Relations*. Brussels: European Commission.

European Commission (2003) *Science Shops. Knowledge for the Community*. Brussels: European Commission.

European Commission (2007) *Taking the European Knowledge Society Seriously* (Working document from an expert group on Science and Governance in relation to Science, Economy and Society). Brussels: European Commission.

European Commission (2007) *The European Research Area: New Perspectives*. Brussels: European Commission

European Commission (2007) *Towards a European Research Area. Science, Technology and Innovation. Key Figures 2007*. Brussels: European Commission.

European Commission (2008) *A more research-intensive and integrated European Research Area. Science, Technology and Competitiveness key figures* report 2008/2009. Brussels: European Commission.

European Commission (2008) *Challenging Europe's Research: Rationales for the European Research Area (ERA). Report of the ERA Expert Group*. Brussels: European Commission.

European Commission (2008) *Opening to the world: International cooperation in Science and Technology. Report of the ERA Expert Group.* Brussels: European Commission.

European Commission (2008) *Reports of the ERA Expert Groups. Executive summaries.* Brussels: European Commission.

European Commission, EIRMA, EUA, EARTO, ProTon (2005) *Responsible Partnering. Joining Forces in a World of Open Innovation. A Guide to Better Practices for Collaborative Research and Knowledge Transfer between Science and Industry.* Brussels: European Commission.

European Research Advisory Board (2005) *The Social Sciences and the Humanities in the 7th Framework Programme.* Brussels: European Commission.

European Research Advisory Board (2007) *Research and Societal Engagement*. Brussels: European Commission.

European Research Advisory Board (2007) *Research Management in the European Research Area. Education, communication and exploitation.* Brussels: European Commission.

Fahrenkrog, G., Polt, W., Rojo, J., Tübke, A., Zinöcker, K. (eds) (2002) *RTD Evaluation toolbox: assessing the socioeconomic impact of RTD policies.* Seville: Joint Research Centre, Institute for Prospective Technological Studies.

Felt, U. (2008) – *Taking European Knowledge Society Seriously*. Speech at the European Conference 'Science en Societé - Dialogues et Responsabilité Scientifique'. Paris, November 2008

Gaskell, G. et al. (2005) Social values and the governance of science. *Science,* (310).

Gaskell, G. et al. (2006) *Europeans and Biotechnology in 2005: Patterns and Trends – A report to the European Commission*. Brussels: European Commission.

Gastil, J., Levine, P. (eds) (2005) *The Deliberative Democracy Handbook: Strategies for Effective Civic Engagement*. San Francisco: Jossey-Bass.

Georghiou, L. (2001) *The Impact and Utility of Evaluation*. Conference on international best practices in evaluation of research in public institutes and universities, Brussels, October 16, 2001.

Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P., Trow, M. (1994) *The new production of knowledge: the dynamics of science and research in contemporary societies*. London: Sage Publications

Giddens, A. (1991) *Modernity and Self-Identity: Self and Society in the Late Modern Age.* Stanford: Stanford University Press.

Gieryn, T.F., (1983) Boundary Work and the Demarcation of Science from Non-Science: Strains and Interests in Professional Ideologies of Scientists. *American Sociological Review*.

Gieryn, T.F., Boundaries of Science. In Jasanoff, S. et al. (eds.) (1995) *Handbook of Science and Technology Studies*. Thousand Oaks: Sage Publications.

Grablowitz, A., Delicado, A., Laget, P. (2007) *Business R&D in Europe: Trends in Expenditures, Researcher Numbers and Related Policies*. Brussels: JRC/IPT/Erawatch.

Granovetter, M. S. (1973) The strength of weak ties. *American Journal of Sociology,* vol. 78, nº6, pp. 1360-1380.

Gregory, J., Miller, S. (2000) *Science in public: communication, culture, and credibility*. Cambridge: Basic Books.

Guba, E.G., Lincoln, Y. S. (1989) *Fourth Generation Evaluation.* Newbury Park, CA: Publications.

Hackett, E.J. (2005) Essential tensions: Identity, Control and Risk in Research. *Social Studies of Science*, 35.

Hakkarainen, K., Lonka, K., Paavola, S. (2004) *Networked intelligence: How can human intelligence be augmented through artefacts, communities, and networks?* Paper presented at the Scandinavian Summer Cruise at the Baltic Sea

Holsapple, C.W. (2004) *Handbook on Knowledge Management*. 2nd Edition. Berlin: Springer-Verlag.

Hutter, B.M. (2006) Risk regulation and management. In Taylor-Gooby, P., Zinn, J. (eds.), *Risk in Social Science*. Oxford, UK: Oxford University Press.

Irwin, A. (2001) Constructing the scientific citizen: science and democracy in the biosciences. *Public Understanding of Science*, vol. 10, no. 1.

Jamison, A., Ostby P. (eds.), (1997) *Public Participation and Sustainable Development – Comparing European Experiences*. Aalborg: Aalborg Universitetsforlag,

Jasanoff, S. (2005) *Designs on Nature. Science and Democracy in Europe and the United States.* Princeton: Princeton University Press.

Jasanoff, S. (1990) *The Fifth Branch: Science Advisers as Policy Makers.* Cambridge, MA: Harvard University Press.

Kalpazidou Schmidt, E. (2006) RTD Evaluation and Policy in the European Research Area. *Evidence & Policy, a Journal of Research, Debate and Practice,* May 2006, vol. 2, issue 2, pp 185-209.

Kalpazidou Schmidt, E. (2008) Research management and policy: Incentives and obstacles to a better public-private interaction. *The International Journal of Public Sector Management,* vol. 21, nº6.

Kalpazidou Schmidt, E., Krogh, E., Langberg K. (2003) Innovation and dynamics in public research environments in Denmark: a research-policy perspective. *Science and Public Policy*, vol. 30.

Kass, G. (2000) Science and citizens – Public debate on science and technology: issues for legislators. *Science and Public Policy*, Vol. 27, No. 5.

Kuhlmann, S., Boekholt P., Georghiou L., Guy L., Héraud J-A., Laredo, P., Lemola, T., Loveridge, D., Luukkonen, T., Polt, W., Rip, A., Sanz-Menendez, L., Smits, R. (1999) *Improving Distributed Intelligence in Complex Innovation Systems*. Brussels and Luxembourg: Office for Official Publications of the European Communities.

Kuhn, T. (1996 [1962]) *The Structure of Scientific Revolutions.* Chicago: University of Chicago Press.

Laredo, P., Mustar, P. (2000) Laboratory Activity Profile: an Exploratory Approach. *Scientometrics*, Volume 47, N. 3.

Lash, S. (2002) *Critique of Information*. London: Sage Publications.

Latour, B. (1987) *Science in Action.* Cambridge: Harvard University Press.

Levidow, L., Marris C. (2001) Science and governance – Science and governance in Europe: lessons from the case of agricultural biotechnology. *Science and Public Policy*, Vol. 28, No. 5.

Lewin, K. (1948) *Resolving Social Conflicts: Selected Papers on Group Dynamics*. New York: Harper & Row.

Limoges, C. (1996) *L'université à la croisée des chemins: une mission à affirmer, une gestion à réformer*. Quebec: Actes du colloque ACFAS.CSE.CST, Gouvernement du Québec Ministère de l'Éducation.

Longino, H.E. (1990) *Science as social knowledge. Values and objectivity in scientific inquiry*. Princeton: Princeton University Press.

Lyotard, J-F. (1984) *The Postmodern Condition*. Manchester: Manchester University Press.

Martínez, M. (2008) Complexity and participation: the path of strategic invention. *Interdisciplinary Sciences Reviews*, vol. 33, nº2, pp. 153-177.

Mejlgaard, N., Stares S. (2009) Participation and Competence as Joint Components in a Cross-national Analysis of Scientific Citizenship. (Forthcoming) *Public Understanding of Science*, 18(4).

Merton, R. (1973) The Normative Structure of Science. In: *The Sociology of Science. Theoretical and Empirical Investigations*. Chicago: University of Chicago Press (267-278).

Montefalcone M. (2006) Università e impresa. Un dialogo difficile. *Conoscenza e innovazione*, n.1/06.

Mouffe, C. (1999) Deliberative Democracy or Agonistic Pluralism? *Social Research*, 66(3): 745-58.

Nowotny, H. (2006) Real science is excellent science – how to interpret post-academic science, Mode 2 and the ERC. *JCOM*, 5 (4).

Nowotny, H. et al. (2001) *Re-Thinking Science - Knowledge and the Public in an Age of Uncertainty*. Cambridge: Polity Press.

Nowotny, H. et al. (2005) *The Public Nature of Science under Assault*. Berlin: Springer.

Nye, J.S., Donahue J.D. (2000) *Governance in a globalizing world.* Washington: Brookings Institution Press.

Parvan, S.V. (2007) Is Europe growing more innovative? Eurostat Community Innovation Statistics, *Statistics in Focus, Science and Technology*, 6.

Parvan, S.V. (2007) Weak link between innovative enterprises and public research institutes/universities, Eurostat Community Innovation Statistics, *Statistics in Focus, Science and Technology*, 81.

Patton, M.Q. (1997) *Utilization-Focused Evaluation: The new century text.* Thousand Oaks, CA: Sage.

Plattform Forschungs- und Technologieevaluierung 2006. Special Edition, nr 28, New Frontiers in Evaluation. Vienna, Austria.

Popper, K. (2002 [1963]) *Conjectures and Refutations: The Growth of Scientific Knowledge*. London: Routledge.

Quaranta, G., (2007) Knowledge, responsibility and culture: food for thought on science communication. *JCOM*, 6 (4).

Reardon, J. (2001) The Human Genome Diversity Project. A Case Study in Co-production. *Social Studies of Science*, 31 (3), 357-388.

Renn, O. (2008) *Risk Governance – Coping with Uncertainty in a Complex World*. Earthscan.

Rip, A. (2003) Societal challenges for R&D evaluation. In Shapira, Ph., Kuhlmann, S. (eds) *Learning from Science and Technology policy Evaluation. Experiences from the United States and Europe*. Cheltenham UK, Northampton, MA, USA: Edward Elgar.

Robertson, R. (1995) Glocalization: Time-Space and Homogeneity-Heterogeneity. In Featherstone M., Lash, S., Robertson, R. (eds), *Global Modernities*. London: Sage Publications.

Rossi, P. H., Lipsey, M. W., Freeman, H. E. (2004) *Evaluation: A Systematic Approach.* Thousand Oaks, CA: Sage Publications.
Santos, B. de Sousa (ed.) (2003) *Conhecimento Prudente para uma Vida Decente. 'Um Discurso sobre as Ciências' revisitado.* Porto: Afrontamento.

Scanlon, E., Whitelegg, E., Yates, S. (2006) *Communicating science. Contexts and channels*. London: Routledge.

Schofer, E. (1999) The Rationalization of Science and the Scientization of Society: International Science Organizations, 1870-1995. In Boli, J., Thomas, G. (Eds.), *Constructing World Culture: International Nongovernmental Organizations Since 1875.* Stanford: Stanford University Press.

Science and Public Policy (2005). Special Issue on Evaluation of European Union Framework Programmes: the 2004 Five-

Year Assessment, vol. 32, no 5, October 2005.

Scott, P., Gibbons, M. (2003) 'Mode 2 Revisited': The New Production of Knowledge. *Minerva*, 41.

Scriven, M. (1991) *Evaluation Thesaurus*. Fourth edition. Thousand Oaks, CA: Sage Publications.

Shadish, W.R., Cook, T.D., Leviton, L.C. (1991) *Foundations of Program Evaluation.* Newbury Park: Sage Publications.

Shaw, I.F., Greene, J.C., Mark, M.M. (eds) (2006) *The Sage Handbook of Evaluation.* London: Sage Publications.

Siune, K., Kalpazidou Schmidt, E. (Eds) (2003) *The uses of evaluations in Europe*. Report from the European RTD Evaluation Network meeting, Report 2003/2. Aarhus: Danish Institute for Studies in Research and Research Policy.

Spaapen, J., Dijstelbloem H., Wamelink F. (2007) *Evaluating Research in Context. A method for comprehensive assessment.* Second edition. Consultative Committee of Sector Councils for Research and Development (COS), the Netherlands, the Hague.

Suares, M. (1996) *Mediación. Conducción de disputas, comunicación y técnicas.* Buenos Aires: Paidós.
Treise, D., Weigold, M. F. (2002) Advancing Science Communication: A Survey of Science Communicators. *Science Communication*. p. 313. 23.

van Kersbergen, K., van Waarden, F. (2001) *Shift in Governance: Problems of Legitimacy and Accountability*. Haag: Social Science Research Council.

Vedung, E. (1997) *Public Policy and Program Evaluation*. New Brunswick, NJ: Transaction Publishers.

Villasante, T. R. (2006) *Desbordes creativos. Estilos y estrategias para la transformación social.* Madrid: La Catarata.

Vinther, T., Siune, K. (2000) *Danske TV-nyheders dækning af forskning og udviklingsarbejde,* Rapport 2000/2 udg. Aarhus: Analyseinstitut for Forskning;

Weiss, C. (1998) *Evaluation.* 2nd edition. Upper Saddle River: Prentice Hall.

Wilden, A. (1987) *The Rules Are No Game. The Strategy of Communication.* New York: Routledge.

Wilson, A. (1998) *Handbook of Science Communication*. London: Taylor & Francis, Institute of Physics Publishing.

Woolgar, S (1991) Configuring the User – the case of usability trials. In: Law, J. *A sociology of monsters – Essays on Power, Technology and Domination.* London: Routledge (58-99).

Woolgar, S. (1988) *Science: The Very Idea.* London: Routledge.

Ziman, J. (2000) *Real Science. What it is, and what it means*. Cambridge: Cambridge University Press.

WHAT'S THE LINK

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Between 1860 and 1870, the forerunner of Impressionists Manet made the first attempt to liberate the perception in painting from any prejudice or conventionality and to manifest it in its fullness of cognitive act. It was an overcoming of the 'classical' and the 'romantic' as poetics addressed to mediate, influence, guide the artist's relationship with reality.

The programme was not clear, but there was an explicit guidance to realism, as will to express the perception, the feeling of light and the transparency of the atmosphere and water in the most immediate way and with a rapid technique without touching up. His aim was to represent landscapes and works en plein-air, with natural chromatic touches of colour, regardless of any nuance of chiaroscuro and avoiding the use of black to dark colours in shadow.

These techniques, especially the use of coloured shadows and the relationship between complementary colours, derived from the Chevreul's optical theory on simultaneous contrasts. However, a decisive step towards giving the painting a foundation in the scientific laws of the vision, there will only be with the Neo-Impressionism of Seurat and Signac in 1884.

The attempt of these latter was to go beyond Impressionism and the mere appeal to sensory perception, and to meet the need for a more direct relationship between science and art. Concerning this relationship «*there were three hypothesis: 1) scientific process and artistic process tend to the same cognitive result, and then one of two is redundant and it is to choose the best, [and if this were true, the art should succumb]; 2) the art has a purpose and a function completely different from those of science,[it has therefore, no methodological control]; 3) both lead to equally valid results in terms of knowledge, but different, and then we must clearly distinguish what you know by science and what you know by art*» (Argan, 2002).

In essence, the purpose is not to create a scientific painting, but to establish a science of painting, to put the painting as a science in itself: the theoretical content of Neo-impressionism is derived from science, art aims to objective knowledge (as well as science), but its task is to experiment and verify the propositions of science, facing problems that traditional scientific methods cannot solve, with a new technique, the *pointillism*.

Seurat reads a series of six articles by the theorist and painter David Sutter, published in the journal "The Art" with the title of *Phénomènes de la vision*, thus improving his positivist belief of linking the science to the creativity of the art: «*It's necessary to observe nature through the eyes of the spirit and not just with the eyes of the body, as a being devoid of reason [...] there are eyes of a painter as well as voices of a tenor, but these natural gifts have to be fed by science to reach their full development [...] science free from all doubts, can move freely in a very extended field; so it is a double insult to the art* *and science believing that one necessarily excludes the other. As all rules are inherent in the laws of nature, nothing is easier than identifying its principles, and nothing is more indispensable. In the art, everything must be sought*» (Argan, 2002).

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References

F. Minervino, *L'opera completa di Seurat*, Rizzoli, 1972

G. C. Argan, *L'arte moderna. 1770-1970*, Sansoni, 1970

Websites

The Art Institute of Chicago

http://www.artic.edu/aic/collections/artwork/27992

Wikipedia

http://it.wikipedia.org/wiki/Georges_Seurat

http://en.wikipedia.org/wiki/Georges-Pierre_Seurat