# THE FUTURE OF KEY ACTORS IN THE EUROPEAN RESEARCH AREA: SYNTHESIS PAPER

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**Contribution to the DG Research Expert Group on The Future of Key Actors**

## ABSTRACT

Many of the conclusions of this synthesis report are fully consistent with the directions of current research policies. The work of this High Level Expert Group on the Future of Research Actors (RA) in the European Research Area (ERA) highlights the importance of efforts, already well underway, to reinforce the functioning of the ERA as an integrated base that overcomes a wide range of geographic, institutional and disciplinary barriers to the both the competition and sharing of knowledge. Knitting together the different European research actors into a more transparent and diversified whole would seem to be one of the best ways to create a stronger platform for knowledge creation and diffusion. A less anticipated conclusion, and less part of the existing consensus, is that simply pursuing the ambition of multiplying the number of effective research platforms in Europe may miss a key part of tomorrow's research agenda. The in-depth expert papers on the eight different research actors of the ERA, the insights arising from the synthesis developed in this paper, and the analytical results of a rare scenario pooling exercise, all *point very clearly to the risk that current policies are excessively technology centric and may miss crucial emerging attributes of research and research actors in the knowledge society*. Thus, over and above the value-added for assessing the direction and implementation of current approaches to improving the production and use of research in Europe, this report recommends new policies aimed at accelerating the development of emergent forms and sources of research. The policy message is that Europe must move beyond industrial-era challenges to embrace those of the knowledge society.

**Further opening, expanding and integrating the European Research Area requires:**

1) Policies that put into practice expanded criteria for designing and funding research programmes for the European Research Area to include user-centred technological, organisational and social innovation.

2) Policies that initiate experiments that validate (quality/trust/transparency) new forms and producers (including individual independent researchers) of knowledge.

3) Policies, both budgetary and regulatory, that create and facilitate both new collaborative environments for research, including user-centred research, and new governance processes.

4) Policies to enhance the capacity of policy makers (including at the regional level) to recognise and facilitate new forms of research and particularly new approaches to the governance of research processes.

5) Policies to abolish national borders for researchers and for students both within Europe and outside Europe.

6) Policies to strengthen the autonomy of universities, including areas so far strictly controlled by most governments such as a university's strategic profile and selection of specialisations.

7) Further research is required regarding the relationship between the changing nature of research and intellectual property rights (IPR).

8) Further research is required regarding the functional division of labour amongst different research actors in the context of the emerging "open innovation model".

9) Further research is required in order to describe and analyse the contribution of civil society to research and innovation.

10) Further research is required on how to establish trust in highly complex and diversified knowledge societies.

11) Further research is required to define and measure new forms of innovation, particularly with respect to the innovation related research occurring in the service sector, SMEs and the community (social innovation) that point towards new models of innovation.

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# 1. INTRODUCTION

The mission entrusted to this group is the following: describe the situation of the main research actors in Europe; identify attributes of the present that might frame the evolution of research in the future; construct scenarios that describe distinctive outcomes for research in 2020, from a heuristic perspective; and, finally, based on the preceding elements, draw up public policy recommendations.

Before considering these different points, it is necessary to define the methodology and terms that will be used throughout the report.

At a general level this work conforms to the expectation, articulated by the Lisbon Summit strategy, that knowledge and innovation will become the main sources of wealth creation. The authors of this report take the view that this vision of a more knowledge intensive economy and society calls for a reconceptualization of societal development and hence a renewal of the frameworks proposed by the social and economic sciences.

## SOME DEFINITIONS

Knowledge is defined today as a learning and cognitive capacity. Most importantly, it has to be apprehended in action. This implies a fundamental distinction between information and knowledge. Information consists of explicit formatted data which, unlike knowledge, cannot on its own generate new information. Although it can easily be copied and transported (writing on paper or in digital form), its use always involves the implementation of other knowledge, some of which is partially embodied. For instance, simply reading a scientific article does not allow for the replication of an experiment that, in most cases, requires the mobilization of practical, theoretical, common sense and experience knowledge, not to mention diverse material and organizational investments[1].

Various authors have proposed different typologies of knowledge. Some are based on the source of the knowledge and its format. Traditionally a distinction is made between implicit knowledge (e.g. daily life or common sense knowledge, experience knowledge, local or indigenous knowledge, action knowledge) and explicit knowledge (practical, theoretical or creative knowledge). Other typologies emphasize the context in which knowledge is used, as defined by the knowledge itself (normative and descriptive knowledge, strategic and operative knowledge, scientific and empirical knowledge, past- and future-oriented knowledge). Finally, certain authors focus more on the modes of inscription of knowledge, and thus distinguish between: 'embrained' knowledge (based on certain conceptual and cognitive skills), embodied knowledge, 'encultured' knowledge (built up in the processes of socialization that lead to shared forms of understanding), embedded knowledge (in systemic routines), and encoded knowledge (which can be considered as equivalent to information).[2]

This extension of the concept of knowledge helps to reveal a number of current phenomena. First, it exposes “research actors” that have typically not been included as long as knowledge was essentially defined as codified knowledge produced by basic or applied scientists. Now,

[1] For a synthetic analysis of the subject: Foray, D. (2000). *L'économie de la connaissance* Paris: La Découverte

[2] Amin, A., & Cohendet, P. ((2004). *Architectures of Knowledge: Firms, Capabilities, and Communities* Oxford: Oxford University Press) synthesized these diverse conceptualizations.

as is developed in more detail below, the field of actors engaged in knowledge production expands considerably. Second, the redefinition of the concept of knowledge is accompanied by a redefinition of research activities themselves. If the production of knowledge by researchers mobilizes other knowledge that is varied in nature, in its mode of construction and in its appropriation, this can have multiple impacts on the material, organizational and geographic conditions likely to stimulate that production. Such developments are reflected in recent economic analyses of the growth in the share of intangible capital (education, training, R&D, etc.) and the steady expansion of knowledge-intensive economic activities.

Yet the enlargement of the concept of knowledge may take the analysis even further, beyond the expansion of both the number of actors and of the ways knowledge is actually produced. Reconceptualising knowledge might also allow for the possibility that research, as the generic form of knowledge production, enters into economic and social life in new ways. Such explorations do not undermine more restrictive terms like “scientific research,” which continue to describe both particular research practices, like laboratory experimentation, and particular research results, like codified and peer certified findings. On the contrary, the combined broadening of the range and refinement of the meaning of research can be seen as a way of avoiding confusing different types of knowledge in a period when the boundaries and definitions are being challenged. Indeed, it is hoped that one of the main contributions of this report will be help to avoid the error of allocating all of the increases in the production and circulation of knowledge, often linked to the spectacular development of information and communication technologies, to the past’s more limited set of knowledge categories.

As the expert papers make clear, the greater intensity and incomparably more extensive circulation of both codified and non-codified knowledge, including from scientific sources, is what makes the facilitating role of ICT so apparent. Even ‘laypersons’ now seek and find specialised information, further helping to drive up the demand for ever more efficient information tools. Greater access to information and capacity to network helps, in turn, to propel a virtuous spiral of engagement and democratisation that then generates further investment and innovation in the social and technological infrastructure. A similar self-reinforcing cycle is occurring in the transaction and networking spheres as people pursue their desires to trade, discuss, collaborate and invent. Blogs and wikis, email and chat, all are giving new meaning to the qualitative and quantitative extension of knowledge that may someday underpin a knowledge-based society and economy.

## METHODOLOGY

The group's work adhered to a precise, predefined framework established at the outset by DG Research. Eight 'actors' were chosen as particularly important subjects and a monograph on each was commissioned according to a set structure that consisted of: an introduction that defined the object of analysis and the main concepts used; a description of the present situation; an analysis of the key developments as they appear today; an identification of the major forces likely to impact on future developments; and, finally, scenarios for 2020. The aim of these monographs was to provide a rich and well-documented presentation of the main trends considered pertinent to the evolution of each actor, its missions, its competencies, and its relations with the other actors of the research and innovation 'system'. The most forward-looking part – the scenarios, accompanied by policy recommendations – aims to broaden the range of possible futures. In this respect the scenarios are intended neither to take into account all current constraints nor to draw a path from today leading up to 2020; rather, the scenarios project contrasting worlds in order to allow the assumptions that underpin today’s choices to be examined more explicitly.

The different monographs on which this report is based concern the following research actors (in alphabetical order of the authors' names):

Civil Society – Henning Banthien

Researchers – Andrea Bonaccorsi

Small and Medium Enterprises – Bart Clarysse

Universities – Attila Havas

Research and Technology Organizations – Jos Leyten

Multinational Enterprises – Guido Reger

National Governments – Jari Romanainen

Regional Governments – Luis Sanz

The first versions of these monographs were discussed during a one and a half-day meeting in September 2005. On this basis, a first draft synthesis, aimed at highlighting the 'common disruptive trends for the elaboration of possible future contexts', was drawn up and a framework for the elaboration of scenarios was proposed. At a second meeting in November 2005 an overall discussion was held around comparisons between the different hypotheses that had guided the elaboration of the monographs. This discussion provided a number of complementary elements for the synthesis. A final gathering, to consider the policy implications, was convened for a half day on May 4, 2006.

The structure of the present report corresponds to these different steps. First, there is a synthesis of the monographs highlighting those elements that seem to be the most relevant to an analysis of possible contexts (scenarios) for research fifteen years from now. This first part aims to gather the author's insights about how the present may be setting the stage for possible futures that are not simply a linear continuation of the past. The second part adopts a cross-cutting perspective by identifying the concepts and frames of analysis, common to the different monographs, in order to reveal the emergent realities and descriptive tools that might offer operational insights for decision makers. The third part focuses on mapping the scenarios based on a framework established in the first and second parts. The paper concludes with a number of questions regarding the assumptions that underpin current policy choices and a set of eleven policy recommendations.

A few additional points are worth mentioning at the outset:

Although the monographs followed a set pattern, the Commission left the authors free to choose their own hypotheses and frames of analysis. The idea was to facilitate a proliferation of models, an approach considered advantageous in a creative exercise like this one. Consequently, in order to construct a coherent analysis this synthesis paper does not simply aggregate all of the diverse elements but instead attempts to select those parts that fit into a logical story. Hence the first part of this paper does not claim to cover all the points developed by the monographs but rather proposes a reading that is as exhaustive as possible while still aligning what is presented to the analytical aims discussed above, i.e. identifying the new regimes of production and circulation of knowledge in a knowledge-based society and economy.

The choice of 'actors' to consider is not intended to be exhaustive. For instance, Europe and its institutions have obviously not been treated as such, although they appear in the analyses of other actors. It is moreover necessary to relativise the concept of an actor. As we will see below, each category comprises extremely heterogeneous sub-categories. Furthermore, the idea that the 'actors' defined at the outset can disappear or be completely reconfigured is one of the hypotheses that has been put forward to elaborate the scenarios. This is consistent with the aim of gaining a better understanding of the articulation between the 'institutional' definition of the actors – which is more or less what was opted for in the choice of themes for the monographs – and a 'pragmatic' definition which takes as a starting point the analysis of

activities and effective practices. Exploring this changing articulation and its dynamics helps to expose the emergence of new categories and identities.

## 2. SYNTHESIS OF THEMATIC REPORTS

These different reports are grouped together in three main sets: first the world of researchers and their institutions, then that of firms and, finally, that of collective institutions, including national and regional governments, as well as civil society.

### RESEARCH ACTORS SUMMARY PART A: THE WORLD OF RESEARCH

This part groups together the syntheses of the three monographs on researchers, research and technology organizations (RTOs), and universities, respectively. None of these actors are situated in exactly the same space, they represent complementary points of view on composite realities: for instance researchers are an integral part of RTOs and universities. Moreover, as will become clear below, today's RTOs have two sides to them: they are indeed clearly identified organizations with a history behind them, but they may also be a mode of functioning of research that has been imported by a number of other institutions – which obey other logics – like universities. Hence, rather than considering each monograph as an exhaustive description of an 'actor', the following summaries concentrate those aspects considered most pertinent to the futures oriented task of the HLEG.

#### *RESEARCHERS: KNOWLEDGE PRODUCTION IN TRANSITION (BASED ON THE CONTRIBUTION BY ANDREA BONACCORSI)*

The paper on researchers focuses primarily on people who currently belong to public research systems. Three main themes appear to be central to achieving a dynamic understanding of the research actor as defined by the author: the evolution of the researcher population, transformations in knowledge production, and researchers' relations with 'society'.

#### A CHANGING POPULATION

The population of European researchers is currently facing a demographic problem. As in most sectors, this population is aging, in line with the general trend over the past sixty years. This leads to the expectation that huge numbers of researchers will retire over the next few years and that as a consequence it will be necessary to rapidly recruit new researchers, whose numbers will obviously depend on the resources allocated to R&D, in part contingent on public policies. Some analyses estimate that it will be necessary to recruit 700 000 researchers[3] in Europe by 2010. This recruitment challenge poses a number of problems:

First, students in Europe tend to be turning away from science and technology, especially when it is research-oriented. Some see this as a consequence of the more critical attitude that has developed towards technical 'progress', which is perceived as bringing as many threats as it does hopes. Others stress the lack of attractiveness of careers in these fields in terms of workload, status and pay. In Europe researchers salaries are relatively low when compared to industry or the service sector.

[3] http://europa.eu/abc/europein2005/research_en.htm

In the context of internationalization of higher education and research, the question of remuneration is crucial. In the absence of European policies that take into account stiff competition to recruit the best PhDs and post-docs, many young European researchers are attracted abroad, especially to the US. For the same reasons, this outward migration is not compensated for by sufficient inward migration, both quantitatively and qualitatively. From this point of view, the development of training in English for undergraduate students seems to be essential, since an international approach is important from the first years of university training in order to enhance the attractiveness of the European education system.

The research job market in Europe is fragmented, organized on a national or even local scale, with a low level of competition. Selection takes place in a relatively opaque way, which often favours local candidates. This mode of functioning does not promote international openness and leads to unequal levels of quality. Many authors agree that the broader a market is, the greater its specialization and the higher the overall level of quality. The low level of internationalization of the European research job market is not offset by intra-European mobility, which remains limited due to the rigidity of statuses and organizations, and the absence of systems for managing scientific careers on a European scale, even if young researchers, typically post-doctoral, are much more mobile than they used to be, thanks to a strong European policy. Scientific dynamics and the capacity to innovate, strongly based on the possibility of establishing original links between separate research currents, would undoubtedly be enhanced by active policies to promote mobility.

The prospects offered by research are also limited by the relative absence of diversity in the modes of financing, which is primarily by the public sector. Even if the intrinsically risky nature of research activities argues for a large proportion of public funding, it is worth noting the emergence of different layers in this public funding – regional, national, European – with more relative weight at regional level. Since private and industrial funding remain stable at a low level, one of the questions for the future is the development of funding via private foundations, non-profit associations and NGOs, which seem to be one of the most promising ways of boosting research, considering the increasing involvement of 'civil society' in research activities in general.

## TRANSFORMATIONS IN KNOWLEDGE PRODUCTION

From a general point of view, scientific knowledge is knowledge produced in accordance with accepted protocols (experimental rules, controls) and subject to inter-subjective scrutiny and criticism. As noted in the introduction, this characterization accounts for the specificity of science in a context marked by the emergence of forms of research other than academic, and the emergence of actors (think tanks, patient organizations, consultancy firms, environmental pressure groups, etc.) other than researchers in the research world. It does not imply – as some analysts seem to fear – that all kinds of “research” will be put on an equal footing, or that certification of scientific knowledge will escape from academic actors’ prerogatives. Although, once again, the issue of trust and the legitimacy of both the sources and outcomes of research are now open to greater contest and potentially diversification. This does not, as pointed out earlier, erase the crucial distinction between research activities – which are likely to develop beyond the frontiers of the academic world – and science, which is the output of academic activities, still submitted to rigorous certification processes controlled by academic actors. These distinctions will be considered further in the next section of this paper.

Three attributes of the present may play a role in shaping the context for research actors in the future:

The development of the Web and electronic communication tools facilitates not only the circulation and sharing of knowledge, but also its production. This process can be far more

flexible than it used to be in traditional research settings and involve non-professionals in research, leading to new forms of collective innovation. Yet the way in which intellectual property rights (including contracts and transaction/payment systems) are defined and managed is going to play a crucial part in these developments. Various options (Creative Commons, Open Source model, patent pooling, etc.) are worth assessing and discussing.

For some time now, knowledge production has been described as increasingly multidisciplinary and application-driven. This sometimes leads to confusion. The fact that a project started with certain possible uses being taken into consideration does not necessarily mean that it is a matter of applied, short-term research. In fact, even today a growing part of research is both motivated by applications and involves investigation of fundamental questions. Certain experts have proposed to call the studies that fit this dual characterization 'Frontier Research'[4], in so far as it is set in a fast-growing space at the intersection between basic and applied research. In a way that converges with this development, multidisciplinarity has become possible through the creation of concepts which allow different sets of knowledge to be articulated at deep explanatory levels and not only for applied purposes.

New research domains are developing around information and communication technologies, biotechnologies, materials and nanotechnologies, which are no longer based on access to large physical facilities but on decentralized facilities (e.g. genomic databases, networks of molecular biology laboratories, etc.) or an institutional complementarity (e.g. between hospitals, medical schools and laboratories; between software developers, electronic designers, and communities of users). With this development the question of equipment and devices likely to encourage scientific and technical creativity is set in new terms. Two forms warrant careful examination: the first is based on networking that makes it possible to pool data, tools, models, etc.; the second relates to the platform model which has been put forward by some analysts. The notion of a platform[5] attempts to formalise the attributes of a network insofar as it connects a set of devices, tools, instruments, technologies and discourses which are used by a heterogeneous group of people, ranging from basic scientists to engineers and users, to pursue a specific goal. The heterogeneity of this grouping may lead to the production of new research 'entities', new technologies and new practices, in short, trans-disciplinary built-in innovation.

Having noted these disparate developments does not answer the question of the capacity of the research system, as currently constituted or through its institutional and organizational innovations, to support or anticipate the reconfigurations that might arise from changes in the conduct of researchers' day-to-day work and their interactions with one another and with other actors.

## RELATIONS BETWEEN RESEARCHERS AND SOCIETY

Relations between researchers and 'society' have intensified in the past few years. The development of a number of controversies in the public sphere has undermined the illusion, harboured by many, that science is able to do away with all uncertainties. It has consequently encouraged the intervention of lay persons on problems that have scientific dimensions, thus leading to a democratization of scientific and technological choices and a demand for accountability. Moreover as will be discussed in more detail in the part on civil

[4] European Commission- DG Research, (2005). *Frontier research. The European challenge. High level expert group.*

[5] Keating, P., & Cambrosio, A. (2003). *Biomedical Platforms. Realigning the Normal and the Pathological in Late-Twentieth-Century Medicine* Cambridge MA: MIT Press

society, many actors in civil society believe that their specific problems are inadequately addressed by researchers and have therefore sought the means to pursue their own research agendas through associations, pressure groups, foundations, and so on.

As a result new forms of expertise are emerging, facilitated by the development of ICT that allows both access to content and contact amongst actors. In many cases this expertise, that in some cases can be considered quasi-professional, is mobilized by researchers in the definition of research activities and innovation. This tendency is expected to intensify in the near future and, in certain cases, it may give rise to collaboration between researcher-innovators and users that go beyond current categories and frameworks.

This strengthening of ties between research and society attests to new and emerging ways of articulating complementary forms of knowledge. It also poses a challenge, related to the potential for confusion as new players and concepts develop, which is how to make sense of these different contributions and ensure that they are integrated in stimulating and creative ways, both in terms of how research is defined and conducted.

The above-mentioned developments all contribute to shaping a context for research that is slightly out of line with classical representations. Researchers can no longer be treated as a population subject to homogeneous organization, structured according to disciplinary divisions, with ties to the social world mediated by administrative and political authorities. On the contrary, there are now a multitude of groups that interact in varied ways, re-arranging or even partially erasing boundaries between disciplines and between different forms of knowledge, science being only one of these forms. The question here, to be addressed in the following parts on institutional forms, is how are organizations adapting to the new types of knowledge creation, diffusion and use?

## *Research and Technology Organizations: reconfiguring research networks, between basic and applied research (Based on the contribution by Jos Leyten)*

Research and technology organizations (RTOs) are generally non-profit organizations that provide innovation, technology and R&D services to a variety of clients (firms, public services, administrations). This makes them 'in-between' organizations: their financing is comprised of both private resources (via contracts, patents and licenses) and public funds; they increasingly straddle applied and basic research, and are thereby engaged in 'frontier research'; and their work has a distinct multidisciplinary dimension that includes the economic and social sciences. This particular positioning is a source of tension, so that the specificity of RTOs depends on a balance being maintained between their diverse components.

RTOs, sensitive to changes in the environments in which they are set, already have a history rich in reconfigurations. Invested with a mission to support industry following the Great Depression in 1929, they turned towards Big Science (nuclear research, mainframe computing, large chemical laboratories and test facilities, etc.) in the post-WWII years and developed generic support activities for scientific and technical research. This was followed by a period (roughly 1970-1985) of research driven by public issues: environmental research, human factors research, public health, and research for industries considered to be of national strategic importance. More recently, reduced public funding has prompted RTOs to increase their share of contract research and, in order to do so, to expand the sphere of their competencies. The following section looks at current developments that may play a role in once again reconfiguring RTOs.

## RTOs AT THE CROSSROADS

Historically and by construction RTOs have tended to encourage multidisciplinarity and have been less constrained by the boundaries between basic and applied research. Consequently RTOs have many assets conducive to playing a strategically important role in the current context. With links to Big Science RTOs have expertise in the development of tools and concepts (mathematical modelling, complex systems theory, etc.) that allow them to articulate and blend the sets of heterogeneous knowledge and technology that are considered to be major sources of innovation today.

RTOs are also well configured to take advantage of the increasing number of actors involved in research and the intensified relations between the scientific community and its environment, as mentioned in the preceding section. Research related controversies and public debates have brought the ties between techno-scientific choices and socio-economic organization into sharp focus. For example in the case of nanotechnologies efforts have been made to incorporate the analysis of socio-economic or 'political' factors very early on in the research process. In addition, firms are increasingly aware of the fact that the end-user plays a decisive part in innovation. Information and communication technologies, in particular, involve active users who often adapt, alter and invent 'tools' to put to expected and unexpected uses. This partly explains the need for much closer collaboration amongst the technology, production, marketing and strategy divisions in companies. Such developments also favour RTOs, even more so than universities, because it corresponds well to the structure and functioning of these 'hybrid' institutions.

## RTO AND NETWORK ORGANIZATION

Innovation that relies on the mobilization of skills, knowledge and widely diverse approaches is part of the development of networked innovation systems and networked R&D. It is becoming difficult for any one actor (company, research institution) to have all of the required resources. Consequently, the various actors focus on certain core competencies or core-products, while engaging in extensive networking with other players in the innovation system. This nevertheless supposes an open innovation regime and a definition of intellectual property rights that allow for the sharing, circulation and collective re-elaboration of knowledge at every point in the network. At the same time, the existence of specific research fields with strong externalities leads certain actors to adopt closed strategies relying on maximum intellectual property rights protection in order to secure the potentially huge profits that can accrue. For RTOs it is likely that the former, open networking approach, is more in keeping with their mission than the narrower proprietary approach.

Another set of reasons for adopting an open networking rather than a property rights strategy is related to the emergence of both highly versatile enabling technologies and mass-customization. As already noted, users are no longer constrained to the selection and adaptation of specific technologies for their own direct use since in the process of using they also 'invent' and develop new technologies or at least new applications that, in turn, define and structure the pursuit of new research agendas. Such developments are already apparent as ICTs advance and as the tools for easy and cheap manipulation of the basic building blocks in bio- and nano-technologies become available to a wider public. If the ICT model is anything to go by, these developments should soon take the shape of a proliferation of innovation in the peripheral and cross-cutting zones of these fields. This implies steady cooperation between different actors (companies, research organizations) to set standards and to be able to cover the service chain linked to any product and maybe also to users or user-representatives. This shifts the nature of research contracts away from binary cooperation to produce clearly delimited objects towards plural links that share a common but often ambiguous objective. Such practices also mean that it is increasingly difficult to dissociate the service provision which constitutes the object of research contracts from the

acquisition of competencies that, up until now, have largely been funded by basic research grants.

In large measure RTOs are well suited at both an operational level and in terms of underlying legal and economic models to take part in these networks and emerging practices. However, the networking imperative is not enough to unambiguously define RTOs' strategies. The weakening of public financing and the internationalization of R&D confront RTOs with many possibilities and choices, not all of which can satisfy the constraints imposed by statutory and/or partnership arrangements. Given the pressure to achieve levels of excellence in keeping with the standards of international competition RTOs are being driven to seek out very specific niches or even engage in an active policy of participation in similar foreign organizations that have competencies in the targeted sectors. This entrepreneurial strategy, partly necessitated by the reduction of public financing, entails a risk for RTOs should they pick the wrong niche or end up withdrawing, to some extent, from the local, regional or national economy. Such moves can undermine both the justification for public support of the RTO and the RTO's traditional sources of competencies, markets and relations. Explicitly or implicitly certain public policies may be encouraging this type of behaviour, pushing RTOs towards either a detachment from or withdrawal into the local economy. Neither of which are considered, by many analysts, as viable strategy in the long term.

Such observations lead to a series of questions regarding RTOs. First, as RTOs reconfigure, what is their place in Europe? Is there a way of combining internationalization and territorial anchorage so that RTOs' provide research excellence on a European scale? Second, which markets should be targeted as priorities? Emergent markets which, from a quantitative point of view, seem highly promising in the short term? Or mature markets that seem far richer qualitatively in terms of learning and possible diversification? The answer to this question can obviously not be the same for all RTOs, RTO projects and RTO partnerships with enterprises, civil society, etc.. However, should value creation in the future depend on incorporating more 'intelligence' into products and services in highly specific markets, then the latter, qualitative approach may be the most appropriate.

## RTOs AND INSTITUTIONAL CONVERGENCE

The changes discussed above are putting the RTO model to the test in several respects. First, the ascendance of entrepreneurial activity, linked to the decline of public support and the necessity of conducting more client determined research, has meant that the distinction between RTOs and completely private research centres is less clear-cut. One extrapolation of this line of development might lead to a situation where long-term scientific and technological research is left entirely to the private sector. This could lead to the fragmentation of RTOs into small units that could either be bought out by private firms or else function much like independent private consultancies.

Second, numerous pressures are causing the traditional actors of fundamental research (universities, large research organizations) to turn towards partnerships and contractual research, which brings them closer to RTOs. This could lead to the disappearance of RTOs as an institutional form, but to their maintenance and generalization as a specific research practice, defined by the application/research mix and the role of the client, in other institutions like universities.

Third, RTOs may retain some degree of institutional specificity by finding revenue models that leverage their current competencies. By systematizing mixed forms of research, oriented towards both the public – itself defined as a holder of knowledge and expertise, and possibly forming different types of collective or community – and technical and scientific communities. The in-between positioning of RTOs and their multidisciplinary culture could constitute a decisive advantage.

### *UNIVERSITIES: RELATIONS BETWEEN RESEARCH AND HIGHER EDUCATION (BASED ON THE CONTRIBUTION BY ATTILA HAVAS)*

The preceding sub-sections on researchers and RTOs considered a number of issues that concern universities: the challenges of demography and recruitment apply directly to these institutions, as do transformations in the production of knowledge like the contractual approach to research practiced by RTOs and now adopted by university labs. The focus in this subsection is on the institutional constraints that universities impose on research in an effort to balance the different missions entrusted to them – teaching and research – and the way in which these missions are defined and articulated to one another.

Universities across Europe reflect a multitude of different realities. In certain countries they constitute the preponderant share of the research and higher education system; in others they coexist with large research organizations and even, as in France, with other types of higher education institutions (*Grandes Ecoles*) which are also increasingly engaged in research. On the whole, there is less investment in higher education in Europe than in other countries such as the US or Japan, funding is primarily from the public sector, and students pay a relatively low share of the costs of their education. However, it must be noted that the funding of university-based research has increased substantially over the last 15 years. There has also been a diversification of the sources of funding for research institutions to include: national governments, supranational bodies such as the European Commission, regional governments, business enterprises, and civil society.

The respective weight of teaching and research, and the mechanisms through which research activities can be financed and encouraged vary considerably, depending on the country and the university. In general, however, universities in Europe currently face the same challenges: offering courses to young adults; meeting the demand for on-going education and training; and participating in knowledge production in increasingly diverse contexts and with an ever-greater variety of partners.

How to effectively pursue these three missions simultaneously is not self-evident. Indeed the juxtaposition of these different tasks currently weighs on universities, generating strong tensions, in part due to limited resources. A situation exacerbated by the fact that the main missions of universities are not always defined in unambiguous ways nor do key stakeholders, such as the managers of universities or governments, always agree on the same priorities. Still there is a widespread assumption, resting on more than thirty years of official rhetoric, that public authorities will introduce policies to enable all the citizens to acquire the skills necessary for lifelong learning. An almost equally longstanding policy goal is also expected to persist, that is to encourage the professions involved in the production, distribution and certification of knowledge to accord greater recognition to the informal knowledge of users and practitioners. What role universities will play remains to be determined. Should they differentiate and specialize or standardise and universalise? Will other institutions take up the teaching-learning challenge? All these questions remain open.

The link between research and higher education is often seen as self-evident. As is the link between high-level, high-quality research and the best teaching. The significance of these assumptions has grown with globalization and the idea that universities now function in their own global market. Symptomatic of this point of view is the classification of higher education institutions, proposed by Shanghai University, that only takes into account research-related indicators. Thus, the best universities are those with the greatest concentration of internationally recognized researchers. This approach seems somewhat limited, at a minimum because it:

- reduces the 'higher education market' to only those universities that, on the basis of academic excellence, occupy a place in the international arena for training elites (economic, social and scientific);

- excludes many forms of knowledge other than purely academic knowledge;

- oversimplifies the link between academic excellence and learning;

- weakens the diversity and specificity of the criteria for evaluating the quality of research by excluding a range of less strictly academic activities such as research done through training, applied industrial research, knowledge diffusion through popularization and participation in public debate, and support for public policies and services;[6]

- uses the spectre of competition in the higher education market to favour a restrictive definition of research that is out of phase with both research practices and policies, such as spinning off start-up enterprises as a way to encourage knowledge and technology transfer;

- encourages universities, as the official certifiers of diplomas (especially PhDs), to favour entrenched disciplines rather than emerging transgressive[7] fields for both students and the careers of teacher-researchers.

All told, the standard account of excellence in higher education runs a high risk of exacerbating the mismatch between the educational mission, that remains profoundly marked by the disciplinary stamp, and the emerging reality of research practices that display ever greater multi-disciplinarity.

## RESEARCH ACTORS SUMMARY PART B: FIRMS IN INNOVATION NETWORKS

This part presents the synthesis of two monographs, one on multinationals and the other on small- and medium-sized enterprises. In both these studies the subject was approached from a particular angle, that is, the development of technological innovation in sectors where technologies are central. Thus, the aim was not an exhaustive presentation of the role and place of firms in research and innovation. The financial sector, to cite but one example, could in itself be the subject of an entire study focused on research and the funding of research. These two monographs nevertheless outline a common, key theme: the networks in which innovation is constructed and the role of intellectual property rights in the way these networks are configured.

### *MULTINATIONAL ENTERPRISES: DEFINITION OF MULTINATIONALS AND INNOVATION MODELS (BASED ON THE CONTRIBUTION BY GUIDO REGER)*

Today's multinationals see innovation as a strategic element in economic competition. The life cycles of products are increasingly short and firms are encouraged to produce returns on investments more and more quickly. This has resulted in the development of an R&D race in

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[6] Larédo, P., & Mustar, P. (2000). Laboratory activity profiles : An exploratory approach. *Scientometrics*, 47/3, 515-539.

[7] Nowotny, H., Scott, P., & Gibbons, M. (2001). *Rethinking Science: Knowledge and the Public* Cambridge: Polity Press

which firms strive to outstrip their rivals. A significant proportion of all R&D is consequently concentrated in multinationals although, proportionally-speaking, SMEs seem to produce the most innovation. R&D activities enable firms to build-up knowledge about the technologies at the heart of their activities. R&D also plays a crucial role, essential to the firm's long-term competitiveness, by enabling firms to identify, acquire and apply knowledge that has been developed by others.

The organisation of R&D by multinationals generally falls into one of two typical strategies.

### THE MULTINATIONAL AS A STRUCTURE: THE CLOSED INNOVATION MODEL

The first strategy is historically the oldest. It is based on a multinationals appropriability advantage. If they are able to maintain a temporary monopoly over certain knowledge or technologies, they can derive huge profits owing to the size of the markets to which they have access. Companies that adopt this strategy have put R&D at the heart of what gives the firm its strength. In this schema the multinational appears to be a closed space, with a high density of strategic activities concentrated around the head-office. The linearity of the model in which innovation more or less defines the firm has generally translated into a spatial distribution of activities. 'Downstream' activities, that is, commercialization, marketing and adjustments to local conditions are exported towards 'peripheral' branches, distant from the head-office. With this strategy protecting knowledge through intellectual property rights is essential since without this control it becomes difficult to reap the benefits of innovation.

### THE MULTINATIONAL AS A NETWORK: THE OPEN INNOVATION MODEL

More recently different strategies have developed. In the one elaborated here innovation results from the interactions of diverse actors including, from the multinational’s point of view, suppliers, customers, users, public research organizations, universities, consultants, producers of complementary products, etc. In this scheme innovation can emerge in any of the places in which the firm is active; hence, the importance of having R&D units spread throughout the firm's different branches and agencies. This decentralization of activities is accompanied by a decentralization of budgets and decision making towards the divisions and business units. The idea is to increase the capacity to react to the market and to customers' needs, and to facilitate the integration of changes into the firm's organization and production. Unlike the centralised and proprietary model, this strategy takes advantage of innovation wherever it occurs and in a wider range of forms, including new products outside the existing range.

This strategy depends on networking and flexible investments in R&D projects close to promising sources of innovation, where ever they may be. Networking is also the main channel for gaining access to potentially important resources and is based on various forms of association, including: arrangements between firms for joint R&D or technology transfer, links with start-ups, spin-offs and the public R&D system, licenses, minority holding, subcontracting, etc. It is set in a context of either a weakening intellectual property rights, due to such difficulties as legal enforcement, prohibitive costs of excluding others from the research process, or the uncertain nature of both the products and viable business models associated with cutting-edge innovation. This collective production of knowledge depends on being able to construct lasting and functional relations for the open sharking of knowledge amongst research actors.

Multinational firms that adopt this strategy derive competitive advantage from the capacity to integrate heterogeneous elements, by constantly adjusting the borders of the firm in relation to the networks to which it belongs and which it helps to create. In-house R&D is then understood as the production of competencies which constantly allow the firm to analyse the knowledge contributions of other actors, to understand possible articulations with its own

activities, to enter – where relevant – into partnerships with those actors, and to build operational arrangements into which these different contributions will be embedded.

## TOWARDS A NEW MODEL?

Today the models used to understand the strategic choices of the past breakdown into three periods. The first strategic period was developed and applied in the 1950s to 1970s. The second strategy started to appear in the 1970s with wider implementation in the 1980s or in some cases even later. Both strategies reflected the understanding of the time about the relationship between the functioning of market economies and corporate success. In the third, current period, multinationals are seeking ways of distributing decision making across different levels and of coordinating different activities in an economic context where the old rules no longer provide clear guidance.

The emerging new conceptions of innovation highlight the role of a multiplicity of actors and the plurality of the knowledge that needs to be mobilized for commercial success. The old linear model that separated basic research from applied research and innovation along a temporal axis is gradually being replaced by a 'whirlwind' model in which different forms of research activity overlap and interact. Still, even these new approaches generally take the invention of goods (physical products) as the starting point for thinking about innovation. The legacy of past successes in goods production, from the telephone to the transistor, tends to dominate thinking about innovation despite the fact that the preponderant share of industrial activity in developed countries has been, for some time now, in the field of services. In particular there is often a fixation with technological innovation. As a result models of innovation built on the experiences of tangible production are often applied to the service sector's intangible outputs. In certain cases this may be appropriate, in others not.

Service sector innovation has an interesting set of characteristics[8]. In most cases it appears to be inseparably linked to technical and organizational development. Therefore it has a marked multidisciplinary character, often incorporating the contributions of economic and social sciences. The sources of service sector innovation are situated all along the chain of service production, from manager to customer to user. Most innovation in services demands a rich definition of knowledge that includes practically all the categories now considered as relevant. In many cases, fine adjustment of the service to the customer is at the heart of the innovation process. The tension between local and global, between centralized and decentralized, is thus resolved in practice. In short, many properties attributed to the new aspects of knowledge production can be found in service sector innovation. The assessment of the role of research actors might usefully explore the case of innovation in the service sector and how it might be applied to the consideration of innovations for which the technological input is assumed to be crucial.

### *SMALL AND MEDIUM ENTERPRISES: DIVERSITY OF INNOVATION NETWORKS (BASED ON THE CONTRIBUTION BY BART CLARYSSE)*

SMEs are obviously an extremely heterogeneous group, ranging from high-tech start-ups to small building contractors to the local pizzeria to sub-contractors in the car industry to computer service firms. However the sectoral coverage tends to narrow considerably when the focus is on research related issues. And despite the fact that technology based SMEs only account for around 10% of all SMEs most analytical work on innovation for firms of this

[8] For a synthesis: Gallouj, C., & Gallouj, F. (1996). *L'innovation dans les services* Paris: Economica

size has, as with MNEs, been strongly biased towards technology and technology-based enterprises.

## TECHNOLOGY-BASED SMES

Technology-based SMEs that engage in knowledge and technology transfer from the research world to the economic world are seen as playing a mediating role amongst various research actors. Such activities involve joint exploration of technologies and the networks in which they are used. In the current context there appears to be a growing number of these kinds of firms, encouraged partly by strong incentive policies and partly by an increasing number of mobile researchers seeking growth opportunities.

These high-tech growth pursuing SMEs can be sub-divided according to differences in the institutional linkages: no link with a particular entity (start-up); link with another firm (corporate spin-off); link with a university or research centre (academic spin-off); and the nature of their financial resources (venture capital or not). SMEs which set up without any previous formal link with another organizations are sometimes called independent research-based start-ups (RBSU). These latter firms can be differentiated, not on the shared characteristic of engaging in R&D, but on the basis of distinctive configurations of resources (financial, human, technological) .

Corporate spin-offs emerge on the basis of knowledge acquired from the parent company. The spin-off may happen when the parent company restructures in order to re-focus on core competencies and consequently externalizes potential developments that fall outside that field. Or the spin-off may be created by employees who are unable to develop a project within the parent company. In the past few years there has been an upsurge of academic spin-offs due, in part, to pressure from government on universities and research centres to transfer their research results to commercial applications. These firms often start off with only a few customers identified while work was still underway at the university laboratory. Long-term growth for these firms depends on two factors. First, the capacity to broaden demand to include other potential customers. Second, maintaining effective relations with research institutions. There are cases where these SMEs become so absorbed by their initial or primary customer that the link to research languishes or dies, reducing its ability to evolve. In other cases it is the university that is unable to provide the research effort required to nourish interactions and partnerships with the firm.

Many high-technology SMEs also suffer from internal managerial and commercial weaknesses. This is to be expected in the case of academic spin-outs whose promoters lack a business culture. But similar problems can be found in many of the independent RBSUs. Only corporate spin-outs defy the rule since the parent company usually provides key technical and operational knowledge regarding ongoing innovation and business development. Access to the parent company's networks can also make a decisive difference.

SMEs in the European context must also contend with the historically less developed, when compared to the United States, venture capital market. Research based SMEs in Europe face a venture capital market that is reluctant to invest in areas in which there are high asymmetries of information. In Europe only 10% of venture capital is invested in technology-based SMEs. Moreover, the infusion of VC financing and expertise usually takes place later on in the firm's life, when the technologies and managers have already matured a little. SMEs therefore lack the financial means to grow during their start-up phase. The more their project is based on innovative, developing technologies, the more difficult it is for them to finance it. The bursting of the Internet bubble reinforced these tendencies.

All these high-tech SMEs have been the subject of considerable and positive expectations on the part of governments. Spurred on by a few success stories public policies have supported

these firms in the hope that they would grow into the leading enterprises of tomorrow. Many observers have lamented the inability of Europe to take commercial advantage of shining innovations like the web browser invented at CERN, a public research lab in Switzerland by Tim Berners Lee, but brought to market by Netscape (even if ultimately beaten by Microsoft's Explorer) in the United States. Concern has been expressed that if Europe is unable to nurture these technology start-ups and spin-offs then the prospects for long-term growth will be diminished. However, as noted above, this view is based on a technology centric approach to innovation and overlooks the other ingredients required for the success of such firms. Be it in Europe or elsewhere only a handful of these SMEs can be expected to evolve into larger companies and cannot be treated as the future saviours of Europe wide economic growth.

Still, even if SMEs remain small they often have the potential to develop internationally, becoming mini-multinationals based on highly specific competencies. Others SMEs can contribute to the diffusion of research, in particular firms that have close relations with the work going on in RTOs. Some high-tech SMEs are also able to act as intermediaries between the research world other, more traditional types of SMEs that are unable to develop their own R&D capacities. However the research undertaken and used by SMEs as a whole is certainly greater than just the contributions made by high-tech SMEs.

## 'TRADITIONAL' SMES

Despite the huge contribution to the economy and employment of traditional SMEs, the role of this type of firm with respect to research and innovation is generally underrated and understudied. In part this is because traditional SMEs are more closed to the outside world, often controlled by families and are less open to venture capital or other sources of external financing. There is evidence, however, that many of these firms are experiencing significant growth and international development that is, in part, related to R&D and innovation strategies. Traditional SMEs engage in research for a variety of purposes, including the development of new business models, new products or services as well as improving existing products or services. Pursuing this path helps to cultivate commercial networks and extend the often deeply rooted experience based knowledge of firms of this scale.

Traditional SMEs operating in local markets that are open to either new entrants or imports are often faced by product market competition from both within and outside Europe. To cope with such competition, particularly when either the nature of the output or of the local market limit the competitive advantages that can arise from pursuing economies of scale, such firms must innovate to survive. In order to innovate these firms must attempt to be in contact with a broader range of clients, use outside expertise and in general try to leverage the density and diversity of networking to spur innovation.[9] Evidence that this approach works can be seen in cases where small traditional firms have started exporting and by connecting to the wider world have subsequently experienced higher rates of growth.

The capacity to change and to innovate in traditional SMEs, as with other types of SMEs, is related both to the network to which the firm belongs and to its internal organisational capacities. Executives face the challenge of managing not only product innovation but also organisational change with its emphasis on training and retaining staff. All innovative SMEs, once again including research based SMEs, also face difficulties raising the necessary funds. Thus, irrespective of the category of the particular SME, its position vis-à-vis knowledge-production is directly related to the form of network to which it belongs and especially to the way in which it dynamically reconfigures that network as it evolves. An evolution that is

[9] See Mustar, P. (2002). *Les PME à forte croissance et l'emploi.* Paris: OCDE.

certainly influenced, when it comes to research, by the nature of the intellectual property rights regime that applies to the firms particular products and processes.

## RESEARCH ACTORS SUMMARY PART C: POLICY AND SOCIETY

This part covers three monographs on the role of research actors who represent the interests and aspirations of society in diverse forms: national governments, regional governments, and actors from civil society. When considering these actors it is particularly important to take into account the inter-relationships amongst the various actors, without ignoring that each actor's role in research is based on distinct objectives and motivations. However, it is necessary to note, since the place of European institutions was not treated directly by any of the monographs, that the role of the EC as a distinct actor is not dealt with in this sub-section.

### *NATIONAL GOVERNMENTS (BASED ON THE CONTRIBUTION BY JARI ROMANAINEN)*

A variety of actors are involved in making and implementing national science, technology and innovation policies: advisory bodies, national agencies, ministries and specialized institutes. These actors engage in a wide range of activities, including planning, forecasting, strategic intelligence, and consultation with stakeholders. The national level actors are involved throughout the process, which covers identification of needs, agenda-setting, implementation of policies, monitoring and evaluating the effects of policies, and benchmarking.

Three broad areas of analysis are pertinent to possible trends in STI national policies: the paradigm adopted by government decision makers for conceptualising both R&D/innovation processes and how public sector policies might intervene effectively in such processes; changing market conditions including so called globalization; and the growing role of users, individuals or citizens, in the processes of research and innovation.

#### CHANGING R&D MODELS

Turning to the first set of factors shaping STI policies at a national level, there have been important changes over time in the models used to understand both public policy and the processes of research and innovation. In the 1960s the basic model, in both spheres, was direct and linear. A firm's market success rested on innovations arising directly from R&D. A government's success in assisting firms rested on direct financing of basic science to underpin R&D. Later, with a greater recognition of the role of customers and the market as key drivers of innovation, government policy shifted to encouraging closer relations between research and industry on the grounds that this would bring the scientific agenda and enterprise needs into closer congruence. Subsequently the models became even more multi-dimensional. The links connecting R&D, innovation and market success were viewed as more complex. Direct government sponsored R&D could no longer claim to be the driving force behind winning innovations in the marketplace, rather public policies aimed to stimulate successful innovation by facilitating and encouraging actors to interact. Linearity was replaced by a focus on the importance of interactions amongst all the actors potentially involved in research and innovation.

Most recently there has been a proliferation of models and means for government intervention as well as the multiplication of the levels of those interventions, from local to global, via the regional, national and European levels. Arising out of this complexity has been a growing preoccupation with coherence and coordination, both horizontal (between different ministries, agencies, etc.) and vertical (between the different levels of intervention). Such efforts have also attempted to take into account the importance attached to promoting national interests in supra-national European and International arenas.

## OPEN MARKETS, NETWORKING AND KEY NODES

With the increase in the knowledge intensity of products and services, firms have had to develop strategic partnerships and cooperation. Networking and clustering within and across industries have appeared as a way of developing and gaining access to knowledge and necessary competencies, while allowing a re-centring of firms on core business activities, often characterised by product differentiation and specialization. In this general context the question of “local conditions” takes on new salience. Particularly in those local markets where openness may unsettle both the underlying factor costs (in production) for output going to local or external markets and the actual supply conditions in the market for the given product. Spurred by such changing conditions of business many firms seek to include an assessment of the implications of local economic conditions (with respect to both supply and demand) in strategic decision-making. One part of the strategic assessment with implications for a firm’s ultimate decision regarding investment or market positioning is the extent to which a specific place is conducive to innovation. And one aspect of the assessment of whether or not a particular place is more or less ‘favourable’ than another place for innovation are government research policies and the relations, encouraged or discouraged by research policies, that exist amongst research actors in a particular place.

However defining a ‘favourable’ environment is not self-evident and can be different depending on the specific sector, product or even the firm's 'ethical' choices. In certain cases the proximity of dynamic markets seems to be a key criterion; for others, the price of labour and/or other inputs is decisive; and still in others it is access to competencies and knowledge that predominates in shaping decisions. What then becomes central are the underlying conditions for networking and adaptation, as a means for redistributing competencies and tasks in ways that enhance innovative capacity. The level of education, the quality of infrastructures and political stability can all be important. As a result the nature and alteration of underlying conditions comes to involve many different elements. Policies need to be multifaceted and multidisciplinary, including: partnerships between the public and private sectors, and a diverse range of service such as mediation services (e.g. brokering, networking), expert support services (e.g. mentoring, training, consulting) and some financial services (e.g. venture capital, loans, guarantees).

Considering the range of issues that need to be addressed brings to the forefront the question of coordination between the different actors of research policy at the national level, but also between the different levels of policy intervention, from the European to the sub-national region. As the next section on the role of regional governments as research actors observes, there is an increasing role for the "sub-national" level in most countries, even in centralised ones such as France and UK. Some analysts attribute this to the hypothesis of increasing differentiation between regions and that this differentiation will be more often, intra-national than international. From this perspective, science and technology policies needs to be conceived and implemented at several levels involving not only coordination and complementarity, but also attention to the ways in which policies might compete or be redundant. One approach deemed particularly effective in addressing these complex challenges is the creation of centres of excellence for research and innovation in target areas.

## WHAT ROLE FOR NATIONAL GOVERNMENTS FACED WITH CUSTOMERS, USERS AND CITIZENS?

As noted earlier in this report, many factors such as improved education, the ageing of the population and changes in lifestyle can all generate a demand for products that are increasingly sophisticated and personalized. At the same time many markets are becoming at once more global and more local, with changing cost structures, more segmentation, and

new intermediaries which allow for finer adjustments to customer demands. Product differentiation is thus based more and more on design and ability to tailor to specific contexts of use (branding) rather than on unique technological features. Firms are increasingly customer-oriented and strive to form richer and more lasting relationships, primarily through consultative design and implementation processes. In this context, national governments are turning to new forms of action that favour experimentation and the creation of pilot environments and test-beds that can be used to simulate product demand. These policies facilitate and support the development of various physical or virtual platforms for experimentation and co-development.

Finally, the involvement of civil society in science, technology and innovation policies, especially through NGOs, is increasingly marked and is leading to the integration of many social and environmental issues. There are now more mechanisms of self-regulation (guidelines, standards) implemented through interactive processes and consultation involving public- and private-sector actors and representatives of civil society. Governments have a role in promoting these processes of interaction and to assist with organize the debates amongst the different actors. Overall then, national policies constitute an important component of a more 'favourable' business environment and can play a key role in helping firms to adapt and, in certain cases, maintain existing production and distribution relationships with the national economy.

### *REGIONAL GOVERNMENTS (BASED ON THE CONTRIBUTION BY LUIS SANZ)*

As made clear in the preceding sub-section national research and innovation policies often operate and have an impact in terms that can be regionally specific. This underscores the potential for public bodies that are exclusively regional in focus to play a distinctive and potentially even more locally tailored role. Taking as given the fact that there is considerable diversity in the organisational forms of public authority at the regional level, often enshrined in specific constitutional and legal formulations, there has been a general reinforcement of the power and role of regionally anchored institutions. This trend towards 'decentralisation' can be observed in both nations that have evolved towards federalism and in those states that have remained more unitary. This strengthening of the regions also reflects the intersection of national and European policy which, in a number of ways (structural funds, Committee of Regions), contribute towards regional growth.

Despite recent trends, it would be a mistake to assert that the ascendance of regional authority and of policies crafted to regional specificity are irreversible trends. History is filled with cycles alternating between greater centralization and decentralization of power and policy. That said, current forces towards greater 'regionalization' has been particularly evident in the field of research and technology policy. Initially regions' were motivated to become active in this area because of the belief that innovation develops 'naturally' close to research centres producing basic knowledge, provided there are adequate means for facilitating communication between the research and business worlds. Supporting basic research and technology transfer in a given territory and providing subsidies for the local industries that engage in R&D benefit local economic development. After a series of changes, regional policies now have slightly different rationales. Considering that knowledge is only partially codified and that interactions between diverse actors therefore play a crucial role in the dynamics of collective learning, the 'territory' seems to be a relevant entity in these processes. Regional governments can try to create the appropriate conditions to facilitate these interactions.

The forms of intervention of regional powers in research and technology policies vary widely. Considerable emphasis has been put on supporting research in universities which have become more and more regionalized. In certain countries such as Spain regional policies

have created public research and technology centres and RTOs. Regional authorities have also introduced policies for attracting and developing a qualified local workforce by providing incentives for doctoral students in a specific subjects to locate at research centres within the region or by financing the training of students from the region at external international research centres. Regional authorities have also spurred the creation of two types of research vehicle: technology clusters and technology parks. Clusters are concentrations of local industries which support one another in a particular sector, with a view to generating a competitive advantage for the regional market in that sector. Science and technology parks are based on the idea that bringing together, in the same area, researchers from universities, RTOs, SMEs and/or large firms, helps to facilitate the transfer of knowledge and cooperation, and thus to promote intrinsic innovation potential.

The distribution of prerogatives between regional, national and European government remains fluid. National level authorities generally retain the leading role in policy formulation and implementation, but there are likely to be very wide differences in the extent and nature of this leadership, depending on the country. The reality of ongoing changes in the allocation of responsibility across different levels of public initiative means that regions face an unstable policy context when attempting to define a specifically regional role in local research. Certain regions do take the initiative by creating, for instance, trans-border research coalitions. However even these efforts remain limited because in most cases the regions' ability to define policy remains subject to the national government's discretion, particularly when the main tools – especially financial – critical for policy implementation are kept by central governments. The open question remains how far regionalisation in Europe, strongly present in current trends, will go. Taken too far it might create excessive competition between regions and, in the absence of coordination at European level, lead to a fragmentation of efforts and the absence of a coherent strategic vision. Alternatively, if current policy trends are reversed there could be a weakening of regions and a strengthening of large-scale European level projects that concentrate and integrate research without taking into account the concerns of local authorities and local context.

### *CIVIL SOCIETY (BASED ON THE CONTRIBUTION BY HENNING BANTHIEN)*

The term civil society refers to all inter-individual relations and all social, economic, cultural and religious agencies which exist and operate in a particular society outside the public sector. In concrete terms it consists of a range of non-profit associations and organizations of individuals, which act as mediators between government authorities and individuals. The European Commission lists the following types of organisations as making up civil society: 'trade unions and employers' organisations ('social partners'); non-governmental organizations; professional associations; charities; grass-roots organizations; organizations that involve citizens in local and municipal life; churches and religious communities' (EU-Commission, Science and Society Action Plan, 2001). The organizations that make up civil society occupy a variety of positions and strive primarily to ensure that the political world and government take into account certain problems or interests, or fulfil certain functions for which neither the state nor the private sector take full responsibility.

Civil society is thus an aggregate, encompassing a wide variety of organisations and relationships. The attributes of specific civil society actors must be described on a case by case basis. In some cases, civil society organisations act as consumers' representatives, in other cases, they act as citizens' representatives, or users' representative, patients' representatives etc. The role of a civil society organisation needs to be understood with reference to its specificity: who it represents and to what end. The following sub-sections adopt this specificity of identity and purpose to organise the discussion. Today the idea of civil society has a number of positive connotations. It is readily associated with values such as autonomy, responsibility and solidarity. Increases in the political and economic weight of

civil society organisations is generating greater political recognition, in part a sign of a healthy democracy. But also a risk since these organizations often defend entrenched and possibly conflicting interests resulting in stalemates.

## CIVIL SOCIETY'S INVOLVEMENT IN RESEARCH AND KNOWLEDGE-PRODUCTION

Traditionally, the production of research has not been a major preoccupation of civil society organizations. When it came to science these organisations tended to confine activity to informing the public through publications or events such as science fairs. Gradually, this role has changed as civil society organisations have begun to represent the views of specific constituencies on issues like the acceptability of the risks associated with certain technologies. Some civil society organisations have been asked to participate in the preparation of research policies (participatory technology foresight). Finally, specialized associations, working in the health or environmental fields, for example, have begun to engage in research as a way to improve the effectiveness of lobbying efforts and as a way to influence policies.

However, the impact of civil society organisations has usually be considered rather marginal. Citizens and the organisations that claim to give them a voice are often been treated by the scientific community and policy makers as victims of irrational fear, who need to be trained and informed, rather than as contributors to defining and advancing research policies and processes. Nevertheless, in recent years, as the role of a wider range of research actors has become increasingly apparent, there has been a growing respect for the views and involvement of civil society organisations.

## CITIZENS' INVOLVEMENT IN SCIENTIFIC AND TECHNOLOGICAL CHOICES

One of the factors that has enabled civil society organisations to play a more prominent role has been the erosion of the exclusivity of scientific information, not only in terms of access to specialised sources but also in terms of claims to know “the truth”. People concerned by a problem and especially those engaged in various movements or associations can talk on an equal footing to experts. This more overt contesting of “scientific authority” has often served to highlight uncertainties, questions for which science has no, or only partial, answers. Once these controversies are brought into the public spotlight it becomes apparent that science is not an avenue to absolute certainty and that often experts are divided. In this way civil society plays a key role in enriching the debate surrounding important research topics.

These developments, among others, have created a context favourable for citizens' involvement in scientific and technical decision making, particularly as a way to ensure that the political and ethical dimensions are made more explicit. A range of democratic processes – conferences, citizen juries, parliamentary hearings, public debates – are being used and tested throughout Europe in order to address the uncertainty surrounding the directions and priorities for research. In some areas such as health, the authorities in charge of scientific policy include representatives of patient organizations on scientific committees. These representatives can put forward proposals on certain research protocols, directly concerning the content of science. These consultative approaches, that reflect a more 'plural', culturally diversified European society, are part of the finding the balance between the different points of view regarding research agendas.

## INTEGRATION OF CONSUMERS AND USERS INTO INNOVATION

For some time now civil society stakeholders, such as consumer unions, have played an important part in the evaluation of products and thus in the selection R&D agendas. Now this type of engagement is spreading, driven by people’s interest in the quality of life (ecology, health, etc.) and facilitated by easier access to the debates. Full-blown communities of users

or consumers are using the internet to engage in research. The internet has made it easier to pool information and to collectively produce knowledge regarding expected and unexpected uses and modifications of products. The pharmaceutical and the ICT sector offer striking examples of relations between users and researchers, more or less explicit depending on the case. For instance internet sites that collect medical stories written by patients or friends and family of people who are ill can become sources of useful data and innovation for pharmaceutical companies. So far most of these relationships remain informal. However users, like many civil society organisations such as consumer unions, are beginning to enter into professional relations and even contractual partnerships with researchers and industry. This brings questions of power and the negotiation of property rights to R&D results to the forefront.

#### CIVIL SOCIETY AS A 'SCIENTIFIC ENTREPRENEUR'

In several key areas, including health, citizens organized in various collectives have shifted from a 'consultative' position to an active one. Non-profit associations are playing an increasing part in the direct funding of research, alongside other financiers such as government or industry. In some cases this funding is substantial and involves the creation of research policy. Some of these groups are able to collect large sums of money. As a result they can enter into or even create research 'markets'. The capacity to finance research brings with it the power to explore new fields and to reopen research on subjects that had been disregarded by research actors in both the public and private sectors. This can lead to competition amongst actors in civil society both for the financial resources required to implement research policies and for consideration by the scientific community.

## 3. IDENTIFYING COMMON DISRUPTIVE TRENDS FOR POSSIBLE FUTURE CONTEXTS

This part identifies and describes a number of disruptive factors emerging from an analysis of the relationships amongst different research actors. Five main topics are addressed: A) How can knowledge be described and characterized today? B) What changes can be identified in the definition of knowledge producers? C) What are the consequences on the organization of research likely to be and what role will the rules of access to knowledge play? D) How can the localization of the production of knowledge be conceptualized? E) How can the greater public scrutiny to which science and technology are subjected be understood and integrated?

### A) WHAT KNOWLEDGE?

The assessments of the attributes of the different research actors, as synthesized above, provides a rich base for analysing the hypothesis, formulated in the introduction, regarding the enlargement of the field and categories of knowledge production and use. Throughout these accounts knowledge plays a key role as both input and output. As such it is clearly a pivotal resource for development and welfare in Europe as well as in other parts of the world. Knowledge as a resource takes on various forms, from highly implicit to explicit and codified. And knowledge is a **distributed** resource, not restricted to what is produced through R&D activities, but diffused throughout society across boundaries between scientists and non-scientists that are now more permeable.

Even in the realm of industry oriented R&D and innovation activities, the closed and linear model of knowledge creation and use is definitively outdated. The old model no longer corresponds either to the conceptualization of research activities or the way in which most research activities are actually organized. Many analyses have demonstrated that, first there is no one-way move from fundamental research to application but continuous movements

back and forth, and second, that there is (or at least there should be) a strong integration between basic research, applied research, development and marketing. Innovation thus appears as a process that integrates various forms of research, and the knowledge it creates, in a wide range of patterns.

One strand of evidence of this transformation is emerging, according to all of the research actor reports, be it for multinational companies and RTOs to universities and regional governments, from the real pressure to develop market-oriented, customer-oriented R&D activities. As noted above, it is important to not confuse the specific practices that constitute and differentiate market-oriented R&D and applied research. These two forms of research remain distinct but the inter-weaving and inter-dependence of the processes has changed the conditions of 'relative autonomy'. Indeed, it is such changed conditions that help to explain why and to what end the concept of frontier research[10] was invented. This term denotes a form of user-oriented research on possible applications that entails investigation at a fundamental scientific level. The expert group that devised this concept proposed that one of the main tasks of the European Research Council should be to identify and support the development of teams or laboratories working on frontier research. The hypothesis underlying this recommendation is that this type of research is also at the frontiers of disciplines and institutions, and that it is therefore necessary to have a vigorous policy that enables audacious researchers to dare to make creative breaks.

The changing nature of research is also evident in the recent proposals to develop use a **platform model**[11] for advancing research. A research platform is a set of devices, tools, instruments, technologies and discourses which are used by a heterogeneous group of people, ranging from basic scientists to engineers and users. The heterogeneity of this grouping may lead to the production of new research 'entities', new technologies and new practices, in short, trans-disciplinary built-in innovations. For example, an experimental stock market trading room that can simulate the ways in which traders, economists, sociologists and engineers collaborate may produce new kinds of economic knowledge, new tools for trading and new trading practices.

The tendency, when research and innovation processes appeared stable and predictable, often reduced to fabricating technology, was to take the insights of the social sciences' into understanding these processes for granted. Now, as it is becoming more evident that research and innovation processes encompasses not only the elaboration of technology but also the reconfiguration of socio-technical links[12], more effort is being made to include the insights of social studies. The aim is to root the understanding of knowledge creation and use in an analysis of the changing social and economic fabric. Furthermore, from this point of view the social sciences are not just another analytical tool for improving the design of otherwise 'scientific' processes and policies but have become an integral part of the instruments, methods and concepts used to advance and conduct research. Integrating the research insights of widely dispersed scientific, consumer, marketing and investment decision makers, within a firm or a community, calls for both techniques and knowledge from the social sciences. This point was also underscored by the findings of the Key

[10] European Commission - DG Research, (2005), op.cit.

[11] Keating & Cambrosio, 2003, op.cit.

[12] Akrich, M. (1992). The De-scription of Technical Objects. In W. Bijker, & J. Law (Eds.), *Shaping Technology/Building Society. Studies in Sociotechnical Change* (pp. 205-224). Cambridge Mass.: MIT Press.

Technologies Report[13] regarding the importance of the social sciences for the new models of research and innovation. Taken as a whole, the evidence and arguments presented here drive to the conclusion that research and innovation must be defined in ways that go significantly beyond restrictive technological and industrial conceptualisations. Not only is it important to incorporate organizational and social innovation, reflecting the socio-technological changes in what and how knowledge is produced and used, but also the (re)emergence of know-how and know-why as potentially dominant spheres of value-creation and exchange.

## B) Producing knowledge: towards a learning society?

Reviewing the activities of research actors in the European Research Area reveals that both the range of knowledge producers and the definitions of the knowledge being produced are far more diversified than was previously thought. Consultants, administrative experts, consumers, non-governmental organizations, media-specialists, commercial intermediaries, 'citizen groups', patient organizations, and even spontaneous and 'fluid' assemblies of individuals brought together by common interests using the Internet, are all now knowledge producers. These heterogeneous mix of actors, inputs, outputs and processes also reveals that creativity emerges from configurations which, in part, not only ignore disciplinary and institutional boundaries but oppose them. The emphasis is constantly on the fecundity of networking, on open innovation, on new forms of collaboration and on the mix of genres and competencies; that is, on the elements that favour learning processes.

Moreover, institutional boundaries seem far fuzzier. In a context of growing integration of various forms of research, the differences measured in terms of knowledge production between RTOs, multinational companies, NGOs, universities etc. seems to shrink. Consequently, it is worth raising questions regarding both the convergence of certain actors and the dissolution of others as new participants and relationships emerge. This, in turn calls for less pre-fabricated, less institutionally based perspectives that can begin to situate policy debates using concepts, that may be more adaptable and appropriate to more dynamic and networked research systems, like 'community of practice' and 'epistemic community'.

### *The user's multiple involvements*

A central question raised by the research actor analyses, from the point of view of research and innovation, is: who is the 'user' and what do they do? Three initial answers can be teased from the preceding synthesis.

First, **users** conduct research and engage in innovation through their use of ideas, gizmos, spaces, raw material, etc.[14] Everyone does this, although certainly not in ways that are always codified or even explicit. A currently commonplace example is how young people's use of short-text-messaging via the telephone or internet chat has started to give rise to a whole range of new inventions and research initiatives, not to mention new fields for constructing social and commercial relations. Such examples, demonstrate once again the familiar conclusion that inventors (particularly of the most ultimately pervasive inventions) often have little idea of how their tool will really come to be used.

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[13] European Commission - DG Research, (2005), *Creative system disruption. Towards a research strategy beyond Lisbonn*. Synthesis report, Key technologies Expert Group

[14] Akrich, M. (1998). Les utilisateurs, acteurs de l'innovation. *Education permanente*, 1(134), 79-90.

More importantly, as part of an effort to understand the range and nature of research actors in the early 21st century, is the conclusion that the end-use innovator's innovation is not simply about technology or tool fabrication but, as stated previously, about the social context. This is why all actors, involved at one point or another in the creation of output, including the typical case of a technological device, are potential innovators: they are in position to re-define both the output and its corresponding environment. This is increasingly the case for more familiar forms of industrial goods and services production where participants, from the sales people and advertising agencies to journalists and customer services agents, now take on user roles at one stage or another and thereby take part in knowledge deepening and discovery. Even more striking when it comes to shifting to participatory use-driven research are a number of emerging areas of social and economic life where the production of unique creations breaks away entirely from the industrial era's separation of conception and execution, production and consumption.[15]

Second, some papers mention **the emergence of a 'professional user'.** These are people who acquire broad expertise in being a user in certain specific contexts that might be defined by technology or by social factors or a particular combination of both. Such users might belong to communities (like Internet forums for example) or more formal associations like NGOs, and they might also act as intermediaries between designer-producers of devices and 'lay' users. They provide the latter with advice, suggestions and solutions to problems (which are sometimes real innovations), and give producers indications on what should be altered or improved. As such, they are clearly participating in knowledge production linking technical features and uses in context.

Third, the 'user' 'citizen' or 'consumer' can act as a **research policy-maker**. Uncertainties, lasting conflicts of interest or values, and ethical problems are some of the factors that push forward the so-called democratization of public decisions regarding science and technology issues. Increasingly, users or citizens' representatives are integrated into research policy debates and decisions through a broad set of procedures.

### *COMMUNITIES OR THE SOCIAL EMBEDDEDNESS OF LEARNING ACTIVITIES*

For the past twenty years 'science in action' has been the subject of in-depth investigations which have provided much insight into scientists' work and its links with the world outside science. Recently Amin and Cohendet[16] produced a remarkable synthesis of three sets of work: management literature, the evolutionary approach in economic literature, and the anthropology of learning. They developed the concept of a community, that is particularly useful for developing a coherent analysis of the various tendencies that have appeared in the research actor monographs. The key hypothesis, largely supported by the anthropology of learning, is that knowledge is created out of a dialogue between people and the combination of their tacit and explicit knowledge. This approach insists on the embodied, distributed, trans-human and pragmatic nature of knowledge generation. Knowledge is produced within relatively autonomous informal groups, 'communities of practice' consisting of individuals engaged in similar activities, who regularly communicate about those activities. Individual and collective learning is thus embedded in a constantly reactivated sharing of practices, organizational resources and a common culture, all of which is continuously reconstructed during interaction. This conceptualization of knowledge as living knowledge has three advantages for the analysis being conducted here.

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[15] Green, J. (2005). Sense Making and Making Sense, *Key Technologies for Europe.* Brussels, 19th and 20th September 2005.

[16] Amin & Cohendet, 2004, op.cit.

First, it allows knowledge-production in diverse environments to be described in similar terms. We have seen that the corollary of the broadening of knowledge as a category is the expansion of the range of actors potentially involved in its production. The idea is nevertheless not to erase the differences that distinguish 'science' from other forms of knowledge-production. Epistemic communities, engaged in the deliberate production of knowledge, are part of communities of practice. They are distinguished as epistemic communities only by the nature of their explicit objective – knowledge-production – and a number of organizational features related to that objective (nature of the mechanisms that allow for conflict-resolution and for the validity of the knowledge produced to be established).

The second advantage of this conceptualization is that it serves to describe the emergence and functioning of groups which transcend the boundaries of institutions or organizations. In the preceding sections we saw the emergence of such *agencements* that associate RTOs, universities, firms and actors from civil society, constantly challenging the boundaries of institutions and the specificity of organizations. Communities of research practice may be long-lasting or short-lived, may or may not imply institutional convergence or the emergence or disappearance of certain organizations. For instance Linux communities have emerged in many different, highly active groups that run through firms and other organisations without necessarily jeopardising the integrity of the existing institutions.

The third advantage of using an active, contextualised conception of knowledge is that it emphasizes the collective practices underlying knowledge production. Knowing is something people do. As a result firms have not choice, if the aim is to gain recognition of a form of organisational knowledge, but to address the interplay between knowing and knowledge. This means that a research actors' constant engagement in learning processes becomes a key element. From this point of view the term 'knowledge-based society and economy' can be misleading. It conjures up the image of a static source of knowledge, sitting in an ever growing pile, as the basis for economic and social development. The term 'learning society and economy' seems far more appropriate, for the dynamic is situated in the relationship between learning and knowledge. In a learning society people still invest-in and accumulate knowledge but it is learning that is the activity that creates the knowledge, maintains it or lets it vanish through forgetting. Using learning as the conceptual foundation provides a more open approach to encompassing all research actors, especially users, within an analytical framework capable of generating new policy insights.

And, as will become apparent in the following section this conceptualization of knowledge has a number of consequences for thinking about the organization of research and questions of localization.

## C) Knowledge access and research organizations

All the monographs stress the link between forms of knowledge access (including intellectual property rules) and the organisation of research activities. An examination of this link reveals two idealised models of configuring access and organisation.

The first configuration involves an intensive circulation and transformation of knowledge, particularly using the access and networking facilitated by the internet, travel, etc.. This phenomenon is associated with a relaxation of intellectual property rules. It is also assumed that the 'complexification' of products, services, etc. makes it very difficult for a single actor to concentrate all the knowledge and competencies it needs. Big companies, SMEs, RTOs etc. therefore tend to focus on core competencies and markets, defined of course in a dynamic way, while at the same time engaging in extensive networking in order to secure access to the knowledge and competencies they need. Exchanges of knowledge can take various forms and be performed in a variety of institutional/financial arrangements. This model is

described as a 'new open innovation model': it stresses the fact that innovation derives its strength not from technology alone but rather from a creative mix of various elements incorporated into a good business model.

The second configuration refers to the 'traditional closed innovation model' based on the privatization of knowledge, which appears as a strategic resource, especially for companies positioned in markets where externalities play an important role. It leads to a concentration within the company of all research activities necessary to its business model.

In practice things are considerably less clear-cut than the contrast between these polarised models might suggest. First, because knowledge, as already pointed out, does not fall into neat categories and spans a broad range of different forms and processes. This means that at a fundamental level it is not so simple to sever the link between tacit and codified knowledge or, for that matter, to easily convert tacit into explicit. Any appropriation of knowledge requires learning and the mobilization of tacit knowledge. New knowledge, in particular, can circulate and be appropriated only in confined spaces which correspond more or less to the communities in which it has been developed. As a result the idea of knowledge as a pure public good needs to be seen in more relative terms.[17]

Second because in practice actors adopt not only mixed strategies but also strategies that are dynamically reconfigured over time as a function of changes in the type of knowledge, the evolution of its appropriation, and market dynamics. Those who produce knowledge are often able to determine the communities that will have access to it and those that will be excluded, using a variety of strategies ranging from the selection of specific organisational forms to tools for intellectual property rights management like disclosure and secrecy rules. The way in which intellectual property rights are used is increasingly important, both quantitatively and qualitatively. New objects are patented, including software, instruments, basic materials and databases, even business practices. These rights are being used by both new and old research actors. As already discussed many universities and researchers in public research organizations are taking more aggressive approaches to gaining revenue from their intellectual property by protecting the results of their work. But the use of IPR management is also taking on new meanings, not all contrary to the aims of knowledge sharing. Patents have an increasingly important strategic role as part of the negotiating process for constructing networks, establishing boundaries between those who will have access and those who will be excluded, and signalling the competencies of a community that is going to be involved in joint projects with other communities.[18]

From a policy perspective the challenge is to create an environment where the emergence of new forms of knowledge is facilitated by the appropriate fluidity and sophistication of the system of property rights. In the current context this is not an easy task. As new and old research actors define and contest new forms of knowledge as well as new relationships within the processes of knowledge creation, it is difficult for public authorities to assess the conflicting interests and appropriate range of mechanisms needed to calibrate and assign rents from intellectual property. This is currently very unsettled territory. For instance should policy makers be intervening directly to extend the field of research in certain areas through policies like: compulsory licensing, the purchase by public institutions of patents in order to make them available to those who want to develop new knowledge, user- and use-

[17] Callon, M. (2002). Is Science a Public Good ? In P. Stephan, & D.B. Audretsch (Eds.), *The Economics of Science and Innovation*. London: Edward Elgar.

[18] On all these points see: Foray, 2000, op.cit.; Amin & Cohendet, 2004, op.cit

differentiated price policies (for researchers/multinationals), or the creation of a link between the degree of exclusivity of a license and the obligation to exploit it?

These questions and policy responses take on considerable salience given the explicit goal of achieving a knowledge society. So far, however, the debate over the extent to which diversified and creative networks are essential for the knowledge society has not been resolved. Hence there has been no resolution of the question of the importance of open sharing of knowledge. There can be little doubt that entrenched interests are protecting status and business models. As a result the forms of the networks and the knowledge that a society is capable of developing are shaped on the basis of past models. How severely this will limit the diversification of forms and networks of knowledge remains an open question.

## D) Localization of knowledge

Place matters, but the question is how? On the basis of the research actor monographs the only generalisation that can be made is that location does play a central role in knowledge production. However the nature of this role does not appear to be uniform across all actors or forms of knowledge. First of all, in the context of networking-based innovation, the research actors have different ways of 'being present'. Some research actors are local through a direct physical presence, others through cooperative relationships with other companies, RTOs, universities or a wide diversity of partners who happen to be in a specific place.

Choosing a specific form of local presence is often determined by a variety of familiar factors like access to local markets and/or access to expertise in these markets. Firms may have a strategy of development based upon emergent mass-markets (abroad) versus one based upon mature and sophisticated markets ('home'). The strategies of some firms call for access to unique centres of excellence and even to be part of the setting up of such centres. Or choices about where to locate may simply be the outcome of assessing which place offers better access to needed resources at lower price and risk than elsewhere. However a less familiar calculus may be introduced into the picture, not only as new forms of knowledge and new actors or actor relations emerge, but also as the underlying economic and social logic of the industrial era begins to be replaced.

All this raises questions regarding the scope and nature of research policy at the level of each actor (within multinational firms, RTOs, etc.), and for the role of national, regional and European governments. What is the optimal balance between centralization/decentralization of R&D activities, management and policy-making? Or between direct support activities for R&D and activities aimed at improving the coordination between different levels of intervention and action? What about the potential contradictions between local development and internationalization? To what extent might policies that enable firms to pursue the 'best quality according to international standards' conflict with policies aimed at ensuring that 'research is a means for local economic development'?

Once again, the conceptualization proposed by Amin & Cohendet can be useful for considering the question of localization. The notion of community which emphasizes the collective, situated dimension of knowledge production and the role of organization and material devices seems to argue for a restrictive definition of space based on geographic proximity and face-to-face relations. This approach converges with the options taken in certain public policies, through the development of technology parks and competitiveness clusters. Yet a second approach can be developed, which considers that there are other ways of constructing proximity in space. Information and communication technology, mobility of people, temporary and open collective gatherings, the sharing of tools and methods and so on are all means for organizing interaction and ways of working together to create and use knowledge.

Taking a more open approach to network learning breaks away from a dependence on the classroom or laboratory or cluster as the models for 'local' knowledge production. Often networks are understood as an assemblage of well-identified points (actors) linked by channels that appear to be neutral, in which information or objects flow. Another definition of networks[19] considers that the nature of what circulates on the network plays a crucial part in allowing, or not, the creation of 'proximity' that can give rise to the sharing that makes up local identity. Two laboratories thousands of kilometres apart, which exchange biological material and agree on certain research procedures, can be far closer than two geographically close neighbouring laboratories which work in similar fields but have no interaction of this kind. Amin & Cohendet note that 'individual sites [can be understood] as a node of multiple knowledge connections of varying intensity and spatial distance, as a place of trans-scalar and non-linear connections, and as a relay point of circulating knowledge that cannot be territorially attributed with any measure of certainty or fixity.' (p.93)

Therefore the question is shifting from a choice between a restrictive definition that offers a polar choice of localization versus internationalization to a choice amongst **different forms of internationalization (modes of ubiquity).** Should new forms of knowledge and new research actors continue to proliferate there is a good chance that the tools, both social and technical, needed to alter the practices that lead to the formation of 'localism' will follow pace. New redefined regimes of presence may emerge in which the 'local' versus 'global' distinction becomes merely a spatial characterization. This would mean that there is no opposition a priori between anchorage in a territory – which allows many specific resources to be integrated – and inscription in a geographically extended network. In certain configurations this may be the means to create diversity, specificity and additional wealth.

## E) R&D UNDER PUBLIC SCRUTINITY: EXTENDING THE SCOPE OF LEARNING PROCESSES

'Transparency', 'accountability', 'trust', 'ethics': these words are present in all the research actor monographs. They have acquired legitimacy. But some questions remain. What is the precise content of these terms? How are these terms translated into more pragmatic constraints and imperatives? And what effects do these constraints and imperatives have on the organization of research, on policy-making and on strategies? What are the scope and content of public intervention in R&D policies?

The expert papers explore a number of answers. They chronicle many specific demands for transparency, accountability and ethics, expressed by different groups, often with respect to particular controversies. Such 'political' pressures are conveyed in more general ways by politicians who, in order to meet these demands introduce procedures, rules and laws. For example the conditions that determine how civil society organisations play a role in helping to shape research agendas and outcomes. Going into a little more detail, it becomes clear that the forms of intervention of the public are multiplying and diversifying. There is also increasing investment in the analysis of the content of R&D, and in the identification of links between that content and the definition of social organization. Yet such developments are also triggering questions and concerns. For instance, participatory processes are seen by some as a form of interference by unqualified persons whose intervention should be confined to the surface of the innovation process. From this point of view, consulting laypersons ought to be limited to issues relative to the acceptability of innovations. Others commentators are

[19] Callon, M. (2001). Actor Network Theory. In N. Smelser, & P. Baltes (Eds.), *International Encyclopedia of the Social and Behavioral Sciences.* (pp. 62-66). Oxford, UK: Pergamon; Latour, B. (2005). *Reassembling the Social- An Introduction to Actor-Network-Theory*: Oxford University Press.

upset about the interference that such processes can have on the evaluation of the validity of scientific knowledge. They worry about a possible disappearance of differences between scientific knowledge and other forms of knowledge, and see a confusion of genres on the internet, auguring future chaos.

In an attempt to clarify some of these issues certain authors[20] have proposed a distinction between confined research and research in the wild, which enables us to take into account the diversity of current configurations of knowledge production. By confined research they mean the knowledge production activities which involve traditional research actors: researchers in universities, research and training organizations, multinational enterprises, and small and medium enterprises. Research in the wild relates to the work carried out in many cases by laypersons or at least by a larger group of actors than the circle of researchers. This work is likely to result either in problematization, the starting point for confined research, or in the application of the knowledge and know-how produced by the laboratory. The integration of these other actors in the research collective triggers a powerful learning process that leads to exploration in directions other than those imagined by scientists working on their own. It allows for the conception and testing of projects and solutions that incorporate a plurality of points of view. These processes lead to more robust knowledge and innovation, at a minimum in terms of the ease with which the output can then cross the laboratory walls into the ordinary world. In other words this process poses the issue of acceptability in completely different terms. It has been 'dealt with' upstream, in the formulation of problems and the development of research programmes, so that it does not emerge as a completely separate question relegated to the margins of non-scientific beliefs.

These learning processes also allow the exploration and transformation of the composition of the collective sphere. The section on civil society examined the proliferation of groups, associations and collectives currently working on issues relating to research. What may be worth noting about this more participatory role for civil society is that the development of controversies involving science and technology brings to the fore new groups which are defined via their position in the controversy, or prompts constituted groups to redefine their identity in their confrontation with many possible options.

All these elements outline research configurations that take specificities into account more fully and endeavour to construct models which, instead of flattening differences under an average or implicit norm, try to incorporate them. The case of pharmaceutical research, for instance, provides a clear illustration. Instead of allowing biology to effect a drastic reduction that produces a 'universal' undifferentiated patient, the action of certain groups has made it possible to show that in practice that 'universal' is often represented by particular individuals (white men in the 25-50 age-group, for example). Differences related to age, gender, origins, etc. have consequently been taken into account and made relevant.

Policy makers that want to reap the advantages of this type of more open research need to continue to experiment with new procedures and methods that allow for a more effective inclusion of the public in policy-making and R&D processes. This implies continuing with efforts to analyse, renew and apply consultative approaches such as consensus conferences, focus groups, public debate, parliamentary hearings, etc.. However, as the new forms of research and new research actors become more central the policies aimed at inclusion and engagement will need to go beyond the familiar forms of participation (which have become almost classical even if not systematically implemented). Certain powerful non-

[20] Callon, M., Lascoumes, P., & Barthe, Y. (2001). *Agir dans un monde incertain. Essai sur la démocratie technique.* Paris: Le Seuil

profit associations and NGOs[21] have managed to take over the helm of research programmes and have established management models enabling them to remain in constant interaction with the community of researchers. Other forms are starting to emerge, in which the public authorities are a driving force. Funds are granted to research consortia which associate research laboratories and actors in civil society. In short, the possibilities are wide open and exploring them is one of the main routes to the learning society.

## 4. SCENARIOS

Despite the fact that the HLEG did not conduct a synthesis level scenario exercise there is very rich material from the specific actor scenarios. In this respect the work of this HELG offers a rare opportunity to use a sample of scenarios for different aspects of the same subject to gain a composite picture of the narratives (scenario stories) developed by experts in specific fields. In summary form, the aim of this section is to map the scenarios that were developed for each research actor on to a framework. This framework or map consists of a descriptive model of research actors. The source of the model is the preceding synthesis which highlights the threefold nature of a research actor in terms of what, how and in what context does the actor produce knowledge (act as a research actor).

Prior to briefly developing the model and the variables that can be used to locate the scenarios in a coordinate space the overarching assumptions which frame the scenario map[22] need to be spelled out.

### FRAMING ASSUMPTIONS

When considering the task of constructing scenarios for specific research actors it was recognised that the process envisaged for this HLEG provided neither the time nor the resources to undertake an elaborate scenario process for each actor. As a result one of the key framing assumptions agreed to by the group was that the experts would not attempt to tell the story of the voyage or path that might take a specific research actor from the present to 2020. Rather the idea was to take a “snapshot” of the research actor in 2020 and compare the role(s) and organisational form(s) of the research actor in 2020 with those of today.

Other key framing assumptions for the scenario mapping exercise conducted here are:

- Given the exploratory nature of the scenario exercise, i.e. the outcome was not given, a number of different types of scenario or story about the future are not considered pertinent to this exercise, including contingency and optimisation scenarios that are used when there is a given goal, like save a hostage or recover from a disaster.

- Given the specification of the actors, the level of analysis was not micro nor macro, in the traditional sense, but institutional.

- Given that the study was commissioned by European level policy makers the pertinent point-of-view for policy action is EC decision makers.

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[21] Rabeharisoa, V. & Callon, M. (2002). The involvment of patients' associations in research. *International Social Science Journal*(171), 57-65

[22] For more detail regarding the methodology used in this section see: Miller, R. (forthcoming). Futures Literacy: A Hybrid Strategic Scenario Method. *Futures: the journal of policy, planning and future studies*

- Given time frame, by the EC, is 2020.

- Given that rigorous scenarios require a clear specification of the underlying or "framing assumptions" it was made clear at the outset that over the time span under consideration the following points were assumed: no catastrophes (political or physical); mixed market economies (no sudden imposition of command planning); modestly greater degrees of openness with representative democracy, rule of law, rights (human, children, women, environmental, disable, etc.) all at higher levels than today, worldwide; modest IT improvements like faster processing power, better networking (wireless); nano- bio-techs begin to add significant value but applications and diffusion still only modestly greater than today; productivity (for the world as a whole) continues to grow.

- Additional "history of the future"[23] framing assumptions:

    i. Long-run socio-economic change is compositional. The old co-exists with the new and reallocation is what leads, eventually, to significant shifts in the weights of specific constituent elements of the total system.

    ii. Socio-economic change is incremental in the sense that it takes place in a complex, multi-dimensional present in which inertia (power to oppose change, resistance in all its forms) and the constraints of evolutionary functionality limit the rate of change (deep and pervasive socio-economic transformations take time).

    iii. Over time incremental socio-economic changes can produce radical differences when two points in time are compared – the "Rip Van Winkle" gap.

    iv. Socio-economic change is both dialectical and usually only partially rational, explicit, chosen.[24]

    v. The choices that *are* made (by individuals and collectivities) can be classified in terms of the extent to which the change does or does not contribute to the preservation through refinement of existing socio-economic systems versus incremental transformation that generates cumulative alterations that eventually create a radically different, new socio-economic system.

## A SYNTHESIS MODEL FOR MAPPING THE SCENARIOS

The scenario map consists of a model that was constructed on the basis of the preceding synthesis analysis of the research actor reports.

The aim of this "synthesis model" is to situate the scenarios in an open way but still within the framing assumptions outlined above. Within this frame the method for mapping the scenarios, which in this case have been selected (imagined) by the RA (research actor) papers, is to look at the function and form of research actors in each scenario. The use of these two primary dimensions, function and form, for mapping research actor scenarios is

[23] Miller, R. (2003). Where Schools Might Fit in a Future Learning Society, IARTV. Victoria, Australia (www.iartv.vic.edu.au/publications_f/seminar_series_latest.htm)

[24] Kuntz, C.F., & Snowden, D.J. (2003). The New Dynamics of Strategy: Sense making in a complex and complicated world. *IBM Systems Journal*, Vol. 42(3), 462-483.

rooted, not in a theory of research actor transformation, but in the pragmatic need to look at the future in terms of the roles and organisational attributes of institutions in order for the analysis to connect with the policy interests of the client for this exercise – the European Commission.

The form and function approach presented here is a simple descriptive method that assumes that the primary attributes of a research actor scenarios can be captured along three dimensions: what is the form of knowledge produced; how is this knowledge produced; and in what context is the knowledge produced, meaning what is the relationship of the actor to the world around it.

In more formal terms this can be written as:

RA = f (F, H, C)

The variables are defined as follows: RA, for the Research Actor; F for what 'form of knowledge' is being produced by the RA; H for 'how' the RA is organised and actually produces knowledge; and C for the 'context' and relationships that define the RAs socio-economic situation in the "external" world of actors and context outside the boundaries that define the RA as an institution.

Without going overboard in developing the model it is useful, particularly since the papers on the different research actors often make this distinction, to further sub-divide the three dimensions into those that are internal and those that are external. Meaning the descriptive attributes of the goals, organisation and relationships from within the actor's own internal constituencies, rules, decision making systems, power allocations, etc. and those outside the research actors boundaries.

Again in symbolic form (where i is internal and e is external):

$\Delta RA = f (F_i, F_e, H_i, H_e, C_i, C_e,)$

Now each of these variables, both internal and external, is quite complex in its own right and probably merits a descriptive model of its own. However, it is adequate for the purposes of this paper, aimed at capturing the attributes of the RA scenarios so as to map them collectively, to now briefly deepen the specification of the variables.

- **(F)** What form(s) of knowledge does the RA produce?

The variable is forms of research produced by RAs, a topic covered in detail over the preceding pages. For the purposes of mapping the scenarios two categories are distinguished: one is where the goal of the research actor is industrial production and research is a classic factor of production, and one is where the goals of a research actor are more diverse and where research cannot be characterised as being primarily an input into industrial forms of production. This variable **F** varies between one and ten.

Scenarios in which the research actor is primarily engaged in producing one form of knowledge for industrial production, for example all types of so called high-technology, will be scored near to one. Scenarios in which the research actor has begun to diversify the forms of knowledge it produces but remains explicitly intent on creating inputs to industrial production will be scored near five. And scenarios that depict research actors without any 'a priori' primary form of knowledge production nor expectation of providing input into any specific form of organising production will be scored near ten.

- **(H)** How is research produced?

The expert papers and this synthesis paper provide in-depth assessments of the different and diversifying ways in which research is produced. One conceptual schema referred to in the expert papers and consistent with the arguments advanced so far in this synthesis paper refers to two forms of knowledge production Mode 1 and Mode 2.[25]

"Mode 1 refers to a form of knowledge production – a complex of ideas, methods, values, norms – that has grown up to control the diffusion of the Newtonian (empirical and mathematical physics) model to more and more fields of enquiry and ensure its compliance with what is considered sound scientific practice. Mode 1 is … the cognitive and social norms which must be followed in the production, legitimation and diffusion of knowledge."

"In Mode 1 problems are set and solved in a context governed by the, largely academic, interests of a specific community. By contrast, Mode 2 knowledge is carried out in a context of application. Mode 1 is disciplinary while Mode 2 is transdisciplinary. Mode 1 is characterised by homogeneity, Mode 2 by heterogeneity. Organisationally, Mode 1 is hierarchical and tends to preserve its form, while Mode 2 is more heterarchical and transient. Each employs a different type of quality control. In comparison with Mode 1, Mode 2 is more socially accountable and reflexive. It includes a wider, more temporary and heterogeneous set of practitioners, collaborating on a problem defined in a specific and localised context."

However, given the reflections of the expert papers and this synthesis analysis, Mode 2 remains somewhat limiting with respect to the range of ways knowledge is produced. In part this may be due to the restricted notions of forms of knowledge, but regardless the point here is to ensure that the variables that serve to locate scenarios on the possibility space map are defined and set to a scale that is sufficiently open. Naturally, given that the future is unknowable and the very concepts that will render the future intelligible have yet to be discovered or develop sufficient sense making force, it is difficult to imagine how to produce knowledge beyond Mode 2. One suggestive view, adopted here evokes the concept of "collective intelligence" or alternatively, "spontaneous learning".

Collective intelligence (or Mode 3) is the subject of a lively on-going discussion, but a working definition is that 'collective intelligence is the capacity of human communities to cooperate intellectually in creation, innovation and invention'.[26] This type of general definition only helps to specify the distinctiveness of how "collective intelligence" produces knowledge by stressing how it differs from the lone researcher in Mode 1 or the purposeful process in Mode 2. Where it begins to push into uncharted territory in terms of how knowledge is produced is when learning as action or spontaneous learning enters the picture. Knowledge that is produced spontaneously through action is learning by doing, experimentation that has heretofore been considered mostly marginal to the kinds of knowledge research actors produce. The idea of "collective intelligence" pushes the envelope, both in terms of what forms of knowledge are being produced and how that knowledge is used.

This variable **H** varies between one and ten. Scenarios in which research is primarily conducted using Mode 1 methods will be scored near to one. Scenarios in which research is largely conducted using Mode 2 methods will be scored near five. And scenarios that depict

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[25] Gibbons, M., Limonges, 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, p. 2.

[26] Lévy, P. (2000). *Collective Intelligence: Mankind's Emerging World in Cyberspace* New York: Perseus Books Group and Wikipedia entry for Collective Intelligence, http://en.wikipedia.org/wiki/Collective_intelligence

research that is conducted spontaneously, takes diverse and complex forms, and can be considered as part of an emerging "collective intelligence" will be scored near 10.

- **(C)** What is the context within which research is produced and used?

By the nature of the assigned task, the research actor scenarios are institutionally sourced. Even for those reports that took-up on the suggestion of attempting to imagine a scenario in which the research actor's institutional perimeter was weak or non-existent still begin from the position of the actor. This variable starts with the socio-economic context. The range of the variable is defined by a vector of socio-economic contexts that ranges from a sort of 'idealised' industrial past, best described by standard economic models of competition, trade, productivity, etc., and at the other extreme, a socio-economic system that bears little organisational similarity with the industrial past. Each of the RA scenarios is then assigned to a different rank on this continuum depending on the explicit or implicit context given for the specific scenario.

In the industrial context research enters into economic and social life primarily as a factor of production for enterprises (public and private) seeking to become more efficient or competitive in a given market. The forms of research and how research is produced can both evolve, but this evolution is limited to the over-riding imperatives of the firm's organisation and markets dynamics or political budget games (in the case of public operations like schools, universities, hospitals, etc.). In this industrial context research is channelled into a narrow and clearly pre-determined set of relationships that are central to such issues as the efficiency of a nation's "national innovation systems", the ranking of a nation's global competitiveness based on attractiveness for foreign direct investment and industrial (including finance, design, etc.) jobs, and the classic indicators of industrial economic performance like balance of payments, trade balance, etc.. This research context does not exclude consideration in the scenario of a wide range of elements, including issues like "social capital" that influence the functioning of the research actor. But the over-riding position of research and innovation as well as the research actor is the production of tangible (technological) goods (even if the economy is already dominated by intangibles).

Mid way along this contextual continuum is what might be called transitional society. This socio-economic context is the mixed case. Institutional relations remain largely subject to the logic of industrial production but the shift to services and intangibles output dominate hence the move to more networked and transversal relations. Mode 2 methods find fertile ground and begin to take up a larger share of what is considered research activity. However, the relations between research actors of any sort, using Mode 1 or 2, and society remain structured by the supply-demand dualism, the corporate form of business and employment. In this transitional context research splits into three streams with uneasy interaction across the boundaries. One stream remains the hierarchical, linear processes, institutions and relationships of tangibles research (although intangibles are also researched in this stream). The second stream is oriented to the realities of intangibles, research is much more contextual and transgressive (when looked at from the traditional stream), but the organisational economic logic that rests on bringing a commodity to market through the industrial institutional fabric (firm, job) remains. The third stream, that is hinting at the next context in the continuum, loses all semblance of the industrial institutional frames and even stands in opposition in terms of how it establishes property rights, revenue flows, trust, etc..

But the key to this third stream, that brings the discussion to the third context for the research actor scenarios, is that the economy and society are dominated by the value-added (for wealth and identity) of internalised learning. This context turns contextualised action learning not into a means but an end and as such research is what everyone does all the time. From the point of view of the first context this might mean that no research is done at all, or at least very little in relative terms. Here it is important to keep in mind one of the framing

assumptions regarding compositional change. In this third context for the RA scenarios all forms of research are likely to remain, much like agricultural activity remains in industrial society, only the old forms and institutional logics become a very small proportion (a necessary but not sufficient condition, like food) of aggregate research activity.

In the post-industrial society context there is a shift in what people produce, as well as where and how they produce it. The biggest difference between the industrial and post-industrial context, from an economic point of view, is that "unique creation" has become preponderant. This kind of shift is similar to what happened when industry became more important than agriculture. Of course, as already noted, this does not mean that industry disappears. Agriculture did not disappear when industrial society moved to centre stage. What happened was that increases in agricultural productivity meant that it was possible to meet demand for food without allocating so much time, labour and income to producing and distributing it (contributions also came from improved efficiency in transportation/storage and market expansion as wage work spread). In the case of this post-industrial context, the industrial economy, like the agricultural one of the past, is eclipsed by its own success. Industrial production and consumption, be it for goods or services (including banks, hospitals, schools), become so productive that the time, labour and income devoted to it decline as a share of total wealth created.

One hypothesis of what might make up the dominant share of wealth is unique creation. A unique creation is output (tangible or intangible) that is at once unique and valuable to its user/creator because they designed it, i.e. they did it for themselves. Everyone does this all the time, in completely banal ways, like if you sit down at a desk you rearrange the chair, the light, the keyboard, etc. to your own tastes. Similarly if you make yourself a sandwich, you add more or less of the different ingredients. It is a unique sandwich that corresponds to your idea of the most valuable output given the constraints like available time, number of ingredients, extent of hunger, etc..

Two key attributes of unique creation help to clarify the ways in which this type of economic change might alter the context for research.

First, without speculating what this new economic star will devote time and energy to (who in the 19th century could have dreamt up the importance of the automobile for "fordist" industrial mass-production/consumption in the 20th century?), it is worth noting that unique creation (self-determined output) could be well suited to a society that allocates a larger share of its wealth to the tasks of 'researching' identity and community.

Second that since unique creation depends on an individual's capacity to refine their own tastes, what they like and want in the unique products/services/experiences that they produce (often jointly with others) this means that greater productivity (efficiency-quality) depend on learning about what you like. This, in turn, means that increasing productivity in an economy where unique creation is dominant will happen through people learning about themselves and their capacity to meet their desires through the world around them[27]. Do we get better at learning through experience? If the answer is yes then a unique creation economy can be an economy with constant productivity growth – assuming that people do get better at learning to learn as they age.

This variable **C** varies between one and ten. With a purely industrial society context ranked near one and a purely "unique creation" post-industrial context ranked at ten.

[27] V. Vinge, Nature, http://www.nature.com/nature/journal/v440/n7083/full/440411a.html

## MAPPING THE RA SCENARIOS

The authors of the RA papers have done an excellent job of providing rich material, capturing the imperatives that appear central to the decisions that decision makers are facing today, for describing the current attributes of research actors. Based on these current attributes the papers also elaborate scenarios that depict the research actors under different assumptions. The scenarios, as was agreed upon in the groups work plan, are constrained by the point-of-view of the actor and are primarily projections of different organisational configurations.

### *CAPSULE SUMMARIES OF THE RA SCENARIOS*

This section reviews each of the RA scenarios in order to distill the basic message of each story and assign scores for each of the three variables of the mapping model. Each scenario is also assigned to one of three groupings: business-as-usual, hybrid or radical change. This classification is largely based on the extent to which the policy measures taken in a particular scenario depart from current practices.

- **Researchers**

  - As civil servants. In this scenario the diversity of forms of knowledge is very low (F=1) and the methods used to conduct research remain very restricted (H=1). There is no comment on context, assumed to be industrial (C=1). Classified under the "business-as-usual" set of scenarios because the scenario restricts policy to familiar approaches.

  - The "return of national policies." In this scenario the diversity of forms of knowledge produced is slightly higher than in the previous scenario (F=2) and the methods significantly more diverse due to the official integration of non-academic actors (H=4). There is no comment on context, assumed to be industrial (C=1). Classified under the "hybrid" set of scenarios because it combines some old and some innovative policy directions.

  - "Knowledge as private good." In this scenario the diversity of forms of knowledge remains low, yoked entirely to industrial research imperatives (F=1). The methods are also non-diversified as efficiency of industrial research output becomes the benchmark (H=1). There is no comment on context, assumed to be industrial (C=1). Classified under the "hybrid" set of scenarios due to the mixture of new and old policy approaches. [Note this scenario is excluded from the scenario compilation by classification (Table 1) because it is a low change scenario but included in the overall two dimensional map (Diagram 4)].

  - "European competitive ecology." In this scenario diversity increases, but within strong traditional accountability frameworks (F=3). The institutional conditions are significantly transformed with much more dynamism and heterogeneity of relations giving rise to experimentation in methods (H=5). Given the extent of institutional change, although there is no direct comment on context, the context is assumed to have moved somewhat towards post-industrial (C=3). Classified under the radical change set of scenarios since the policy measures depart considerably from current practices.

- **Research Transfer Organisations**

  - Strong RTO. In this scenario the forms of knowledge produced by the RTOs becomes even narrower than the present with a focus on global winning technologies (F=1). Organisationally the way knowledge is produced by RTOs remains highly conventional, with a strong hierarchical and disciplinary structure along the lines of the "linear model" of innovation (H=1). The context remains the industrial competitive one, with the international division of labour simply shifting up the pyramid so that OECD countries remain in the lead for the highest value-added industrial activity (C=1). Classified under the business-as-usual set of scenarios since from a policy perspective there is very little innovation.

  - Dissolution of RTO. In this scenario the forms of knowledge are controlled, innovation is reigned-in and research is harnessed to solving specific problems like health and environmental conditions (F=0). Since this is a low research intensity scenario and the funding as well as missions of the research actors are restricted the methods used are not innovative (H=1). The context has a largely social focus and remains conventionally industrial (C=1). Classified under the hybrid set of scenarios due to the departure, in a regressive way, from current policy practices.

  - Networks of innovation (universalisation of the RTO). In this scenario the forms of knowledge have exploded with a proliferation of socially embedded innovation across all areas of human activity (F=7). Knowledge production, in the words of the scenario has become 'socialised', although the process is still cast in terms of "the entire knowledge chain from basic research … to applications" (H=5). The context has also moved considerably in terms of a broader spectrum of research but the core around which the economy functions remains the industrial context, albeit more user based (C=6). Classified under the radical change set of scenarios since there are a number of major policy innovations in this scenario.

- **Universities – in the "Double Success" context**[28]

  - Unchanged – institutional business as usual. In this scenario universities remain fairly isolated from other RAs and the forms of knowledge produced are largely in the old categories (F=1). Universities continue to produce knowledge using the linear, discipline bound methods of the past, with slight evolution in the inter-action across disciplinary frontiers (H=2). The focus of universities both in terms of training and research is to serve the industrial competitive economy, with some consideration of social issues – but in industrial form (efficiency of "factory" hospitals, schools) (C=1). Classified under the business as usual set of scenarios given policy continuity of this scenario.

  - Radically reformed – institutional renaissance. In this scenario universities make more of an effort to adapt to changing economic and social circumstances, becoming much more closely linked to "external" research (F=4). However the university is still a university and still uses the same ranking and disciplinary evaluation systems (H=3). And the context remains resolutely competitiveness oriented with very wide regional

[28] Only one of two contrasting scenario sets has been selected here. The double success set was chosen because it scores higher on the transformative dimensions of the model and therefore adds more to the variance of the sample used in this scenario pooling exercise.

disparities that policy only addresses “half heartedly” (C=2). Classified under the hybrid set of scenarios due to the mixture of conventional and innovative policy.

• Universities disappear – institution expires. In this scenario research and “learning” melt into the highly active knowledge society, without universities to channel or oppose new forms of knowledge (F=6). Without the dominance of entrenched practices a whole range of new joint scientific activities emerge, with new mechanisms for inter-subjective evaluation, trust and access (H=6). However changes to both what and how knowledge is produced and used are constrained because the society is still considered to function within an economy dominated by industrial wealth creation (C=5). Classified under the radical change set of scenarios because the policy framework in this scenario is significantly transformed as measured by the degree of institutional change.

**• Multinational Enterprises**

• Long-Boom – Dramatic investment in innovation. In this scenario high levels of investment in research, deregulation, competition and seamless global flows all propel MNEs to become very effective managers in producing a great deal of conventional industrial innovation (F=3). Given the aim of innovation and advances in management practices arising from strong competitive verdicts on what works and what does not, there are more open methods for conducting research (H=4). The basic economic and social divisions of labour and status remain unchanged in a firm dominated world (C=1). Classified under the hybrid set of scenarios since the boom depends on a mix of conventional and innovative policies.

• Cyclical – Lower investment in innovation. In this scenario the wild card is the extent to which breakthrough innovations fuel economic growth, but the role of MNEs and the overall output of new forms of knowledge is relatively modest due to lower levels of investment (F=3). Methods are open and although competition is not as fierce a force pushing better management of research there are the social and cooperative impulses that lead to outside-in processes (H=4). The context remains rooted in the same economic and social organization as the present (C=1). Classified under the business as usual set of scenarios since the policy mix remains basically conventional.

• Handpicked – Innovation by chance. In this scenario the dominant forms of knowledge remain technology centric, even though the production of this knowledge now happens primarily in those places (outside Europe) where industry is still maturing, leaving a slightly more conservative values mix in Europe that creates constraints that demand social research (F=3). By a different path, meaning less emphasis on high-technology innovation, the European MNEs are relaxed enough to be equally open to different research methods as was the case, for other reasons, in the previous scenarios (H=4). The context is global industrial society (C=1). Classified under the business as usual set of scenarios since the policy mix remains basically conventional.

• Zero-growth – Innovation cooperation. In this scenario incremental innovation dominates the internal efforts but is open to more diverse breakthroughs from outside Europe (F=3). The static nature of this scenario generates its own sort of methodological innovation, since coping with inflexibility is challenging plus the modest openness to outside forms of knowledge sustains some changes in the way MNEs manage research (H=4). The context is still global industrial society (C=1). Classified under the radical change set of scenarios because there is a significant

departure from the traditional policy stance, away from fiscal and industrial intervention.

- **Small and medium sized enterprises**

  - Academic spin-outs: from hype to reality. In this scenario knowledge transfers in the high-technology field between research institutions and SMEs work very effectively, but the field of innovation remains fairly narrowly defined in terms of technology (F=2). The production of knowledge is organizationally somewhat more dynamic as the relationships are more fluid and intensive between the research world and SMEs (H=2). The context is strictly business as usual with industrial competition dominant (C=1). Classified under the business as usual set of scenarios given that the policy approach is largely a continuation and extension of existing initiatives.

  - Business model innovation as a source of competitive advantage. In this scenario the capacity of firms to engage in a wider range of research, linked to both the traditional knowledge creation sectors and the broader public, leads to somewhat greater diversity of knowledge forms (F=4). The proliferation of business models and the innovation it leads to in terms of research generates considerable creativity in how knowledge is produced (H=5). But the context constrains diversification of forms of knowledge and methods for producing it since the context is seen as unchanged from the industrial, technology focus (C=2). Classified under the radical set of scenarios due to the important policy initiatives that will be necessary to allow for significant business model innovation (a type of change that is highly policy dependant).

- **National Governments**

  - Business as usual, innovation lags. In this scenario, national governments do not significantly expand the focus of science, technology and innovation (STI) policies to cover a broader range of knowledge (F=3). Similarly the policy focus remains on the conventional methods and producers of knowledge such as universities, innovation clusters, etc., such that methods and division of labour in the research field are roughly the same as today (H=2). The socio-economic context is assumed to be basically stable with slight advances in networking, globalization and diversification (C=3). Classified in the business as usual set of scenarios since it is explicitly assumed for this scenario that there is continuity in the facilitator and controller role of national level decision making that uses STI policies to target innovation.

  - Radical transformation, innovation leap. In this scenario national governments do everything right in order to ensure that national innovation systems become significantly more effective across a wider range of economic, social and ecological fields, even to the point where there is a flourishing of new forms of “local knowledge”, but there is still a strong focus on the performance of STI (F=7). The high-performance national STI policies include “policy learning” and the recognition that the way research happens has become “transgressive”, with new validation mechanisms, a blurring of boundaries and the inclusion of users, service sector and non-technical activities, the organisation of how knowledge is produced diversifies considerably (H=7). In terms of socio-economic context the industrial imperative of “investment attractiveness”, which for this actor is rooted in good STI policy, maintains the predominance of the competitiveness paradigm even as the flourishing of “local knowledge” begins to hint at the potential to change the mix (C=6). Classified under the radical change set of scenarios since the national level RA significantly transforms the way policy is conducted (policy as action research – experimentation), to the point that the old institutions and processes are surpassed.

• Regionalisation, local and European levels strengthen. In this scenario the national level policy role, including STI policies, diminishes leaving a mixed (uneven) picture for the validation and range of different forms of knowledge that are advanced at European and local levels (F=3). How research is produced also has an uneven character, with certain fields and areas highly advanced and others lagging considerably, the networking is more intricate but not far beyond the linear methods of the past (H=4). The context evolves somewhat, without gaining the momentum or coherence of a newly emergent system, so fails to push very far beyond the basic industrial order (C=4). Classified in the hybrid set of scenarios reflecting the mixed attributes of this scenario.

**• Regional Governments**

• Business as usual, diversity is maintained. In this scenario the continuity of policy approaches means that the diversification of forms of knowledge already occurring will continue but in modest ways that will depend largely on specific local conditions, such as the way authority is distributed across different levels of government and political history (F=2). Without a strong policy direction or integrating coherence the proliferation of research methods occurs in a fairly haphazard and widely distributed way, allowing for pockets of innovation to flourish (H=4). Socio-economic change in these scenarios remains largely within the industrial, competitiveness and linear innovation frame (C=1). Policy is assumed to be business as usual for this scenario so it is classified in that scenario set.

• Radical transformation, strong decentralization/regionalization. In this scenario the polarization of policy interest/jurisdiction gives regional authorities a strong role but without necessarily altering the diversity of research or forms of knowledge produced (F=3). With increased local initiative it seems likely that there will be somewhat greater diversity with respect to the ways in which research is conducted, still the level at which policy is initiated is considered compatible with either high or low method diversity (H=4). Socio-economic change in these scenarios remains largely within the industrial, competitiveness and linear innovation frame (C=1). Classified in the radical set of scenarios since it is assumed that there is a radical change towards local initiative although the policy mix continues along fairly conventional lines.

• Centralisation, trans-national government. In this scenario there is a hollowing out of the regional role, but once again without necessarily having any specific bias one way or the other on the diversity of what or how knowledge is produced through research (F=2, H=2). Socio-economic change in these scenarios remains largely within the industrial, competitiveness and linear innovation frame (C=1). Classified in the hybrid set of scenarios since it is assumed that although regional level initiative is “radically reduced” the overall integrative, EU level policy context remains fairly conventional and does not eliminate regional disparities and the mix of policies that reflect these differences.

**• Civil Society**

• Citizens for Innovation, the role for civil society in an economically governed Europe. In this scenario the openness and immense expansion of joint production across all kinds of economic activities has sparked the emergence of a whole range of entirely new forms of knowledge – action research is in full swing (F=8). With the experimentation taking off in the economic sphere and escaping from many of the old institutional constraints in terms of firms and research organizations there is also an explosion of new methods for producing knowledge (H=8). In terms of socio-

economic change the internalization of research through joint production across the economy alters basic functioning even though in the remnants of the old economy competitive industrial conditions persist (C=7). Classified as part of the radical change set of scenarios since the policies that establish this degree of credibility and transparency for civil society engagement with production are a major departure from current closed, elite systems that defend vested social and economic interests.

• Knowledge Stock Exchange, European civil society melts into the market. In this scenario there is considerable development of new forms of knowledge, but within a strong private property framework that has limited diversity somewhat (F=6). Based on new and effective market creating mechanisms, combined with institutional innovation throughout society, the range of organizational approaches to research increases within the logic of conventional forms of commodification (H=6). The socio-economic context is highly dynamic as transaction infrastructure, including civil society organizations, becomes more open and creative within the scope provided by marketability (C=5). Classified as part of the hybrid set of scenarios since the policies consist of the standard market driven agenda but expressed in a much more open way, less captured by vested interests.

• Political Powerful Civil Society. In this scenario civil society institutions wield sufficient power to brake the emergence of new forms of knowledge (F=4). On the other hand within this more limited range of knowledge production the involvement of civil society has moved the organizational side, but still within a narrow corridor that is deemed necessary for civil society to exercise control (H=5). In terms of the socio-economic context there is less dynamism as caution and planning, as a way to avoid the risks associated with change, slow transformation (C=4). Classified as business as usual in so far as the strong political constraints that currently generate directionless and often contradictory policy continue to generate stalemate.

### *CHARTING THE RA SCENARIOS*

The following table summarises the different actor scenarios in terms of the three variables (leaving aside for now external and internal) specified above: F, H, C. Each scenario is ranked using a scale from 1 to 10 that correspond, as specified above, to the two extremes of the scenario mapping variables.

**Table 1: The RA Scenarios Scores by Descriptive Mapping Variable**

| | Business as usual | Hybrid Version | Radical Change |
|---|---|---|---|
| Researchers | F (1), H (1), C (1) | F (2), H (4), C (1) | F (3), H (5), C (3) |
| RTOs | F (1), H (1), C (1) | F (0), H (1), C (1) | F (7), H (5), C (6) |
| Universities | F (1), H (2), C (1) | F (4), H (3), C (2) | F (6), H (6), C (5) |
| MNEs | F (3), H (4), C (1) | F (3), H (4), C (1) | F (3), H (4), C (1) |
| SMEs | F (2), H (2), C (1) | | F (4), H (5), C (2) |
| National Governments | F (3), H (2), C (3) | F (3), H (4), C (4) | F (7), H (7), C (6) |
| Regional Governments | F (2), H (4), C (1) | F (2), H (2), C (1) | F (3), H (4), C (1) |
| Civil Society | F (4), H (5), C (4) | F (6), H (6), C (5) | F (8), H (8), C (7) |

## COMMENTS ON THE SCENARIOS

In order to take full advantage of this rare opportunity to pool a set of institution specific scenarios the comments in this section are divided into three parts: weak signals, links between the different scenario groups, and the map as whole.

### *SCENARIO WEAK SIGNALS*

Detecting weak signals or the phenomena that are around us that have the potential to become significant, in one way or another, is a difficult task. A story, depending on how it is told and what it is about, can help to draw attention to the events or patterns that otherwise might fade into the background or just fail to catch anyone's attention. However not all types of scenarios are effective at revealing the hidden potential of the present. For instance the scenarios that tell the story of strong economic growth, high levels of research funding and in general project the success of the existing ways of "doing business", all generate scenarios that lead to bigger, better, faster, more competitive, more innovative, richer, less unequal and a more integrated ERA. Such "good", high positive trend scenarios tend to obscure more than they reveal. On the one hand the successes of the "good scenario" are so dazzlingly bright it makes it hard to detect the faintly glowing weak signals, particularly those that do not fit inside the winning formula. On the other hand even the conflicts and fault lines tend to fade from sight, resolved by the win-win solutions when a rising tide lifts all boats.

Similarly the "bad", high negative trend scenarios also obscure the weak signals in a fog of defensive actions, as all the players scramble to survive. Assuming that the negative scenario does not go over the edge into catastrophic failure then most of the weak signals are drowned out in a sea of "conservationist" success – avoiding catastrophe by preserving what can be preserved of the status quo. Lastly, even the third category of muddling through scenarios that mix and match good and bad, high and low negative and positive trends, are relatively ineffectual at helping to distinguish the emergent phenomena that might, given choice and chance, alter the way the present evolves. This is largely because muddling through or what might be called "ugly" scenarios, a mixture of good and bad, are murky by

definition – no one attribute is dominant, no one systemic pattern emerges. Furthermore these mixed outcomes usually are generated by picking (largely arbitrarily) a particular political solution such as an impasse or lack of leadership or failure to find a compromise.

In the end, scenarios of the good, bad or ugly type do not provide a particularly clear way of identifying the potential of the seeds scattered around us to become tomorrow's forest. Another approach, still using stories about possible futures, is to map the different scenarios within a framework that is intended to identify emergent phenomena, including new incipient systemic patterns. As already noted this is one of the aims of the scenario mapping exercise conducted here. It is not that the map helps to identify better predictions, on the contrary it adds to the ambiguity by highlighting the ways in which assumptions create patterns and leave entire sets of possibilities unconsidered. Deterministic predictive scenarios highlight this type of blindness. There are many infamous examples, like the Chief Executive of IBM who predicted that the world would never need more than five computers or the city councillors in the late 1900s in New York who predicted that if trends continued Manhattan Island would be buried under horse manure. Avoiding such erroneous predictions requires adopting not only a strong version of non-predictive (or "modal") analysis but also rigorous framing and mapping of the scenarios using the methodological approaches adopted here.

Using a model to map the scenarios helps to reveal that scenarios that have been constructed using distinctions like good, bad and ugly or high, medium and low end up with low variance in systemically coherent variable sets. For instance reading across Table 2 it is clear that the MNE, SME and Regional Government scenarios are all bounded by less than two points of variation. There are many reasons for this lack of variation. One is the way the scenario mapping model for describing change in research has been specified. Another reason is the use of growth rates to distinguish scenarios and of institutional "success" (which proxies a version, from the institution's point-of-view of good or bad). The invariance of these three sets of RA scenarios does, however, underscore that institutional continuity may be indicative of a conflict between societal changes and the efforts of these institutions to preserve what is viewed as an order congruent with the institution's interest. Or, looked at another way, the invariance may be indicative of an incompatibility between these RAs and a new research system.

Here we enter into a discussion of weak signals as revealed by the scenario mapping. The actual scenarios for MNEs, SMEs and regional governments, closed within a framework that basically assumes the permanency of the organisational and functional logic of the institution and the socio-economic reality it is embedded in, cannot address the issue of transformation outside its own parameters. Mapping these limitations throws into relief the need to consider the signals of change from outside the realm described by the scenarios. In other words the mapping exercise is one way of posing the question of the relationship between inside and outside the box changes, both internal to a specific institution and arising from the dynamic between the institution and the context that defines both its role and, usually, the means for playing that role. This, in turn, helps policy makers to distinguish and leverage the differences between endogenous and exogenous changes.

**Table 2: Summary of the Scenario Mapping Scores as Averages**

| | *Business as usual* | *Hybrid* | *Radical Change* |
|---|---|---|---|
| Researchers | 1.0 | 2.3 | 3.7 |
| RTOs | 1.0 | 0.7 | 6.0 |
| Universities | 1.3 | 3.0 | 5.7 |
| MNE | 2.7 | 2.7 | 2.7 |
| SME | 1.7 | | 3.7 |
| National | 2.7 | 3.7 | 6.7 |
| Regional | 2.3 | 1.7 | 2.7 |
| Civil Society | 4.3 | 5.7 | 7.7 |
| | | | |
| Average | 2.1 | 2.8 | 4.8 |

This message is reinforced by the fact that a number of specific RA scenario sets, particularly for RTOs, universities, national governments and civil society, show strong transformative potential. All of these RA scenario sets display a major change in the function and form of the institution between the business as usual and radical change scenarios. One of the reasons for this is that these four scenarios were constructed with greater openness to both endogenous and exogenous change. On the endogenous side one of the key elements that distinguishes the higher and lower variance scenarios is whether or not the role and the institution can be separated. On the exogenous side it is the attention to the evolutionary potential of the external socio-economic system, including how the other RAs can take up new roles and organisational forms.

Another point worth noting when analysing Table 2 is the lack of variation of the averages for the three policy differentiated scenario groups (business as usual 2.1, hybrid 2.8 and radical change 4.8). Partly, once again, this reflects the extent to which certain of the RA scenarios were constructed using closed frameworks that did not allow for major transformative shifts and hence generate low scores across the board. Partly this reflects the difficulty of constructing scenarios that are “nested” with a systemic framework that opens up the potential for strong interaction between the institution and its context. It is this difficulty that points to the importance of using “rigorous imagining” techniques for constructing the initial scenarios.

### *SCENARIO GROUPS*

Diagrams 1 to 3 present the three scenario groupings: business as usual, hybrid and radical change. The diagrams help to highlight three aspects of the RA scenarios. First, looking at the within group dispersion, the ranges increase as the degree of policy change increases. This poses a question regarding the institutional adaptability of certain RAs. In other words are some less adaptive than others when there is radical change? As already noted, part of the answer can certainly be found in the assumptions used to construct the specific scenarios – in itself a revealing point. But in part the answer is related to the nature of the changes that are occurring in both other RAs and the overall socio-economic context. The scenarios dealing with three of the RAs, universities, national governments and civil society, exhibit this strong interactive transformation. This means that these scenarios can be useful for considering policies that take into account such interaction and could be more explicitly aimed at generating transformational change.

**Diagram 1: Mapping the Scenarios – Business as Usual**

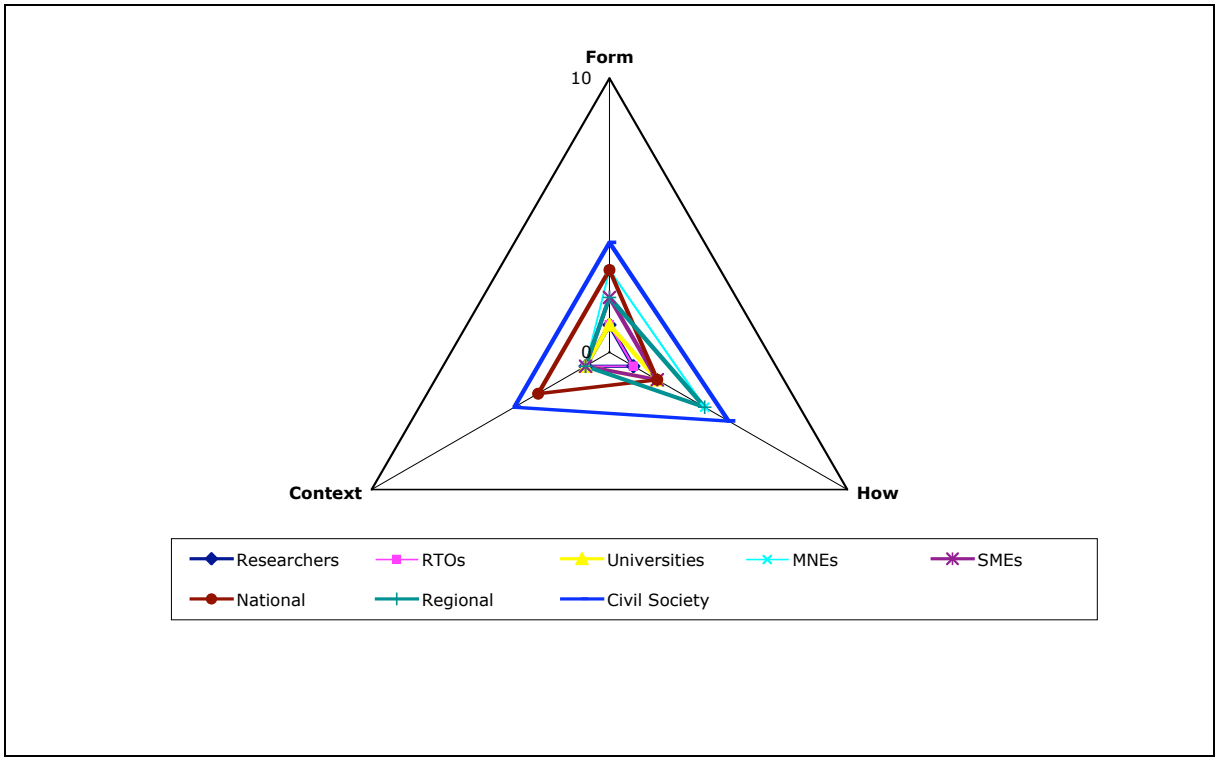



**Diagram 2: Mapping the Scenarios – Hybrids**

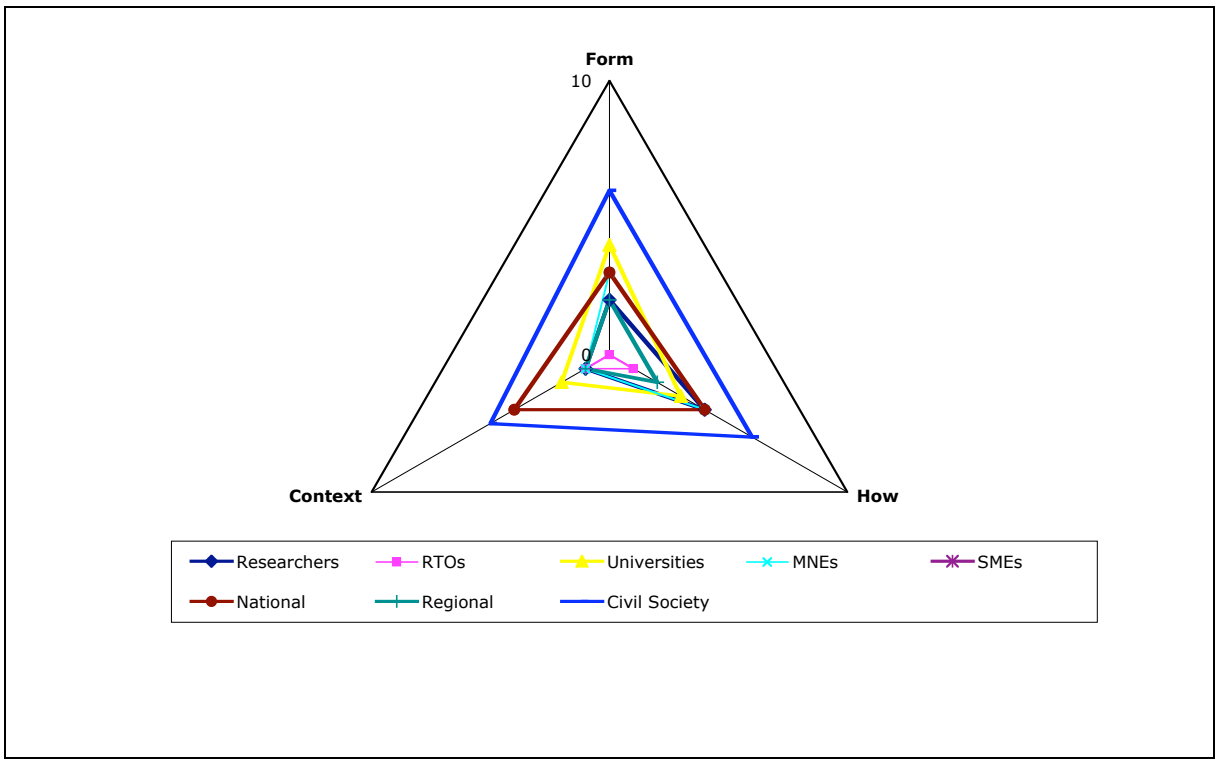
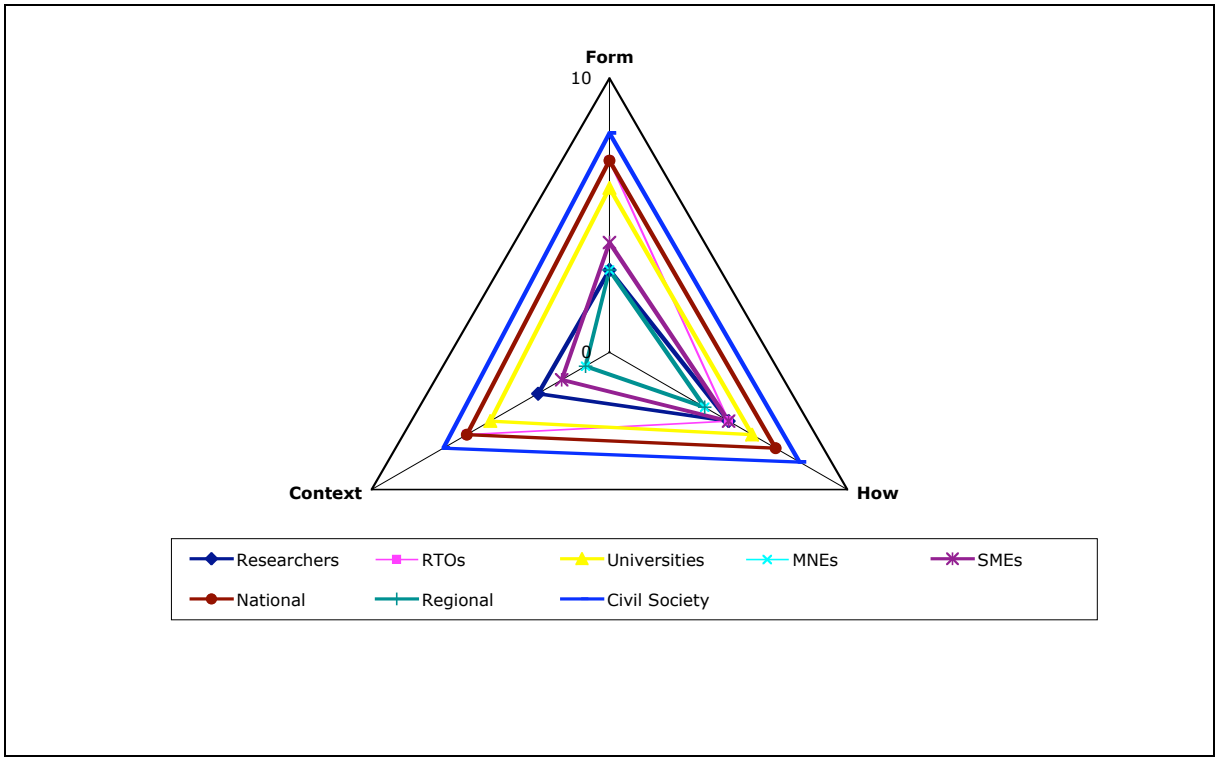


**Diagram 3: Mapping the Scenarios – Radical Change**




Indeed, looking at the three radar charts points out the difficulty of moving towards the outer band when starting from an institutional point-of-view. In part this may reflect the assessment that the internal dynamics, the within the institution analysis of potential and/or desire for change, are generally constrained. In part this is due to the difficulty of imagining changes to an institution without also thinking about the evolution of the context it is embedded in. In both cases an analysis of these impediments and potential leverage points can be an effective way to determine if a particular policy is more or less transformative.

An example of policy reforms that are less transformative are all of those that are aimed at consolidating the industrial model, where research is primarily seen as a key to competitive advantage. In these scenarios research and the ability of a specific place to keep and draw investment, jobs and perhaps profits, is deeply influenced by the degree to which research is conducted more efficiently (cost/performance relative to competitors) and smarter from the point of view of success in the marketplace. Nations, as this story unfolds, are treated in a way that is very similar to firms. This helps to determine what actions the national actor should take. Nations need to follow the example of the smaller, less complex protagonist, the firm. National innovation, like firm innovation, needs to be organised in ways that improve the efficiency of research and maintain competitive advantage in the marketplace (local or global) that can arise from research.

This HLEG exercise looking at the future of research actors could simply fall within this framework. One that imagines different futures for research actors almost exclusively in terms of how such actors contribute, or not, to the research component of national competitiveness. The use of scenarios for policy making is then obvious since the nature of the policy reforms is determined by the imperative to make the research actor input as efficient in competitive terms as possible. Hence which ever scenario or combination of scenarios displays the best outcomes for research competitiveness is the one that provides the positive lessons for policy. While the failed scenarios, according to this criterion of

'research as competitiveness determinant', offer negative lessons that help policy makers avoid mistakes.

Indeed the three low variance scenario sets for MNEs, SMEs and regional governments all provide this kind of insight. Here it is worth underscoring a potentially disturbing message for policy, which is that the scenarios do not argue for focussing on the link, no matter how appealing the fact that it is easy to measure, between levels of spending on research and the success of a national innovation system in industrial competitive terms. Both the low and high variance scenario sets, although the high variance for different reasons, point to the importance of organisational change in the way research is produced and used for achieving successfully competitive industrial innovation. The scenarios point out that the imperatives of efficiency and profitability demand that the managers of research actors and those that allocate funding to this production input (firms and governments) should strive to keep spending to the minimum and output to the maximum, given constraints and targets. The rate at which research effort, including spending, is converted into competitive success is what matters, hence low spending can be an important sign of high efficiency as long as profitability is sustained.

Overall the scenarios that are constrained to only one systemic logic do offer insights about how to improve the existing system, in this case the linear industrial model of innovation for marketplace success. However it is an approach which by design is ineffective at detecting the weak signals of emerging systems and the conflicts, synergies, failures and successes that arise from the collision of distinct systemic logics. Thinking in scenario terms this highlights the importance of remaining open regarding the relationship between specific forms of organisation and specific outcomes. As is well known there are many ways of getting to a similar outcome. In this HLEG, given the institutional starting point for the research actors scenarios, one of the key questions is the extent to which the character of a particular research regime (the logic of what, how, why, where research is conducted) is dependent on specific institutional forms. Again this is a key issue for policy makers since although there is no one institutional set-up or policy mix that serves as the only way to make a particular research regime function it is nevertheless crucial to identify what is more or less consistent.

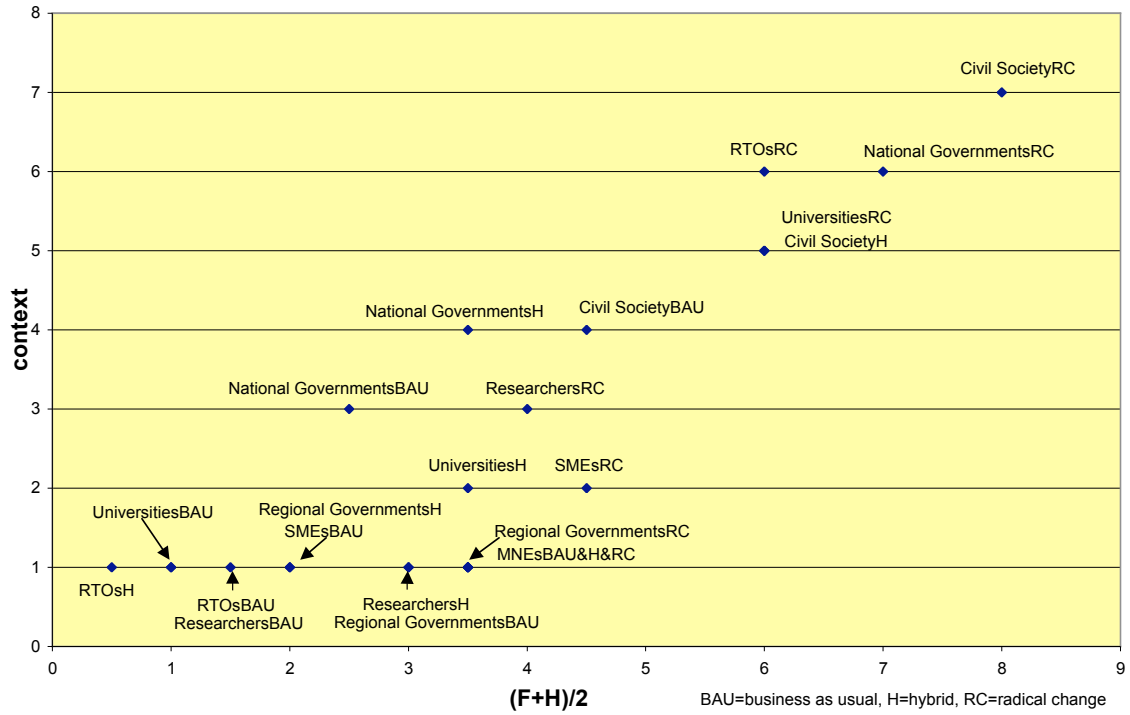
One of the uses of the scenario mapping model is to locate the different actor scenarios, each with specific institutional attributes, into different research regimes or descriptive states. This helps to discover if there are specific connections between the way the research actors are configured and the way the research regime functions. Hence, if the RA scenarios do not vary the research regime, then all that is discovered is that different ways of organising the RA are compatible with a single, unchanging research regime. A finding that, as noted above, can help assess which policies are best for reforming the current system. But this is not at all effective for answering the more transformation related question of how to change RAs in order to change the research system so that it is in closer alignment with the goal of achieving a knowledge society (assuming that the knowledge society is not defined as an extrapolation of industrial society, just with more research).

### *SCENARIO DENSITY AND DISPERSION PATTERNS*

Diagram 4 presents another way of analysing the results of mapping the scenarios by looking at the topography in terms of the "density" and dispersion patterns of the all 24 scenarios mapped by the model. The first observation, looking at the dispersion pattern of the scenario rankings presented in Diagram 4, is that a large number of the RA scenarios are constrained by the current context of industrial society (C=1). The second observation is that large parts of the diagram are not populated by any scenarios. Third, none of the scenarios push out to the farthest reaches of the "possibility space". Last, as is to be expected given the way the

model was constructed, there is an apparent correlation between socio-economic context and the RAs function and form.

**Diagram 4: Composite Mapping of All Scenarios, in Two Dimensions (F+H)/2 and Context (Sample Size 24)**




Imagining the potential of seeds to turn into the saplings, if not the forest of 2020, is one of the main advantages of scenario methods for strategic (goal seeking) purposes. Along these lines an analysis of Diagram 4 provides a range of insights. The first has to do with the Diagram as a frame for the scenarios, is this frame too narrow or too open, given the specific subject and aims of this HLEG? The second question has to do with the way the specific points, the scenarios within the frame, were chosen – why these particular points? Answers to both of these questions depend, in part, on the methods used to construct both the frame and the stories painted within it. Were the methods rigorous, meaning a consistent theory and model that tests the theory?

Turning to the case at hand and looking at the results presented in Diagram 4 shows that the RA papers and the associated scenarios map into fairly narrow bands. This draws attention to way in which the scenarios were constructed. For instance, even the most transformative scenario, the C=7 and (F+H)/2=8 of the national governments scenario, treats government as external to research and hence treats government policy as an “instrument” that influences research as an “object” that is outside the politico-administrative apparatus proper. Certainly there is considerable discussion in a number of the RA papers about how research within government needs to improve in order to become more effective at addressing the significantly changed research landscape outside of government. But this way of drawing the line between actor and acted, instrument and object, makes it difficult to address the whole set of possibilities that are described by a world of research in which the public sector is no longer an administrative apparatus but a series of experiments that have merged into a new system of ambient governance. In other words, by construction the model that underlies these scenarios cannot give rise to a scenario that would help to detect weak signals from an emergent system where governance and research merge. A scenario where government in

its “modern” form, as “external” decision maker using instruments (policies) to influence an object (research), fades away.

Another obstacle to selecting more transformative scenarios, i.e. stories located in the upper right corner of Diagram 4, is the difficulty, already noted when specifying the mapping model, of imagining a post-industrial context. Pushing the scenarios into this “uncharted territory” provides a good example of how scenario mapping can be useful for strategic reflection because it exposes a potentially significant omission in the current policy debates.

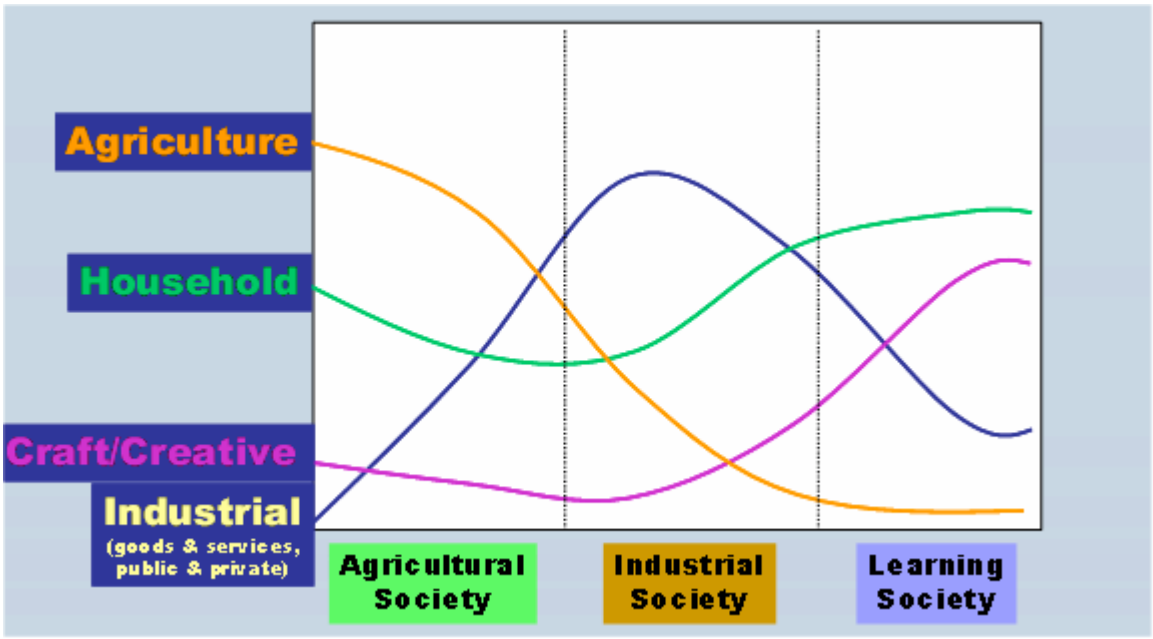
Eschewing all probabilistic speculation regarding the future composition of the economy, there are a number of questions that arise from the following assumptions.

1) The productivity of industrial (goods, services, public, private) systems will continue to increase. Hence the industrial sector will employ less and its output will get cheaper both for final consumption and as input to other forms of production. As a result there is a relative decline in the share of total time and wealth devoted to industrial activity (Diagram 5). Assuming that overall wealth creation does not decline in line with the decline in industry’s share, what types of activity will make up the non-industrial parts of wealth creation?

2) The developing world (China, India, Brazil, etc.) will not be able to follow the exact production/consumption path of the industrialised nations because, at a minimum, following such a path will drive up prices for certain key resources thereby generating a different input/output mix. Could this different mix be consciously biased, through explicit policy choices, towards intangibles and post-mass production/consumption patterns of working and living?

3) Ageing populations, combined with industrial era habits like retirement, remove people from the traditional industrial value-added activities. Could this open up a new post-industrial frontier – a space for activities that are not industrial and connect synergistically with the quest for identity, community and well-being that seem to preoccupy young people today?

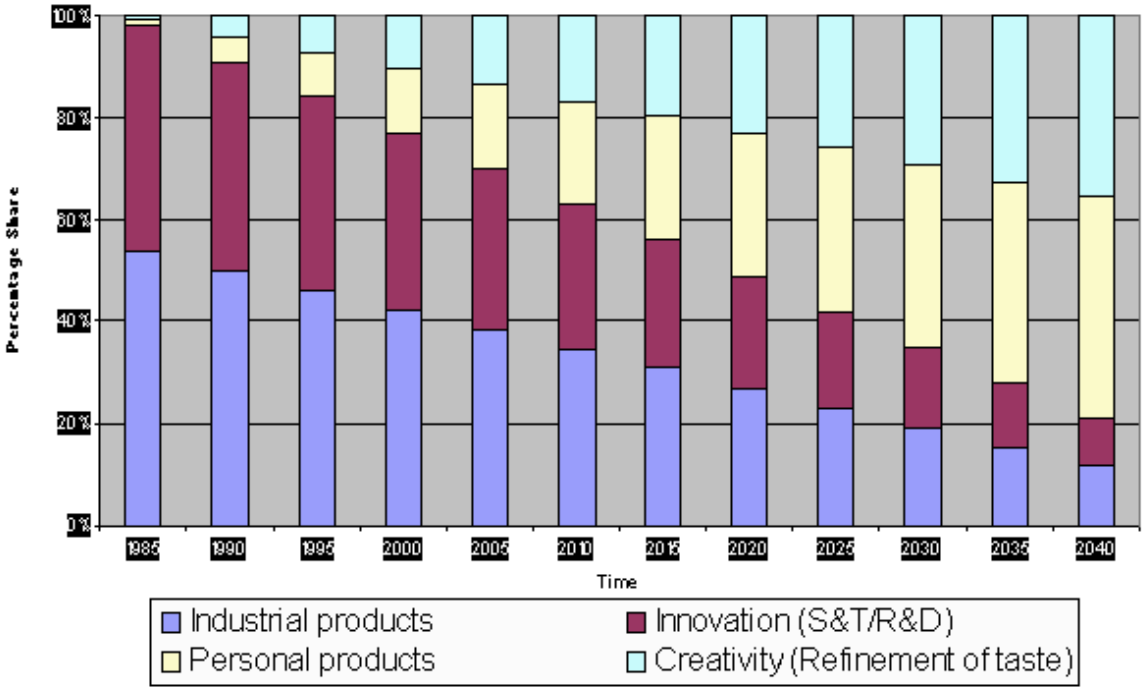
**Diagram 5: Compositional Transformation: Share of total wealth creation by source**




Without assessing the likelihood that these outcomes will occur, nor attempting to answer the questions posed, all three point to the possible (perhaps not probable) emergence of gaps in

the composition of wealth creation. Diagram 5 suggests, without straying into another set of topics, that other activities involving "unique creation" could be one possibility, amongst others. The point, however, in the context of this HLEG's effort to explore the policy issues facing the EC when it comes to research actors in the ERA is the possibility that the focus on STI is too narrow. Diagram 6 presents one way of looking at this policy omission or narrowness. Diagram 6 builds on the implications of a shrinking share of wealth creation coming from all types of industrial activity as presented in Diagram 5. Diagram 6 shows a shrinking share of industrial research serving a shrinking share of industrial wealth creation. And, naturally given the assumption that wealth creation as a whole does not decline, Diagram 6 shows other forms of "research", creativity and learning that are research for "unique creation", moving to take the place of the traditional research activity, in congruence with the expansion of the share of non-industrial wealth creation.

**Diagram 6: Compositional Transformation: Shrinking share of industrial S&T R&D**




Without pronouncing on either the probability or desirability of the decline in importance of conventional research for wealth creation in the ERA, the results culled from the expert papers and presented in synthesis form in this paper do point to changes in what, how, when and where research is conducted. The papers also hint, although only indirectly since the language and stories for making sense of emergent systems is only beginning to appear, at a different socio-economic context. One of the main conclusions of this paper in terms of thinking about the future knowledge society and economy in Europe is to pose a question: is it time to question the assumptions being used to assess the potential of the present? Or, put slightly differently: does the present conjuncture show signs of systemic emergence? And if yes how can policy makers take this into account?

## WHERE TO NEXT? A CHALLENGE FOR POLICY MAKERS

The preceding analysis opens a very wide range of issues for consideration of policy makers, in this conclusion only a few are highlighted.

The first is with respect to policies that could be considered essential for enabling more systemic emergence – the change from business as usual to a "radically different context". Comparing and contrasting the business as usual scenarios with the radical change scenarios shows that the transformation is likely to depend on implementing policies along the following general lines: A) developing new institutions for competition, openness and accountability in the research field within Europe but also worldwide; B) overcoming the barriers to effective links amongst research actors in order to overcome two types of fragmentation – one institutional and the other jurisdictional (across different both levels of authority such as city/nation and across borders within Europe and between Europe and the rest of the world); C) enabling new forms of networking to transform the ways in which RAs interact; and D) transforming the ways in which public policy at local, regional, national, trans-national (European) and global function, away from the administrative and towards the experimental model.

Taking this synthesis paper as whole, and the RA reports upon which it is based, two sets of issues emerge for policy makers.

### GRASPING THE IMPLICATIONS OF SOCIO-ECONOMIC CHANGE FOR NEW FORMS AND PROCESSES OF KNOWLEDGE CREATION.

The clearest signal for policy found in the RA papers and this synthesis analysis is that the conditions – both ends and means – for networking are changing.

**Trust**

- There is a fundamental question about what role the existing institutions will play with respect to enabling or disabling trust in new forms and methods of research. All of the RA papers touch on this critical issue and all highlight, in vivid detail, the conflicts of interest that threaten to pit entrenched power against new claimants. The various scenarios, with often opposing outcomes, point clearly to the important role policy choices will make in favouring one resolution over another to the challenge of establishing trust in the evolving world of research. For instance the pivotal role of universities as the arbiters of what is and is not legitimate scientific knowledge clearly needs to be addressed more openly since both the persuasiveness and efficiency of past practice appears in to be currently weak (or at least inadequate/unwilling to address the flowering of research outside the walls).

**Access**

- The policies of nations and regions that have been treated as largely external to the research process and the internal policies of the actors seen as doing the research are both important for the question of access to the creation, use, diffusion of knowledge. But there is also the possibility that as the network becomes ubiquitous the internal – external dualism becomes less meaningful, even counterproductive. A number of the RA papers touch on the difficulty of governments or MNEs or universities or national governments to "walk the talk" of decision making as research and research as decision making. Evidence of new initiatives, emerging conflicts, experiments and failures, all of which constitute weak signals, are largely implicit in the differences amongst the RA scenarios.

**Use and ownership** (and contracts, payment)

- Much of the debate around intellectual property rights has focused on the forms and business models of the industrial era. From this perspective very little actually changes aside from the medium. The nature of the artefact, say music, its production,

distribution and use all remain unchanged. Only the way it is commodified is altered by the advent of the internet, cheap RAM and the MP3 compression protocol. In this sense there is no new form of knowledge and hence the issue becomes one of how far to preserve the revenue model of existing businesses. But what happens when music is a collective product, not only transgressive of the intermediary boundaries, but altered in its very creation/use relationship. As people start to mix and play and use music to define their own identity, on their web site or within their personal community, they move to unique creation but of composite, cumulative products. A song, a photo, a chair, a method for thinking about the future are all built up layer upon layer, with credit for all contributors built in (for the concept, benefit of status/recognition, and perhaps a modest revenue flow). Under these post-industrial research conditions the IPR issues shift from the zero-sum fight between record companies and listeners to the enabling conditions for a whole realm of new production and transactions.

**Standards (governance) birth, death, entry and exit (competitive market).**

- A number of RA reports argue that it is crucial to make the market for research activity more dynamic and competitive. One approach would be to create a larger and more transparent Europe wide market for post-doctoral research funding (employment and/or project based), including opening access to non-academic research that has passed the test of "inter-subjective validation" and is academically acceptable. Despite the significant hurdles in terms of inter-university and inter-nation barriers that segment the research market quite severely a pan-European post-doctoral funding scheme could be an effective vehicle for both creating a larger more competitive market and spurring institutional reforms to reduce European fragmentation.

- The emergence of new nodes in civil society offer signs of a transformation from 'weakly-linked systems consisting of discrete components' to 'strongly-linked systems of fuzzy components'. Increasingly, as the RA report on civil society argues, complex networks are taking over the management of societal change processes. Non-governmental and market-driven governance patterns are merging with the classical sphere of governmental policy, to fundamentally challenge the third-sector-role of civil society in its ideal-type-position beyond state and market. All of which calls into question the conventional policy formation and administrative methods of the past. Can the current decision making system relinquish its power and prerogatives while at the same time discovering where the collective role still lies in order to assure sufficient experimentation, fluidity and diversity?

- From a European perspective the blurring or even disappearance of the boundaries that defined national innovation systems, as argued in the RA papers, points towards spill-overs beyond the production function STI activities associated with industrial era towards the more pervasive research systems already discussed. Part of this kind of transition is likely to require a strong emphasis on moving existing national and European level STI policy making towards state-of-the-art knowledge management and "strategic intelligence", with the aim of stimulating a learning in context culture.

## THE QUESTION OF LEADERSHIP.

A number of the RA papers stress that realising the potential of Europe to become a more networked and research intensive society will depend on policy. Breaking away from the business as usual or stagnation scenarios is not seen as automatic. Or perhaps, to frame it slightly differently, the defenders of the status quo are likely to sustain the inertia of the present unless there are some deliberate decisions to alter the conditions in which research

is produced and used. This is a significant challenge, with high stakes for turning the possible into the probable.

The RA papers also underscore the critical role of values in shaping the future. Adopting open and dynamic values that embrace diversity and complexity could be decisive. This is because the future is not planned or mapped but lived and chosen in ways that reflect the dominant values. If Europe tries to defend the industrial past, slowing the dynamic of economic and social transformation that has been its hallmark for over two centuries, it will be because of fear and choices that comfort that fear. Alternatively, if Europe pursues the traces of what research might become in a transformed economic and social order, it will be allowing new actors and the systems those actors create to flourish.

Nothing will change the fundamental need to bring together leadership, research and cooperation. What does change, more or less dramatically all the time, is how to put these three ingredients together. The RA papers and this synthesis point to the importance of taking into account four major transformations as EC decision makers attempt to show leadership in the field of research.

**The nature of leadership is itself changing**.

*Authority, knowledge and networking* are all becoming more pervasive and fluid. To lead in today's world does not mean leaning on hierarchies etched in stone but to understand that *authority* must be earned. To know in today's world does not mean amassing huge stocks of dead information but to *know-why, -when and -how* to deepen your understanding. To network in today's world does not mean working the old-buddies club but to plunge into the wide *open communities* of cyberspace.

**The nature of research is changing.**

*Specialisation, truth and knowledge diffusion* are all coming unbound. Conducting research in today's world is not the exclusive purview of a *specialised* elite restricted to a narrow field but a cross-cutting endeavour that is inspired and informed by both amateurs and professionals, often hailing from unfamiliar and unanticipated corners of the noosphere (http://noosphere.princeton.edu/). Discovering "the *truth*" in today's world is no longer a search for an ultimate authority, unsatisfying substitutes for absolutism-past, but a quest to put uncertainty in context using multiple points of view. To *diffuse knowledge* in today's world is not about broadcasting to the biggest market but sharing and creating the unique experiences upon which learning depends.

**The nature of cooperation is changing.**

*Trust, membership and community* are all becoming spontaneous. Establishing the *trust* needed to cooperate on a research topic is no longer the exclusive power of certifying institutions such as universities or regulatory agencies or governments but a wider process based on continuous and accumulated evaluation by disparate sources done in real-time. Gaining and maintaining *membership* in communities seeking to understand or invent is not a protracted effort to win and sustain one's good standing but a conjunctural, as-needed status that corresponds to the tasks and/or interests at hand. Birth and death of a research *community*, be it of practice or interest, is evolving away from the fixed hard-to-be-born and hard-to-die model to one that springs to life when needed and fades away when its purpose expires.

**The nature of the goals that have driven the relationships of leadership, research and cooperation are changing**.

The goals of survival, risk management and learning are all shifting from a world where the ends justified the means to one where the means are the ends. The emergence of spontaneity as opposed to planning as an operational principle brings surprising advantages: for the heightened interdependency that ensures survival; for leveraging sufficient information, greater complexity and further heterogeneity to manage risk; and for the learning that gives meaning to life.

## RECOMMENDATIONS – POLICIES FOR CREATING A SEAMLESSLY OPEN, DIVERSIFIED AND EXPERIMENTALIST EUROPEAN RESEARCH AREA

European institutions and policies face a great challenge. Without claiming to know how the future will be shaped nor if policy makers will select the "best" choices, the work of this High Level Expert Group points unequivocally to the need for a much more flexible, decentralized, enabling policy approach, that enhances the autonomy and capability of a much wider range of research actors to undertake self-directed learning and adaptation. Uniform policy prescriptions will not work. The emerging diversity, complexity and spontaneity of research is incompatible with any type of centralized and rigid policy approach. What policy makers need to do is discover ways to open the boundaries at every level, increasing the diversity and interaction that inspires creativity through competition and cooperation.

The policy recommendations proposed here are an agenda *for* change, aimed at enhancing the capacity of research actors *to* change. It is through an enhanced capacity to change that Europe's deep and diverse knowledge base can be used to take advantage of the transformations in the nature of research that have been analysed in this report.

### POLICIES THAT OPEN, EXPAND AND INTEGRATE THE EUROPEAN RESEARCH AREA

Clearly research and innovation are no longer limited to codified and academic knowledge. However, the expansion of the field of knowledge into new domains, involving new actors and new relationships is not at the expense or a replacement for more familiar activities. But the opening up of new terrain does call for a reconsideration of how traditional academic and business research and innovation are organised and interact, both within the old established institutional frameworks and in relation to the new emergent research subjects, actors and methods. For universities, so long not only the primary source but dominant authority in the research field, radically improving the capacity to change, to break through old boundaries, to improve the circulation of knowledge and individual researchers, to become more diversified and organisationally experimental, is a necessity.

It is not that universities or any of the other established research actors are unimportant in the new knowledge environment. It is that for both learning and research the permeability inside and outside the institutions is much more central. Excellence in teaching and research now cover a broader range of activities, giving new meaning to multi-disciplinarity, a meaning that goes beyond formal exchanges across entrenched boundaries. Within existing university systems, or most business R&D departments, the development of new research programs, new products and new networks is too slow and too insular. Policy makers need to help create a more open and dynamic context for all researchers, what ever and where ever they conduct their research, in order to facilitate the dual task of improving quality and adaptability.

## *Recommended Policy Actions to Open, Expand and Integrate the European Research Area*

1) Policies that put into practice expanded criteria for designing and funding **research programmes** for the European Research Area **to include user-centred technological, organisational and social innovation**.

   An additional point-of-view for funding research, one that goes beyond a technology centric conception of innovation, is urgently needed if Europe is to take advantage of its deeply rooted diversity. This is not meant to replace technology oriented research funding but to bring another large and growing field of innovative activity within the sphere of the research funding agenda.

   Such a broader agenda for research funding includes a significant **priority for service sector activities and traditional SMEs** that are important models and sources of product, organisation and social innovation. It also covers the emergent, more diffuse and still largely non-formalised, **joint creation and learning activities**. All of this research uses technology, in one way or another, and certainly improved tools can be a crucial facilitating factor, but the central aspect of this type of research is not about the tool. The research and innovation of this broader knowledge economy and society is about what is being done, when, how and why. Imagining new purposes or new ways of doing things is as research intensive as discovering or improving a tool.

2) Policies that initiate **experiments in order to validate (quality/trust/transparency) new forms and producers (including individual independent researchers) of knowledge**.

   These experiments should seek to develop new mechanisms and standards for establishing the quality and trustworthiness of research. This does not in any way reduce the importance of using the scientific standard of inter-subjective evaluation. But it may be perceived as a significant threat, particularly in new areas of research activity, to the exclusivity of existing systems. These experiments, like the innovative reputation systems emerging on the internet, may not require centralised institutions. Policy makers need to risk experimenting with new forms of assessment and evaluation that **take into account the diversity and complexity of individual, institutional and spontaneous research communities**. These experiments, some of which will inspire more innovation through failure than by success, must nurture both the growing plurality of entry points in knowledge production and the emergent methods of collective validation as mediated by spontaneous communities and technology enabled transparency. These experiments need to be conducted in ways that integrate the collaborative and participatory measures contained in the next recommendation, number 4, and with careful attention to the findings of additional research into the role of intellectual property rights systems as per recommendation number 6 below.

3) Policies, both budgetary and regulatory, that create and facilitate both **new collaborative environments for research, including user-centred research, and new governance processes**.

   More so than in the past many innovations originate from encounters amongst research actors, mixing different academic disciplines, sector professionals and users. Beyond the establishment of research clusters and technology parks innovation policies today need to support the development of multi-purpose research environments that facilitate creative encounters, including projects that associate research civil society organisations. An example of this kind of platform is in the field of medical supply research for hospitals that spurs cooperation amongst businesses, medical professionals, researchers and the public (current and future patients).

Policy makers also need to act on the fact that the role of users, networks and communities of interest/practice in the research process have changed. This includes the formulation of public policy. Efforts to improve the policy governance processes for research activities in general, and science-technology-innovation policies in particular, should aim to increase predictability, trust and commitment. Initial steps include:

- developing an **inventory of citizen's organisations and "citizen experts"** that can contribute to the broader field of research; incorporating **"citizen-experts" into the evaluation** of Europe's research capacity and output;
- more systematic and comprehensive **use and consultation of civil society organizations** for the determination of European research agendas ; a greater investment in **anticipatory processes** (e.g. foresight research and processes, citizen's summits, etc.) that imagine and reflect on the potential (positive and negative) of the broad range of European research activities;
- **sponsor more multi-purpose inter-regional platforms for experimental and integrative** approaches to the research coordination, including on innovative social science issues like education and the labour market; and
- new learning processes that engage **"citizen-experts" and civil society organisations in the active invention** and deployment of products and processes that are both generated by open innovation processes and help to diffuse such processes to industry, academia and the public sector.

4) Policies to **enhance the capacity of policy makers** (including at the regional level) to recognise and facilitate new forms of research and particularly new approaches to the governance of research processes.

   Four approaches are recommended.

   - One is to always design policy development processes **to involve stakeholders**, including citizen-experts and action researchers.
   - The second approach is to bring **"outside" people** (including natural and social scientists) familiar and open to co-creation and experimentation (along with the learning from failure that is essential for the experimental method to work) into the policy development process.
   - Third there needs to be **new training and participation learning** made available to policy makers already in the public sector so they can acquire the insights and skills needed to develop policies that are more in-tune with the functioning of the new research landscape.
   - And fourth, creating zones for policy initiative outside the existing institutional frame through **autonomous "policy labs"** that work within specific mandates.

5) Policies to **abolish national borders for researchers and for students** both within Europe and outside Europe.

   At a minimum this policy calls for the establishment of a pan-European system that ensures transparency and mobility for researchers. It is time to dismantle barriers to the flow of researchers throughout Europe. An initial list of obstacles to be dismantled includes: differences in the way degrees are awarded, doctoral and post-doctoral

candidates recruited, and research contracts set; the ways in which differences and the non-transferability of pension and health care coverage limit movement; arbitrary administrative procedures that are used to defend institutional budgets rather than advance substantive research tasks; and a lack of transparency regarding admission policies for students. The aim is to establish a large and competitive pan-European doctoral level and post-doctoral market in collaboration with industry. Fostering the necessary excellence also requires recognition of the global nature of knowledge and research. As a result an open European Research Area includes openness to the mobility of knowledge workers throughout the world.

6) Policies to **strengthen the autonomy of universities**, including areas so far strictly controlled by most governments such as a university's strategic profile and selection of specialisations.

   Cooperation and competition should be allowed to generate greater institutional differentiation as well as greater openness to the recognition (professionalisation) of new research actors and new roles for research in the emerging knowledge society.

### *Recommended Initiatives for Further Research into the Future of Research*

7) Further research is required regarding the relationship between **the changing nature of research and intellectual property rights** (IPR).

   Much of the debate around IPRs has focused on the narrow forms and sources of research and knowledge characteristic of mass-production and mass-consumption industrial society. As the work of this High Level Expert Group shows, the knowledge society entails a broader, more inclusive and more heterogeneous understanding of research and the intellectual property rights it gives rise to. A key follow-up activity to the work of this HELG on the Future of Research Actors is to conduct a similar exercise looking at the inter-action/inter-dependency of research and property rights. The necessity for this type of project arises, in part, from a critical relative shift away from technology as the core of research and innovation. And as part of this shift, the emergence of new "open business" models, particularly when it comes to creative (learning-research supported) activity, also call for a reconsideration of intellectual property management and cost/benefit flows in the context of denser and more dynamic networks.

8) Further research is required regarding the **functional division of labour amongst different research actors** in the context of the emerging "open innovation model".

   Traditionally each of the research actors has been defined in terms of a central mission: universities have the dual mandate of academic research and teaching; the RTOs conduct research through networks and partnerships; civil society and business use specific interests to target their research activities. When the forms, processes and participants in research were more narrowly there was less concern about the question of the synergy versus redundancy of these activities. Now as the nature of research changes the differing mandates, and the relationships that might arise if different roles are assigned to different actors, merits careful analysis. Research actor missions are becoming more diversified and potentially more ambiguous – is this an issue that policy must address?

9) Further research is required in order to describe and analyse **the contribution of civil society to research and innovation**.

First of all the task is to discern and analyse the different modalities of civil society involvement in knowledge production, including activities like financing research and direct intervention in proposing and pursuing discovery, activities greatly facilitated by the interent.

A second task is to undertake an inventory and benchmarking of the ever more numerous and varied experiments in citizen participation in the development of research policies, such as focus groups, consensus building conferences, involvement in expert deliberations, etc..

10) Further research is required on **how to establish trust in highly complex and diversified knowledge societies**.

The more knowledge societies differentiate themselves into a variety of participating groups the more this high number of very differentiated actors has to interact. However, in order to communicate – a pre-condition for both cooperation and competition – transaction costs must be reasonable. If there is no trust (in the validity of information, the soundness of arguments, the ethical standards etc.) no interaction can take place and consequently the knowledge society will not be able to benefit from its potential. More research on how trust can be built in societies, analysing the functioning of both new "epistemic communities" and those that cut across existing institutions. Such research should include the wide variety of forms in which civil society contributes to research and the production of knowledge today, including the ethical dimension.

11) Further research is required to define and measure **new forms of innovation**, particularly with respect to the innovation related research occurring in the service sector, SMEs and the community (social innovation) that point towards new models of innovation.

The familiar industrial innovation model where R&D is separated from manufacturing, there is formal investment in R&D, research is conducted by certified professionals, and the performance of the innovation system is analysed using input/output measurement models and techniques now needs to be supplemented by a more interactive model that takes fuller account of the inseparability between design and delivery, the innovation capabilities scattered within organizations and individuals' activities, the absence of formalized units and professional roles exclusively devoted to research in conventional sense, and continuous involvement of users and civil society. An example of the kinds of specific efforts that could help to clarify these issues is to rethink the community innovations