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Thematic Network on Policies forResearch and Innovation in the Move Towards the Era

PRIME TN

FINAL REPORT

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EU RESEARCH ON SOCIAL SCIENCES AND HUMANITIES

Thematic Network on Policies for Research and Innovation in the Move Towards the Era

PRIME TN

Final report

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Preface

Within the Fifth Community RTD Framework Programme of the European Union (1998–2002), the Key Action 'Improving the Socio-economic Knowledge Base' had broad and ambitious objectives, namely: to improve our understanding of the structural changes taking place in European society, to identify ways of managing these changes and to promote the active involvement of European citizens in shaping their own futures. A further important aim was to mobilise the research communities in the social sciences and humanities at the European level and to provide scientific support to policies at various levels, with particular attention to EU policy fields.

This Key Action had a total budget of EUR 155 million and was implemented through three Calls for proposals. As a result, 185 projects involving more than 1 600 research teams from 38 countries have been selected for funding and have started their research between 1999 and 2002.

Most of these projects are now finalised and results are systematically published in the form of a Final Report.

The calls have addressed different but interrelated research themes which have contributed to the objectives outlined above. These themes can be grouped under a certain number of areas of policy relevance, each of which are addressed by a significant number of projects from a variety of perspectives.

These areas are the following:

- ***Societal trends and structural change***

16 projects, total investment of EUR 14.6 million, 164 teams

- ***Quality of life of European citizens***

5 projects, total investment of EUR 6.4 million, 36 teams

- ***European socio-economic models and challenges***

9 projects, total investment of EUR 9.3 million, 91 teams

- ***Social cohesion, migration and welfare***

30 projects, total investment of EUR 28 million, 249 teams

- ***Employment and changes in work***

18 projects, total investment of EUR 17.5 million, 149 teams

- ***Gender, participation and quality of life***

13 projects, total investment of EUR 12.3 million, 97 teams

- ***Dynamics of knowledge, generation and use***

8 projects, total investment of EUR 6.1 million, 77 teams

- ***Education, training and new forms of learning***

14 projects, total investment of EUR 12.9 million, 105 teams

- ***Economic development and dynamics***

22 projects, total investment of EUR 15.3 million, 134 teams

- ***Governance, democracy and citizenship***

28 projects; total investment of EUR 25.5 million, 233 teams

- ***Challenges from European enlargement***

13 projects, total investment of EUR 12.8 million, 116 teams

- ***Infrastructures to build the European research area***

9 projects, total investment of EUR 15.4 million, 74 teams

This publication contains the final report of the project 'Thematic Network Network on Policies for Research and Innovation in the move towards the era', whose work has primarily contributed to the area 'Support activities to stimulate the development of social sciences and humanities in the European Research Area'.

The report contains information about the main scientific findings of PRIME and their policy implications. The research was carried out by 12 teams over a period of 18 months, starting in October 2002.

The abstract and executive summary presented in this edition offer the reader an overview of the main scientific and policy conclusions, before the main body of the research provided in the other chapters of this report.

As the results of the projects financed under the Key Action become available to the scientific and policy communities, Priority 7 'Citizens and Governance in a knowledge based society' of the Sixth Framework Programme is building on the progress already made and aims at making a further contribution to the development of a European Research Area in the social sciences and the humanities.

I hope readers find the information in this publication both interesting and useful as well as clear evidence of the importance attached by the European Union to fostering research in the field of social sciences and the humanities.

J.-M. BAER,

Director

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Aknowledgements

The scientific co-ordinator of this project could not have produced this report without the work carried out by the different individuals responsible for the work packages and their extensive involvement in shaping and writing the corresponding contributions. The latter have heavily relied upon the various background documents, minutes and reports produced by sub-groups and those responsible for specific topics. Finally, this work would not have been possible without the numerous presentations made at the various meetings that took place. Below is a list of all the contributors. The primary author of this report is solely responsible for any omissions, as well as for any inaccurate translation of what has been produced.

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Notes: * relates to responsibility for a subject or topic within a given WP, **Roles are: Core group member, member, member of the corresponding Swiss REPOL network, or expert (when invited to make a presentation. Work package number is added to role when that individual was (co)responsible for the group and its final report.

Abstract

The objective of the Thematic Network was to identify the challenges facing the field of science and innovation policy studies and to study the conditions under which they can most fruitfully be addressed. The project was selected as an exploratory network in order to anticipate potential "networks of excellence". This was done at a time when neither the Commission nor the participants of this network had any clear idea of the concrete form that this "new instrument" might take. The project identified three main questions: what are the scientific challenges? What are the lasting structural shortcomings the field is faced with at European level? And what organisational forms could be devised to best address these? Later we added a fourth question when we started work: which part of the field should such a new instrument cover?Should it deal with research and innovation dynamics at large? Should it focus on public intervention – i.e. research and innovation policies? Or should it address one specific issue, such as IPR, foresight or evaluation? There was general agreement that the latter might be important at the "operational" level but not in terms of fostering "long term" research, our understanding of the primary role of NoEs.

We considered that dealing with "public intervention" and "policies" was sufficient to identify a set of challenges and to propose **a research agenda or a "scientific roadmap"** for the sub-field that was important enough to structure the activity of over 200 researchers. This report presents the results of our work. We have identified three main areas - changing rationales for public intervention, evolving multi-actor spaces and the governance of research and innovation in the ERA, and the transformation of public sector research (including universities) –together with research on ST&I indicators. Altogether these cover 19 themes and over 60 research topics. We thus see two roles for a Network of Excellence: the periodic updating of this scientific 'roadmap' (which requires multi-faceted activities and not simply a few conferences), focusing its intervention, within this research agenda, on just two main activities: facilitating the exploration of new "unconventional" or "heterodox" approaches, and concentrating its research support on issues that require complementarities that are not accessible locally (in one centre) or nationally, that is, research that requires important comparative and aggregative dimensions.

However, it was clear that the field is faced with **lasting structural problems** – for training, for interaction with our "users" (i.e. policymakers) and with regard to our main quantitative source, ST&I indicators. These require the creation at the field level of a **European Platform**. The second part of the report deals with organisational and

implementation issues. It makes concrete proposals for the lasting organisation of "Networks of Excellence" and the European Platform. It suggests that, in a first stage, the Platform might be built on the joint activities of NoEs selected by the EC. However, this requires that the EC takes full account of the specific European dimension of such infrastructures and finds different, more long-term ways of supporting them than at present.

I. EXECUTIVE SUMMARY

The Thematic network has developed over the two years of its duration both a research agenda and a reflection about the organisation of research in our field at the European level. This was arrived at by a very large mobilisation, far beyond the official members of this thematic network and far beyond also what was anticipated at its start. The long list of direct contributors which is at the front of this report illustrates it: over 80 persons contributed directly to the construction of this research agenda, half being from the 10 member groups of the network and the other 40 experts coming from over 30 different institutions. Altogether more than 130 persons participated to the different meetings, seminars and working groups that took place. Very early on in the process, the core group of the network reorganised the structure under which reflections developed, partly to take into account the changing environment, partly to answer to "bottom-up" requirements. Organisational issues (that give rise to part IV of this report) were directly handled by the core group and discussed in overall meetings, while 6 working groups addressed different aspects of the issues at stake. Some of them gave rise to specific groups on a voluntary "bottom-up" basis (such as for IP issues or higher education/research relations).

We thus propose to organise this executive summary in two parts. The first part will deal with the research agenda. It would be presumptuous to try and summarise what has already required a harsh synthesising effort. It will rather sketch the main lines we have arrived at, trying to render explicit how such a structure or segmentation what arrived at. The second part will present our notion of European platform and the roles (and limitations) we see for networks of excellence.

1. Towards a research agenda on science and innovation policy studies

We start with three clarifications before coming to the main "challenges" and "directions" that we have identified. What is meant by research agenda? How did we arrive to the present delineation of the speciality, that is adding innovation to the now established field of "science policy studies"? A third aspect will deal with the structuration of issues and problems that build the research agenda.

1.1. Positioning the notion of research agenda

It is not our purpose here to develop an analysis of the anticipation practices of research communities and institutions. We shall only try and locate our present-day understanding of the establishment of long-term priorities in one speciality.

Learned societies or peer committees in research institutions have a long tradition of producing reports on the future of science which identify 'challenges', 'perspectives', 'directions' (to name but a few terms among the variety of those used). They generally also identify 'goals' and 'priorities' that they consider relevant within the context they examine. While the former are generally shared by most reports (whatever the country), the latter are highly contextual (there is just to consider the huge difference between the different reports dealing with nano S&T). They de facto provide a "consensus view or vision of the future S&T landscape available to decision makers" (Kostoff and Schaller, 2001).

More and more, challenges have turned crosscutting ("interdisciplinary"), especially when coming from "externally" driven issues, when "problem-based". Sharing visions thus required an enlarged set of stakeholders (not only coming from different disciplines but also from different institutional settings) and a more formal process than simply meetings and/or auditions. Foresight, after forecasting and the use of the famous Delphi method, developed as a process to address the issue of consensus building and shared visions within science and technology.

By doing this, it linked with another very different approach developed in industry (and more specifically in the semi-conductor industry), road mapping today associated with the famous Moore's law. Road mapping has first been associated to delineating one future, one technology trajectory (as exemplified by the ITRS Roadmap). However, Walsh (2004) studying an emergent area (MEMS) showed that it can also serve to identify "grand challenges, identifying major technology pathways and product platforms" (Spinardi and Williams, 2004), providing thus another definition of consensus: the shared recognition of the diverse possible alleys that could prove fruitful, facing uncertain situations.

The US National Institutes of Health (NIH) exemplified the merger of the two approaches by producing in 2003 a 'NIH Roadmap' which, through the mobilisation of a large set of stakeholders, sought 'to identify major opportunities and gaps in biomedical research that no single institute at NIH could tackle alone but that the agency as a whole must address to make the biggest impact on the progress of medical research"[1].

We de facto adopted a similar approach, looking in our field at "major challenges" and recognising the existence of different approaches, concepts and theories to address them. We differed however from NIH, our challenges being less driven by "opportunities

[1] http://nihroadmap.nih.gov/overview.asp

and gaps" than by our understanding of the lasting problems faced by Europe and member countries in research and innovation. We also differed by the fact we chose to limit our exercise to 'academia', thus not including 'firms' and 'policymakers'[2]. This is why we prefer the terminology of "research agenda" (compared to this of scientific or S&T roadmap).

1.2. Our Remit: Science and Innovation Policy Studies

The second issue is quite straightforward: on what to build the research agenda? This required that we defined more closely the remit of our effort. Should we take a wide definition as proposed by economists with the economics of technical progress or now the economics of innovation, mostly dealing then with the dynamics of change in firms? [Analysts of systems of innovation have raised a similar issue when they speak of the narrow or broader definition of "systems"]. Should we follow sociologists and anthropologists and include science dynamics? Or should we simply focus on the existing specialty of "science policy studies", dealing with the rationales, forms and modalities of (national) government intervention? We decided to locate ourselves at the interface of the three dimensions. Our focus is clearly public intervention, but more than "policy", dealing with institutional arrangements (which role in the performance of "systems" is underlined by evolutionary economics), dealing also with the multiplication of public interventions and their articulation (regional and European, a specific feature), dealing finally with the enlarged decision process at "system level" (with the corresponding notion of "governance"). Our focus is also more than science and even science and technology to include all the public aspects that accompany the creation of new or improved products, processes and services. Thirdly it incorporates the lessons of science dynamics and in particular the relationship between types of activities and types of organisations: this means that changes in sciences (and especially taking hold of the "new leading sciences, the famous NBIC) are important to consider in the framing of public interventions and structures. It finally takes into account the very important imbrications with higher education. This drives to the following domain or speciality: public interventions for higher education, research and innovation, or in short, "research and innovation policy studies".

As mentioned above, we considered from the start that we needed to address simultaneously "pathways" and "platforms". We thus added to the usual thematic focus that build the core of most foresight exercises, a "structural" dimension, considering the

[2] There are good reasons for this. We have demonstrated in previous projects that when the long term and uncertain future is at stake, policymakers (and especially politicians) tend to redirect questions to researchers (see section IV.2. for a further explanation).

lasting "infrastructures" that are required to be established at European level. Here lies the **normative stand** we took from the start, which is to consider seriously the emergence of Europe as one "system" and of the "European research area". This is reflected in the title we proposed for this network: "research an innovation policies in the move towards the ERA".

1.3. Structuring the research agenda

How to structure the research agenda, was the third main issue we had to address. Two key words explain our approach: challenges and infrastructures. Why is it so? This has to do with the speciality and its development in Europe. Section IV.1, highlights three main features that explain the difficulties the speciality faces at national level to get recognised and develop the adequate infrastructures (for training or access to relevant data): it is small in overall terms (less than 500 researchers within the then 15 member countries); this goes along with a high fragmentation, (each country and more and more regions requiring to have one specialised team) and an important inter-disciplinarity (with economics, sociology, political sciences and management, not counting history, anthropology or geography).

Thus it was clear that the success of any success would largely depend upon the capacity to address directly at the European level lasting structural issues. There is here no difference with the situation in many "natural sciences" like high-energy physics, astronomy, space research and the like. In many of these, the highest ranked dimension of the research agenda was the development of the new facilities required to solve clearly established "locks". Physical infrastructures are one aspect of a broader spectrum. More and more, intangible aspects come to the forefront: human resources and data sets are clearly growing on the agenda of many disciplines, and in this respect social sciences are no different.

We have identified **three key structural issues**, which gave rise to specific developments: training, S&T indicators and interaction with policymakers. Sections III.4. to III.6. develop the results we arrived at (see box below for a short overview). They present three main characteristics. First we have only focused on lasting issues that did not find satisfying solutions in most of the countries during the last 20 years. Second, they do not apply to our own speciality but de facto cover the wider field of innovation studies: this is typically the case of relations with policymakers, our major customers, and of the need for European ST&I indicators. Third, they apply more broadly to any speciality, which is too small to generate a large number of places with critical mass: this is typical of training, when faced with the development of professional master curricula or with attractive research training conditions.

Main directions identified for "infrastructural" activities

Training: 4 main issues identified

- Fostering doctoral training, by creating a European space for PhD students with 3 main activities: PhD annual doctoral conference, PhD summer schools, extensive circulation of PhD students (plus specific attention for the incorporation of PhD students and young researchers in the research projects supported).

- Developing Professional Master courses beyond the two well established ones, to face the growing requirements in an inter-University approach (taking hold of the experience gained by the ESST STS Master course)

- Developing short thematic courses for professionals (along the lines of the existing Twente evaluation course or the PREST Foresight one).

- Developing modules for initiating students in engineering and management to the issues of research and innovation dynamics

Indicators

- The need for an in-depth comparative analysis on the conditions under which indicators are produced within EU countries and the limits/problems faced by present aggregation practices. Directions proposed: develop a European network of indicator producers, and experiment on well-established input indicators on funding.

- The need for new indicators. Within the very long list/review made, focus efforts on human resources and emerging scientific fields, while starting considering difficult methodological issues (European S&T geography, matching of different data sources, and in bibliometrics: classification issues and the handling of social sciences and humanities).

Interaction with stakeholders

Science policy studies have developed nationally in a special relationship with policymakers, most of the groups doing research and acting as "experts" or "consultants" (and quite often as de facto think tanks). They also have often been pro-active in the design and experimentation of new forms of public debate to take hold of the wider involvement of society in the framing of research policies. Similarly many researchers have been involved in groups supporting the framing and evaluation of EU research policy. The issue was then to consider whether there was a broader requirement than the usual dissemination, training and consultancy activities. A previous thematic network (ASTPP) had highlighted the need for a specific layer at EU level to foster "distributed strategic intelligence". The work done translated that into the need at the European level of "fora for strategic intelligence in research and innovation policy" and of an issue-driven experiment to initiate a learning curve.

The other side of the research agenda was the classical one: identify and delineate the main **research priorities**. As witnessed in the different recent roadmaps done, the approach followed was to identify the main challenges faced by research and innovation policies and see how they question our accumulated knowledge or the main established directions of research.

With the support of many colleagues (interacting in different conferences), **six main challenges** were identified during 2002. As mentioned by Laredo (2003) in his recapitulation "they entail radical changes in the locus, formulation and implementation of science, technology, higher education and innovation policies" and "they call for renewed empirical and theoretical work to reconsider our accumulated knowledge in science policy studies".

These changes are first internal to "science dynamics" with the hypothesis of changing "search regimes" associated with the growth of the new leading sciences, often captured under the NBIC acronym[3]. These would require new approaches to the management of research activities and in particular public sector research. They are secondly linked to the economic dynamics with simultaneously the globalisation of large firms, which represent the majority of industrial R-D expenditures, and growing questions on the innovation capabilities of SME, which represent the core of local employment. These go along with a blurring of the systematic connection made between public intervention and national policy: the growing role both of the European and the regional authorities may well translate these changing spheres of relevance for public intervention questioning the ways and means through which "multi-level governance" could be achieved. A third set of challenges is embedded into the wording of "knowledge society" with the question of the status of knowledge in such a society and the new balances that are emerging between what is appropriable and what is "open" knowledge – in the dual meaning of open science but also of open source software –, with the transformation of universities if

[3] Standing for nanotechnology, biotechnology, information and communication technology and cognitive sciences, to which more and more scholars add an "S" for the social and ethical dimensions associated to their deployment in society.

we expect half of an age class to go through higher education, and with the reconsideration of the policy making process based on a larger involvement of stakeholders and new forms of public debate.

These challenges are heavily interconnected so that it was decided to find a more comprehensive framework to organise the discussion. It was a trial and error process; we started with 4 themes, very rapidly discovering that the fourth one (called policy making under situation of uncertainty and new frameworks for nurturing policy processes) was in fact a background dimension of the three other ones. The three themes witnessed very different developments. These are not anecdotal; they translate the level of development of research activities, concepts and hypotheses.

There is within the European community of SIPS a clear interest on **the role and transformations of public sector research** (higher education, government labs and not for profit research performers). Many new approaches and explorations are emerging. They build a rich and diversified research agenda. Section II.3. provides an account of the main directions proposed on: labour markets for researchers, the evolution of intermediary organisations, the diversity of roles and growth patterns of spin-off companies, the dynamics of micro-structures (or research collectives), the new governance structures associated with the growth of new leading sciences, and the changing conditions under which higher education institutions and universities operate.

The second theme focused on **evolving (changing) rationales for public intervention**. It was also very active, giving even rise to specific meetings (on IPR and on higher education policies). But the activity was more exploratory driving to the need of further consolidation and specialised review processes. This might be because the very important "informational approach" (from Arrow to Dasgupta and David) may have borne all its fruits and that we need another parsimonious representation of science, taking hold of the main lessons of science studies, that is entering into contents or the dynamics of search (as suggested by Bonaccorsi). This might also be because other frameworks derived from evolutionary economics and national systems of innovation have had difficulty to translate into adapted policy instruments and mixes the move from market to systems failures. This might relate to the quasi-exclusive focus on industry, forgetting about the long standing role of public needs, most of public investments in research being borne from such needs, and "mission oriented" research having played and still playing a major role in public research expenditures and possibly representing a "public engine for innovation" that has attracted limited research efforts. Or it might be the case that we have overlooked the complex interactions between theory and actual policy processes that can well generate other types of rationales (we have proposed to speak of type 2 rationales) which require a renewed interaction between economics, sociology and political sciences to untangle their interactions. And we should not forget the difficulty we face in conceptualising the implications for "national" policymaking of the rapid globalisation of the R&D efforts of large firms, or the questions raised about the traditional trade-off associated with patents when costs and benefits are no longer associated with the same geographical spaces. All these represent as many directions that section III.1. describes more in depth, proposing a number of explorations to initiate, beyond the well established "mainstream" agenda which participants considered well covered in the present framework of activities (thus probably not requiring more articulation at the EU level).

It is probably the third theme that was most challenging. How could a research agenda be developed around the very unique situation worldwide that Europe is facing dealing at the same time with new policy players (regions in many countries that have entered a decentralisation process, and the European Union), and with new policy processes marked by crises and controversies and the enlargement of stakeholders with new forms of representations, new types of "spoke bodies". These lie in between ""hybrid fora" developed by analysts of scientific controversies, and "arenas" developed by political scientists. Furthermore they are not established once for all and covering the whole field of S&T, but are both problem based and differ in their composition and dynamics depending upon countries (or even regions). The understanding of **the emergence and structuration of "multi-actor spaces" and their role in the governance of research and innovation in Europe**, thus progressively turned into the focus of this third major theme of the research agenda. Yet the agenda remained very tentative. The need for both reviewing existing studies of controversies and procedures developed to address them (such as consensus conferences) was highlighted, as the need to follow in real time new developments taking place (such as in nano S&T). Furthermore, reviews of existing literature showed that the was very limited comparative and conceptualising work done of policy rationales and mixes developed by "new" actors, regional authorities or non for profit organisations (such as the French patient association on neuromuscular diseases). Finally this should provide a renewed framework of analysis at a distance with the normative stands embedded in the notions of subsidiarity or of multi-level governance, and in particular consider cooperative as well as competitive relationships between public authorities. It would also help to reposition the transformation of policy tools and instruments used by the European intervention, such as networks of excellence, integrated projects, the open method of coordination, technological platforms or ERA-Nets.

2. Reflecting on the PRIME TN dynamics: policy implications

The thematic network did not stop at building the research agenda. It was designed as mentioned in the technical annex to explore the interest of developing one or more networks of excellence, the rationales behind it, the long-term objectives to follow and the conditions under which they could be implemented.

This drove us to a set of developments at complementary levels. Though we will take here a logical approach going from the macro issues to the operational setting, this does not reflect the effective dynamics with many go and fro from discussing "macro aims" to debating "micro operational issues" (such as the emblematic notion of "voting rights").

2.1. Small interdisciplinary specialities

The first "macro" level was to discuss the reasons why one of more networks of excellence could be interesting for SIPS. This drove us to consider the key organisational features of this speciality. It is small by any standards taken (probably less than 1000 scholars in its "broadest" definition over the then 15 European countries), and, as already mentioned, it lies at the encounter of 4 main disciplines: political science, economics, sociology and management (not counting inputs from geography, philosophy, history and anthropology, just to name a few). This has a very practical implication: apart from the "historical country" (UK and the 2 main centres, SPRU and PREST), it has had difficulty to gain visibility and recognition within the established national research agencies, institutions, programmes or ministries. Thus the lasting "structural" failures" mentioned for its development. The recent developments it has witnessed are more linked to the needs of governments (and more and more regions) to have local "expertise" or support for the design of their policies and their evaluation. So it is faced with a tension between geographical "fragmentation" and the critical mass required to attain international recognition and excellence. This links with a key word used by the Commission: **integration**. However, we consider it would be dangerous to jump to the construction of an overarching institute to address the dual issue of fragmentation and critical mass. We think that this alternative – market vs hierarchy – might not be productive, and that we need to maintain competition while finding ways to cope with the spreading of capabilities in the different territories of the Union. Thus we have devised a "progress model" that maintains the tension between cooperation and competition while addressing "over-fragmentation". We aim at nurturing competition via competitive calls (thus the importance of the implementation structure suggested) and we expect that the repeated participation in joint projects (within the NoE, but even more in other projects) will foster the integration of teams in virtual multi-located centres. The latter should thus help maintain the spreading of capabilities over Europe while lowering, thanks to integration, the threshold for international recognition.

There is thus a strong rationale for "small interdisciplinary specialities" to develop networks of excellence but it requires to be coupled with a clear view of the relationships between cooperation and competition.

2.2. Five main functions for NoEs

(i) The first section will have, I hope, demonstrated the importance of research agenda setting in a small speciality, if only through the interest and mobilisation it raised. It also demonstrates that, as intense as the process may have been, there were still numerous areas on which further reviews, exchanges and discussions were needed. This activity is critical if we wish to favour long-term anticipations. Thus agenda setting might well be a continuous process punctuated by major periodic efforts. It remains to see how a continuous flow can be built. One can see from the first set of selected NoEs that this was a major output expected by quite a few networks with books and special editions of journals taking hold of the "agglomerated" knowledge on a issue, a problem, a method...

(ii) and (iii) Clearly the review made shows that an important dimension of NoEs will be to address the lasting structural problems we face for the development of the speciality. We have highlighted two of them: (ii) building the adequate facility on our central quantitative resource, that is indicators, and (iii) preparing the adequate human capital through training activities at master and PhD level. They represent issues that are shared by the speciality in its broader definition, here research and innovation studies. We thus consider them as true European "platforms" that should be shared with other related networks of excellence, even if each will have dedicated activities.

(iv) There is a specific issue of articulation with stakeholders, above and beyond the classical (and demanding needs) of "dissemination". We see two aspects of it: one has been coined by using the term "distributed strategic intelligence", meaning that the knowledge base which research and innovation policymaking mobilises is extensively shared and would gain from more inter-acting. This is why the research agenda pushes towards an experiment on fora for strategic intelligence. The other one is connected with the fact that our main funders are also one of our main users, and that we have witnessed in the 1990s a strong tendency towards instrumentalisation, forgetting about the need of longer term research that anticipate on future potential problems and the related new concepts, frameworks and methods they might require.

(v) These 4 functions clearly highlight the fact that NoEs are not there to replace funding agencies. At the same time, it is important to consider that such an effort must find ways to initiate new things and give them time to demonstrate their fruitfulness and get embedded into the normal processes of main supporting bodies. We have considered that there were two types of activities where a NoE might act as a strong leverage system. We focus on long term research with two core principles: nurture diversity (via the support to new ideas, new paradigms, new theories, or said otherwise to heterodox research), focus on projects that require capabilities beyond what is available in given groups, either because of the critical mass required (in term of level and of complementary competences) or because of the need for comparisons and for aggregation which are both central issues in our field.

2.3. Organisational design

The design encompassed three main dimensions: a strategic capacity for action, an operational competitive process and implementation, and a reflective capability.

Build a core decision-making board can be done once for all (it is fixed at the beginning of the project). But there is then no solution in case of dispute than simple break-up. Or the members of the network can elect it. But then you face issues about election: we refused the inter-governmental approach that gives on vote per country or institution. We have suggested to allocate votes along our criteria of constitution, that is collective excellence arrived at and involvement into the network life (for the first election we only took involvement into the preparation of future researchers, looking at PhDs being trained). This requires that we build a specific process for defining votes and for solving conflicts between the board and any member. And, to avoid unbalanced representation or a concentration on the largest groups, we suggest an election process that gives the right to any group of votes that trespasses a given % of total votes to have the right to propose for the overall election a candidate (and if not agreed, to keep the proposal capacity).

Working on the basis of competitive calls requires a credible selection process. We suggest to clearly separate responsibilities: relevance for the decision-making board and scientific quality to a Scientific Committee with the rule that projects can be funded only if their scientific quality is recognised. It also requires you develop adequate financial procedures so that NoEs do not appear as another bureaucracy. This is probably one of the major challenges of the approach, if it wishes to be lasting.

Finally, for solving issues of voting rights but even more for learning about what has been done, about successes and failures, for "learning by doing", there is a need of a external critical monitoring (using both qualitative and quantitative descriptions of dynamics, change...). This is even more important at a time where there is limited knowledge on the instrument, its possibilities and its limitations. We even have not satisfying conceptual frameworks to consider integration, and this is amply demonstrated but the first set of indicators put here and there. Thus the need of a specific activity. And as we consider that we have in our field a specific responsibility on these issues, we suggest that this is the role of a specific group (we have coined the term of characterisation group) to both develop a framework, sets of indicators and methods to develop them.

2.4. A risk for a disappointment phase in the "promise-requirement cycle"?

PRIME TN demonstrated a real capability of instant mobilisation. It raised quite significant expectations that drove to the development of a full project, PRIME NoE, which was selected before the end of this thematic network. At the time of this report, the NoE has had already half a year of existence and we can start seeing both some of the capabilities, which we have already mentioned in our analysis. However this first period also highlights two important limitations in the present design and implementation process.

One potential limitation lies in the objective of self-sustainability after 5 years. It is difficult to describe the functions that the NoE will fulfil because they were poorly addressed at the national level, and then say to public researchers that they should find nationally the means of funding this infrastructure! There is a contradiction in terms, especially if the central motive is fragmentation, which is the recognition that there is a threshold over which diversity becomes counter-productive. Indeed the implementation route selected seems to suggest a model that implicitly recognises that long term research is a "national" issue with the possible exception of some specific facilities (such as synchrotrons or large data bases) and that EC action is just an incentive mechanism to correct country policy failures! As most analysts of public policies highlight, one of the critical requirements for effective policies is the coherence between the underlying rationale (fragmentation that hinders excellence), the objectives that translate it (NoEs) and the implementation structures built (here a one-off support). Search for coherence rather suggests an implementation model that would be near to those developed in the UK for the "centres competition" or by the French process of labs' labelling: if you perform well, you are reproduced up to three times five years...

The second limitation is already faced in the day-to-day life. The objective was to allocate a grant that would represent a significant share of the research activities of mobilised researchers: 20 000 euros representing in the order of one fifth of the cost of a full time researcher. This is all the more significant when researchers are also teaching, thus devoting only half of their time to research. In the application for PRIME NoE, we accepted to consider this aspect and only asked for 20% of the research time... and were granted just 10% of this research time, i.e. 5% of the total cost of a researcher per year. Can a NoE be sustainable on such a small incentive, especially after taking into account the costs of management and of structural activities? We are already witnessing some disillusionment: there is just enough money for meetings, exchanges and reviews, but not for research. But can a NoE be sustainable without the fifth function we have identified? We doubt it, and this is probably the major challenge the EC will be faced with in the next two coming years: how to recognise successful NoEs (like in any research activity, there are risks, and failure is part of the normal process of research life) and help them be sustainable over a relevant period?

2.5. Challenges for EU policy and NoEs on research and innovation

This executive summary has tried to take some distance from the core of the report, using the dynamics of the thematic network and the results arrived at to elaborate further both on the research agenda of the speciality and on the possible roles of Network of excellence. The latter represent a real size experiment that should be given time for learning at the same time there should be an organised effort to monitor developments and foster inter-network mutual learning. This is a challenge both for analysts (and we hope researchers from PRIME and DIME will address it) and for the EC evaluation process.

II. BACKGROUND AND OBJECTIVES OF THE PROJECT

The main objective of the contract as stated in the technical annex (p2) is to explore the challenges faced by research and innovation policies. The technical annex sets two types of priorities: thematic ones linked to the changing environment, and structural ones linked to the conditions of development of the "discipline" known as science (and innovation) policy studies. The final objective is to elaborate the overall conditions for a European-wide development of the field that accompanies and supports the deployment of the European Research Area, hence the title of the thematic network. This overall development was incorporated into the exploration of the feasibility of one or more networks of excellence.

When the thematic network started, the preparation of FP6 was well advanced, especially once the results of the call for expressions of interest launched by the EC in 2002 (with responses in June) became available. Some of the participants in this thematic network had responded and proposed one possible approach for networks of excellence. Analysis of the responses showed that there were numerous options. One was to organise an umbrella approach around innovation dynamics which would cover both disciplinary and inter-disciplinary collaborative work, while at the other extreme the central idea was to set up different integrated projects on each of the main issues identified. Our approach lay in between these two extremes, an approach shared by quite a few other proposals. They considered that the "field" was faced with a number of major challenges around which one needed to organise collaboration, all of which would be inter-disciplinary in nature but with quite different foci. One such challenge was "evolving public intervention" which is the topic of this thematic network. It was addressed by quite a few proposals, and we felt that, in an encompassing analysis of the research priorities and of the different options for addressing them, these answers required us to at least partly reconsider the issues raised, and hence to broaden and reorganise the work programme.

Whatever the approach, we considered that the structural aspects we had identified (WP5 to 7) were enduring and therefore we continued with the three identified structural activities in the format identified, that is mostly internal group work between the TN participants with some external invited experts. Their activities and preliminary achievements are described in sections III.4. to III6. Those sections demonstrate how the approach followed was very different from one group to another.

i) The Training group focused on a survey of capabilities (which was not yet fully finished at the end of the project). It aimed to provide (and its preliminary results served this purpose) as a basis for defining directions for a coherent

European-wide effort, identifying three main directions for action: articulation of PhD programmes and circulation/co-training of doctoral students, curricula issues for master studies (with both accreditation issues, and collaborative activities such as joint programmes or exchange of course material and teachers), "short courses" covering professional training, and R&I awareness-raising of masters students in management and engineering.

ii) The Forum group focused on interactions with stakeholders, especially practitioners of R&I policies at all levels of governance, including NGOs. The starting point was to build on and develop on-going activities fostering exchange and mutual knowledge (such as the OMC as devised in the Lisbon declaration and actively pursued by DGXII), but also to address the limitations encountered in public debate as highlighted by the very "local" nature of the debates on GMOs that took place in different countries. This led the organisers, as stated in the technical annex, to focus on the possibility of developing new "experiments" and, in particular, to consider the ways and means to implement the result of a previous thematic network on "distributed intelligence" (the so-called ASTPP network, see final report, 1999). The group centred their attention firstly on the framework proposed then and the further developments that have taken place in order to identify options for such an activity, and secondly the notion of "demonstration" – what was to be demonstrated, to whom, how, when and on what.

iii) The indicators and data group began from the seeming paradox of ST&I indicators in Europe with a considerable amount of innovative work done on possible new indicators relevant to the changing issues, yet the continuing reliance on the traditional Frascati-based indicators within the OECD framework of data-gathering. Two main directions were rapidly identified which set the framework for the work to be done. The first was to reconsider the reliability of comparisons between EU members based on national aggregations prepared for OECD. The major conclusion from this activity is that there is a clear need to network national indicator producers to discuss in detail conditions for the aggregation of data and to develop tests on traditional input data using one or other methods so as to define adequate intermediary levels of national aggregation that would help in carrying out meaningful intra-EU comparisons and overall EU aggregation. The second direction was to recognise the need for a new wave of indicators and the work carried out so far has identified a set of priority issues, among which the following four have been highlighted: how to better characterise human capabilities (and their circulation: between different types of actors, between countries, between types of activities and so on)? How to build a relevant 'geography' of Europe for ST&I? How to develop a better integration of S&T indicators and social and economic data? And how to trace the dynamics of emerging S&T fields?

The situation was different for the 4 thematic work packages (WP1 to 4). The results from the EoIs were looked at in great detail in a first 'core group' meeting of the TN that took place just after its inception. We could also learn from the results of the last workshop of the NPRNet and of the work on-going within networks such as MESIAS on the internationalisation of large firms or E-pub on public policies. This led us to reconsider and broaden our framework of analysis. First "situations of uncertainty" should not be linked only to policy-making and public debate, but should be central to our investigation of the emergence of a "European system of innovation". It thus entailed a changing focus on both WP1 where rationales should be understood in the light of changing conditions for innovation (giving more importance to firm dynamics and innovation in public goods – the so called 'mission oriented' paradigm) and on WP3, where higher education policies and structures should come more to the forefront. In addition, it led to a complete rephrasing of WP2 from a normative standpoint (how to develop co-ordination between regional, national and European policies) to a more analytical one based on the empirical observation of the growing complexity of policy-making processes, due both to the multiplication of public authorities involved and to the growing role of 'bottom-up' organised stakeholders (whether they are labelled NGOs, or as proposed by Callon in a recent book, 'concerned groups').

This led us to reorganise the thematic issues around three broader lines, each with a somewhat shorter description, in order to take into account this broader remit (see Box 1.).

Box 1. The organisation of thematic work packages

Initial organisation

WP1 – reassessing the rationales for public intervention in the production, access, ownership and trading of knowledge

WP2 – the framing of research and innovation policies in the context of overlapping public authorities

WP3 – Public Sector research

WP4 – policy-making under situations of uncertainty and new frameworks for nurturing policy processes

New organisation

WP1 – Changing rationales for public intervention

WP2 – Multi-actor spaces and the governance of R&I in the ERA

WP3 – Public Sector research

Each thematic group organised its activities along specific lines but with a joint meeting where groups exchanged ideas. The three different groups adopted a similar approach, as described in the corresponding work-packages. They started with a first set of exchanges in order to produce a preparatory document about main issues. This working document was mainly produced by PRIME TN members with the help of selected invited experts. These were discussed in an enlarged core group meeting which was open to external groups interested and brought together more than 50 persons from 35 groups (January 2003). This enabled a second stage of further work targeted on assessing the 'state of the art' and discussions of potentially interesting directions. These took place, as planned, through enlarged workshops. WP3 on PSR held its workshop in July 2003 (at SSSUP, Pisa) and gathered together more than 50 persons. WP1 brought together some 35 researchers in November 2003 at SPRU. Activities in WP2 have been a little less structured. A meeting in Paris helped in developing a second reformulation (December 2003) which then enabled a further elaboration to be developed in the final general meeting which took place in Madrid (January 2004). This latter meeting enabled all those involved to discuss the 'research agenda' that had been elaborated by the different work packages. This, in turn, enabled the production of the final work package reports that are incorporated in this overall report.

Finally WP7 (formerly WP8) was devoted to "organisational design". We decided that these activities would be conducted directly by the core group (made up of representatives of the main institutional participants). The latter met six times over life of the network and also had various telephone and electronic meetings. The group very soon decided that it should focus on helping the development of the six work-packages (and thus redirected some of its efforts towards this end). It divided its activities along two main lines:

First it focused on the governance mechanisms of self-management of a field (a unique new situation which requires one to address issues of strategic management, selection and monitoring, but also visibility and space creation). This led the group to address the notions of excellence' and 'integration' and the possible mechanisms to assess them.

These activities led to two particularly important results:

1) It enabled us to develop a unique consortium agreement that is devised not for managing a contract (whatever this might entail) but for the long-term management at European level (and beyond) of the field. We believe it should be broadly 'transportable' to other fields and therefore a common resource for most areas where ownership of knowledge in the form of patents is not central.

2) It led to a first analysis of the field and its composition. Though the coverage is far from complete, it provided a first overview of the situation and enabled us to identify key directions in which progress towards a stronger establishment at the European level needs to be made.

The second line dealt with options for developing an effective European Research Area in the field – in other words, it discussed the creation of a **European Platform** for the overall management and co-ordination of the field at the EU level. We decided to postpone this last activity until the end of the TN since we wished to get a clearer picture of the evolving landscape. It is well known that the members of this network prepared in parallel (the proposal was submitted in March 2003) a proposal for a network of excellence on this very topic, and that the Commission expects to fund at least one (and probably two) other networks on related topics (they were in the process of being selected at the time this report was being drafted). We therefore only started work on this reflection, mostly within the core group of PRIME TN, in the first part of 2004, which explains the slight delay in preparing the final report. We considered it necessary to the relevance of the analysis since we also wanted to take account of preliminary developments that had taken place in the framework of the first NoEs so as to come up with credible options. All the elements dealing with these options are included in the present report, in section IV.

III. SCIENTIFIC DESCRIPTION OF PROJECT RESULTS AND METHODOLOGY

This scientific report describes the way in which the various activities developed. It first reviews the developments that have taken place in each of the work packages and presents their final results. The final reports of each work package have been fully incorporated in this scientific report, since they represent the views of the thematic network about research priorities in coming years, the reasons why we consider them to be central, and the most fruitful directions to follow. There is a difference between thematic and structural groups. The former were asked to review the situation, to present challenges and to propose open-ended directions, while the latter were asked to devise specific means to deal with lasting structural problems that the field faces at European level. The latter are therefore more "direct" in the way they phrase their recommendations.

The project included one work package that was focused on organisational and policy issues. Its results are presented in Part IV. dealing with policy implications.

Part III. is organised as follows: sections III.1. to III.31 address the three thematic issues and sections III.4. to III.6. the three structural activities. They all have broadly the same structure: they first briefly present the activities developed before examining the results arrived at. This enables us to show the extent of the involvement not only of members of the thematic network, but also of other researchers within the field.

1. Work Package 1 on changing rationales for public intervention

1.1. Overall Development of the work package

The work was initiated by a first internal meeting in Paris (2002). It enabled the preparation of a preliminary position paper about the research agenda that was discussed at the first open general conference of the TN (Paris 2003). The debates led to the creation of a set of subgroups in charge of developing more precise framework papers for the planned workshop on "new rationales for public intervention". This was planned for the end of the first half of 2003, but the sudden death of Keith Pavitt led us to delay it somewhat, holding it immediately before the conference in honour of Keith that held at the Freeman Centre in November 2003. This workshop took place on 11-12vNovember 2003. Two aspects of the proposed agenda gave rise to specific meetings, one in Paris on IPR issues (October 13-14), and one in Twente on higher education policies and their articulation with research policies (November 24-25). This enabled us to prepare a first overall research agenda which was discussed at the second open TN conference (Madrid, 7-8 January 2004).

Box 2 summarises the main elements of the activity that took place.

Box 2. Work Package 1: Main activities

Initiation: internal working group meeting in Paris

The meeting built on the work done by the NPR Net (overall presentation around 'facing the facts' by Salter, Geuna and Steinmueller), on the contribution by Ben Martin on the revised social contract and on the work of Keith Pavitt on the usefulness of academic research and the implications for public policies. The debates were introduced by the presentations of Laurent Bach (BETA) and Paul Nightingale (SPRU). Further presentations and contributions were made by Luis Sanz and Laura Cruz (CSIC), Christina Chaminade (UAM), Philippe Laredo (Armines), Andrea Bonaccorsi (SSSUP). External invited members included Daniel Llerena (SERD, INRA), Bianca Poti (CERIS, CNR). Terttu Luukkonen (ETLA) and Wolfgang Polt (Joanneum), who were invited but could not come, sent contributions. This helped those responsible for the WP in preparing a positioning paper (9 pages) which was discussed at the first TN conference (Paris, January 2003).

The first TN conference (Paris, January 2003) was instrumental in focusing the work along five themes.

i) It was judged critical to work on 'rationales' and their relations with policy (formulating the notion of 'type 1' and 'type 2' rationales).

ii) However, this should complemented by other, more focused actions on specific key issues. Two were highlighted: rethinking the role of defence R&D as a step in elaborating a research agenda on research and innovation in collective goods, and further elaboration on search regimes and possible quantitative/scientometric tests of agglomeration.

iii) The changes in firm RDI activities also need to be considered as these throw into question the dominant practices for public intervention. While the growing role and variety of support for SME was addressed in WP2, it was decided to concentrate the research agenda on large firms and the effects of the globalisation of RD&I activities on localisation and the attractiveness of 'poles' and 'countries'.

iv) The changing landscape in knowledge appropriation, circulation and access has given rise to increasing work on IPR. It was considered critical to start reviewing what is under development to look at the present research agenda and locate potential gaps (e.g. there is very little European work on the effective functioning of patent systems).

v) Most of the work undertaken on public sector research acknowledges the growing centrality of universities; however, little has been done on the articulation of both sets of policies (for higher education and for research).

These broad directions were confirmed in the PRIME TN core group meeting of Karlsruhe (April 28) and led to three specialised workshops for framing the research agenda.

Brighton workshop – The Freeman Centre – November 11-12, 2003.

The workshop brought together 35 participants and was organised into 4 sessions:

- Policy mixes. Organisers: D. Braun, UNIL, and L. Bach, BETA. Presentations by: D. Braun, L. Bach and M. Matt (BETA), P. Nightingale (SPRU), R. Smits (Utrecht University) and A. Bonaccorsi (SSSUP).

- Internationalisation of industrial R&D and implications for public policy. Organiser and presenter: J. Edler, ISI.

- Innovation in public goods. Organisers and presenters: B. Martin and J. Molas-Gallart, SPRU.

- Dynamics of science and search regimes. Organiser and presenter: A. Bonaccorsi, SSSUP.

IPR workshop – Paris (Ecole des Mines) – October 13-14, 2003

The workshop brought together 24 participants and was organised into 3 main sessions:

- Inter-industrial and inter-firm differences in patenting and other IPR strategies. Organisers and presenters: Yann Ménière and F. Lévèque (Ecole des Mines). Presentations by U. Schmoch (ISI), L. Paija (ETLA) and E. Iversen (STEP).

- IPR questions and public research organisations. Organiser: U. Schmoch (ISI). Presentations and background documents by U. Schmoch (ISI), A. Webster (York), T. Luukkonen (ETLA) and M. Mayer (SPRU)

- The effective functioning of the European patent systems. Organiser and presenter: J. Cave (Warwick University), D. Peled (SNI), B. Poti and E. Reale (CNR)

Workshop on policies on higher education, Twente, November 24-25, 2003

The workshop brought together 15 persons. The discussion revolved around the two background papers prepared by J. Enders, B. Jongbloed and D. Westerheijden (CHEPS) on the role of higher education policy and research policy in shaping the European innovation system and on the future research agenda

Madrid meeting

The three workshops gave rise to various preparatory documents, presentations and topic conclusions. All the material was structured and organised by Ben Martin who circulated a preliminary final report before the Madrid meeting. A full session was devoted to an open debate on the report and proposed agenda, while two specific sessions helped in deepening the analysis on the globalisation of large firms and new policy issues (Organiser: J. Edler, ISI) and on policy rationales and mixes (Organisers: D. Braun and L. Bach). These were instrumental in preparing the final report of the work package.

1.2. The reasons for focusing on changing rationales for public intervention in ST&I

A major objective of the PRIME Network is to produce empirical evidence and theoretically grounded analysis of the changing science, technology and innovation (ST&I) policies in European countries (including a comparison with other industrialised nations). A central element of this is to develop a more up-to-date, appropriate and effective rationale for why governments and other public actors should intervene in science, technology and innovation in the light of the emerging challenges that they face. This has been the focus of the efforts of those members of the PRIME Thematic Network (TN) engaged in this Work-Package 1.

'Market failure' and related rationales

The traditional rationale for government intervention in support of research and of technological development relates to the concept of 'market failure' as first set out 40 years ago by Nelson and Arrow. Adopting a welfare economics approach and assuming that knowledge was equivalent to information, they demonstrated that the *social* return from investment in research and development is greater than the *private* one. This means that firms fail invest in R&D at the socially optimum rate and they related this ‘market failure’ to certain characteristics of scientific and technological knowledge (e.g. its non-rival, non-excludable and durable character). The policy implications were consistent with established practices at the time (e.g. protecting intellectual property through the provision of a temporary exploitation monopoly, subsidising basic research) but, as Mowery later pointed out, were rather too general and therefore of limited practical use in formulating specific policies or public interventions. Other forms of intervention justified under this rationale included policies for technological diffusion and for the provision of large collective goods through mission-oriented programmes.

More recently, systemic and evolutionary approaches in economics have provided somewhat different rationales for explaining why, when and how governments should intervene. The growing importance of the concept of the ‘national system of innovation’, for example, in analysing and explaining a country’s success (or lack of it) in relation to innovation has led to the identification of various ‘systemic failures’, for instance, relating to the dissemination of technological capabilities or to the specific needs of SMEs, which have come to serve as arguments to justify particular forms of government intervention.

Work by those involved in WP1 of the PRIME Thematic Network on the current situation with regard to the reasons why governments and other public bodies should intervene in relation to science, technology and innovation has highlighted four issues:

i) the inability of established rationales to suggest specific courses of action; one consequence is the regular recourse to S&T policy experimentation (involving the definition of new tools for policy intervention and their subsequent evaluation), which in turn has nurtured new theorisation;

ii) there is considerable scope for comparative work to aid EU reflection in fostering the move towards the ERA;

iii) the mission-oriented paradigm remains a central component of research and innovation policy in the US but has been less prominent in Europe;

iv) previous rationales and the underpinning theorisation’s have tended to reflect the dynamics of science at the time they were formulated (e.g. physics and ‘big science’, or large technology programmes); given that those dynamics may themselves be undergoing change (with the emergence of new ‘search regimes’ – see Section III.1.3 below), we need to re-appraise the underlying assumptions.

The PRIME approach: articulating empirical and normative research

PRIME research on ST&I policies and the underpinning rationale(s) involves the integration of two parallel activities: (i) empirical analysis and comparison of evolving ST&I policies at EU, national and regional levels; and (ii) examination of existing and emerging justifications for policy interventions. Confronting the existing rationales for STI policies with the 'real' world and searching for new and more appropriate rationales and ways of intervention is thus a critical activity for the Network. Hence, the approach taken seeks to combine both theoretical/normative and empirical research. It draws upon a range of social sciences including economics, sociology and political science. Analysis by the PRIME Thematic Network suggests we should concentrate on a few selected research questions chosen both because we consider them critical and because they will provide a base for integrating the activities of PRIME Network members.

In relation to this, we have set four aims for the research agenda for the coming years:

1) To go beyond purely descriptive research (i.e. country-based case-studies). For several years, we have been accumulating information on policy dynamics, policy instruments and even on the evaluation of programmes at the national level, but the resulting conceptual analysis tends to be nationally biased. The Network has to integrate, using comparative methods at different levels of analysis, the information and capabilities available to develop a more general approach to analysing policy dynamics in the field, thereby contributing to effective learning and improvement in relation to policies instead of simple imitation.

2) To develop a robust theoretical understanding of the dynamics of policy processes. This requires us to combine several perspectives, and to develop relevant theoretical models and conceptual frameworks that can help to test the robustness of new or emerging rationales.

3) To integrate the enormous amount of data and information available on ST&I policies in different countries and regions on a European basis while respecting standards for reliability, comparability and quality.

4) To present and discuss the knowledge produced at various fora (see the Work-Package on the Forum), and to disseminate it through specific activities under the training line of activity in the PRIME Network.

Objectives and themes

It is not the objective of this research agenda to define a precise list of items, all of which would have to be covered and distributed across existing teams. Rather, we are currently at the stage of establishing a framework or a research 'map', setting out the broad research directions, enabling researchers and research groups to locate themselves in relation to this 'map' and encouraging collaboration between them (e.g. to carry out comparative studies). Given the competencies of Network partners, the main lines of joint research activities which are being developed are focused around two principal objectives, each of which can be broken down into three themes.

Box 3. Changing rationales for public intervention – Six major themes

Objective 1: Conditions for knowledge production, ownership, access, use, trade and circulation
Theme 1. Changing patterns in knowledge production and its impact on policy
Theme 2. Globalisation, firm strategies and RTD: implications for public policy
Theme 3. IPR issues in the context of innovation
Objective 2: Science, technology and innovation policy evolution
Theme 4. ST&I policy mixes: issues about their framing, implementation and evaluation
Theme 5. Public procurement and innovation in public/collective goods
Theme 6. Institutional arrangements and academic research

1.3. Changing Patterns in Knowledge Production and the Impact on Policy

Based on extensive discussions which have taken place at PRIME meetings (in particular, the Changing Rationales Workshop held at SPRU in November 2003 and the PRIME Conference in Madrid in January 2004), a group of researchers has developed to focus on this theme. They have built on the earlier efforts of Bonaccorsi (the co-ordinator of this subgroup), Larédo and other PRIME researchers in order to elucidate the key issues where more specific work is needed and to develop an appropriate conceptual framework for the PRIME Network to address these.

One starting point is the important stream of economic theorising on science that originated with Arrow's suggestion of using the economics of information as the conceptual framework. Arrow suggested that economic theory had all that is needed to examine the process of research, that is, discovery and invention. It is not the specific content of the discovery or invention that matters from the economic point of view but rather its *informational* by-product. At each point in time, research activities produce new information that may be used in order to improve the decision-making activity of other agents. The value of research lies in the extra value generated by the improvement in decision-making made possible by new information.

This approach has proved enormously important, providing a consistent framework for the economic analysis of research in both science and technology and exploiting a number of classical results in the theory of information and communication (Radner) and in the theory of search (Stigler). At a general level it sheds light on the incentives of agents to produce and buy information, and on the nature of the equilibrium that result from their interaction. The celebrated under-investment theorem is one example of the derivation of equilibrium conditions (in this case, a market failure in effect) from the intrinsic characteristics of the good produced and exchanged, i.e. information. One of the most useful applications is the use of information theory to evaluate fundamental scientific research (David, Mowery and Steinmueller) or research and development programmes (Marschack and Radner). It is also possible to show that from this perspective a coherent theory of public intervention can be developed, not only in terms of a rationale for state intervention, but even in terms of specific instruments such as funding of basic research or IPRs.

The 'new economics of science' developed by Dasgupta and David basically adds the theory of information asymmetry to the picture. As in many other areas of economics, the introduction of adverse selection and moral hazard into modelling has had a dramatic impact on the existence and nature of equilibrium solutions. In the field of science, information asymmetries are extremely important because the scientist has superior knowledge with regards to the funding agency involved and the public, and to a certain extent also with respect to his peers. The institutional emergence of the scientific community, the universally accepted rules of priority in publication and the norm of open science are stable equilibrium solutions to the problem of information asymmetry.

We label all these contributions as components of the *informational approach* to the economic analysis of science. They represent an extremely valuable contribution to the conceptualisation of science as an activity in which informed decisions are made and cognitive resources are efficiently exploited. On a different ground, the opportunities for deriving implications from the economic properties of information (with or without asymmetries) are exhausted. The challenge now is to produce a parsimonious representation of science from the point of view of its economic content. Clearly, this is a major challenge because the specific aspects of scientific content are so different and so difficult to characterise that no external theory can give more than a rather general account.

Bonaccorsi has proposed that a small number of dimensions may give a reasonably accurate model of a particular scientific field. Three main dimensions are identified:

a) rate of growth;

b) degree of diversity;

c) level of complementarity.

By combining these dimensions, we are able to characterise different 'search regimes' in different scientific fields.

The rate of growth across fields does not depend on the absolute size of scientific activity in each field but on the rate of change in the production of scientific output, i.e. the speed at which new knowledge is created. We are mainly interested in the economic aspects of research activity. Under this perspective, we define the rate of growth in terms of an observable measure of scientific output over time and focus on its long-term dynamics. The rate of growth is interesting for two reasons:

1) scientific fields may grow at different speeds;

2) within any given field there may be changes in the rate of growth, such as sudden acceleration.

Having taken into account the differences in the rate of growth, we next need to consider the *direction* of growth. How *many* different directions of research are pursued at a given time? We propose a distinction between divergent and convergent patterns of search. In divergent patterns, each advance in the search process does not necessarily add weight to the *a priori* hypothesis but rather opens up new sub-hypotheses; a proliferation of new search directions is the outcome of the intrinsic dynamics of the field. On the contrary, a convergent pattern is one in which there are a few large research programmes, with well established research questions, and each piece of evidence adds credibility to one or other of the *a priori* hypotheses.

A third relevant dimension to characterise a research regime is the level of complementarity. By complementarity we mean the extent to which different human or material resources are utilised, in addition to the intellectual resources of the scientist him/herself. We ask what is the minimum collection of resources needed to perform the research activity. The unit of observation is not the institution at large, but the research project (and the associated research team), that is, the minimum organisational entity that is able to produce new results. Complementarities can be naturally described with respect to the type of resources needed. We distinguish between:

- human ressources;

- physical infrastructure (reproducible capital);

- natural environment (non-reproducible capital);

- institutional complementarities.

While we will not enter here into the details of the framework, one of the main claims is that, starting from the 1970s, we have witnessed the emergence of new leading sciences (primarily computer science, biotechnology, materials science and nanotechnology), which are characterised by high rates of growth, divergent patterns and extremely high levels of complementarity of human, physical and institutional types. This pattern is in marked contrast with dominant sciences earlier in the 20th Century, which either had a high rate of growth and strong complementarities but a convergent pattern of search (e.g. high-energy physics), or had divergent trajectories but with low complementarities and/or a low rate of growth (e.g. chemistry).

The previously dominant sciences of the 20th Century were either relatively easily accommodated into the academic system or large public sector research institutions, or they led to the creation of new, specialised organisations around large research facilities (such as particle accelerators or astronomical observatories), generally with separate funding channels. The central government was normally able to direct the flows of funds and human resources to the various fields, preserving the essential ability of science to self-reproduce capable scientists.

The new leading sciences, in contrast, require completely new forms of institutional settings and policy approaches. In fact, in leading sciences the proliferation of new research hypotheses is often so rapid that neither the government nor scientists themselves can monitor accurately and control the overall development. The level of uncertainty is much higher than in ordinary scientific enterprises and very often there are conflicting hypotheses at stake, for which there is no obvious uncertainty-reduction strategy.

Furthermore, the high level of complementarities does not entail the access to a small number of large facilities, but rather the decentralised access to facilities created by researchers themselves in the form of databases, experimental data banks and laboratory toolkits. These facilities must be located *close* to researchers because their fabrication is an intrinsic part of the research activity and there is no established standard for their industrialisation. In this sense, new leading sciences require much more localised research facilities of an accessible type, calling for a much more active policy role at the local level.

1.4. Globalisation, Firm Strategies and RTD: Implications for Public Policy

Background

There is broad agreement that if Europe is to increase its R&D expenditure considerably in coming years, it will be achieved largely within the business sector. Currently, the bulk of industrial R&D is conducted by leading multinational enterprises (MNEs). Therefore, it is the strategies of decision-makers within these companies about their R&D investment in Europe that will play a decisive role in Europe's attempt to achieve the 3% target. Key questions, therefore, include the following: What are the driving forces in relation to R&D decision-makers in MNEs? To what extent will the existing R&D capacities of MNEs in Europe be enhanced? To what extent can more industrial R&D be attracted? And what consequences do the location decisions of MNEs have not only for the companies but also for national or regional innovation systems in Europe? While many analysts from different disciplines have worked on these issues, there is still relatively little work on existing policy requirements and policy practices as regards the shaping of international location decisions and their consequences.

A PRIME subgroup led by Jakob Edler has begun work on the internationalisation of industrial R&D and its implications for policy. In addition to email discussions, the group met at the SPRU Workshop in November 2003 and at the PRIME Conference in January 2004. It has identified important current trends and analysed existing policies and policy challenges within Europe. The main objective has been to identify promising areas where more work is needed in order to understand and better inform policy.

Future lines of investigation – a pre-selection

Against the background of the complexity and diversity of international R&D activities, the exchange of analyses and perspectives on current issues and future trends within the PRIME TN has not resulted in *one* clear mission for future work in this area. However, it has helped to define and prioritise a limited set of conceptual and empirical issues that should be tackled in the coming years in order to sharpen concepts and improve evidence *for* and *about* policy to influence and benefit from industrial R&D by MNEs. The group has identified 3 basic conceptual issues and three empirical issues of future relevance. The former are numbered from (i) to (iii) and the latter from (iv) to (vi).

i) Differentiated cost and benefit analysis

All assessments of and prescriptions for policy need to start with a clear understanding of the consequences of cross-border activities, not only for the internationalising firm, but also for the innovation systems of host and home countries. Given the current and potential future dynamics resulting from re-locations both within Europe and between Europe and other global regions, it is essential to understand the logic of added value of inward as well as outward activities. This needs to be done both at a theoretical and conceptual level and at an empirical and comparative level. Empirical work needs to take into consideration the very diverse opportunities and threats for the various European countries; for example, a 'sandwich' country like Spain will be affected very differently from an accession country, a large and advanced EU country or an advanced, specialised and highly internationalised country (e.g. the Netherlands, Switzerland).

ii) Concepts of policies

The PRIME TN work on internationalisation has highlighted that the step from the analysis of international dynamics to policy prescription is far from simple. Moreover, we still lack a suitable conceptual framework to analyse policies affecting R&D location decisions. While it makes sense to differentiate, as Edler and colleagues have done, between activities to attract foreign actors (inward), on the one hand, and to benefit from knowledge produced outside the country (outward), this dichotomy is nevertheless rather simplistic. A full conceptualisation of policy issues should, first of all, include a differentiation of the policy scope – whether it is macro (i.e. broad policies to attract FDI), meso (sectoral or technology specific policies) or micro (policies geared towards individual firms). Secondly, it should consider the role of R&D in the whole value-chain in order to integrate R&D activities into a broader policy framework. Thirdly, such a conceptual framework is needed to analyse existing and improved division of labour and co-ordination between the various policy levels and also to analyse more systematically the value of international (whether bilateral or multilateral) arrangements. Finally, it should elaborate on the 'problem dimension' to enable the definition and analysis of a strategic fit between existing policies and the policy challenges different countries face at different levels. By working incrementally towards a concept of internationalisation policies along these lines, we should be able – step by step – to reduce the complexity in a systematic and fruitful way.

iii) Underlying rationales and the institutional dynamics of policies geared towards internationalisation

To arrive at a selected set of specific policy instruments explicitly geared towards internationalisation, we first need to analyse the underlying rationales and the dynamics leading to the successful institutionalisation of these rationales. Such an analysis should be based on institutional and reflexive theories, relating closely to the conceptual work outlined here and to the subgroup on 'policy mixes' (see Section VI. below). The added value of such an analysis rests on the assumption that, in order to establish such policy instruments, there must first be some kind of conceptual adjustment within administrative bodies and other stakeholder groups. If one assumes that the knowledge-augmenting interpretation of R&D internationalisation (an interpretation highlighting the value of going abroad to generate knowledge and of hosting foreign companies within one's own country) is the dominant one, existing and deeply imbedded policy rationales run counter to the required new policy requirements. For example, national policy has for a long time assumed a rationale that stresses such principles as the 'protection of local actors', 'reciprocity' of assistance to foreign actors, 'national champions', and the primacy of the home country over foreign pockets of excellence as the preferred research location for national firms. Many of these principles are no longer suited to the new requirements and may actually prove counterproductive. Selecting more appropriate policy instruments, and identifying the underlying rationales as well as analysing the driving forces and processes leading to the adjustment of rationales, is likely to be highly beneficial. Moreover, an analysis of policy rationales would – ideally – include the conceptualisation of institutional structures within and across administrations in order to design and implement policies based on these adjusted rationales. Such a theory-driven analysis should contribute both to a better understanding of complex policy change and – more concretely – of specific policy instruments and the conditions for their successful implementation.

(iv) The scale and consequences of the knowledge-augmenting mode

If policy is to make an effective difference, any change in the influences on the choice by firms of R&D location has to be taken into account. The knowledge-augmenting mode has several significant implications; indeed the more this becomes the primary driver, the more important the characteristics of the research system become. While it appears that the knowledge-augmenting mode has gained in importance, it is far from clear how big this effect is, as knowledge-augmenting depends on the knowledge intensity and 'dynamic' of a technological area (Edler, Döhrn and Rothgang), the intensity and scope of the corporate R&D, and on the level of development of both home and host country (Molero). Therefore, evidence-based policy needs to be better informed about the following: the scale and foci of R&D motivated by this mode; good practice in relation to policy design tailored towards selected, dynamic and knowledge-intensive technological areas; effective institutional arrangements both within companies and between countries in order to let knowledge flow freely across borders; the absorptive capacities of national actors seeking to benefit from knowledge generated outside the country (Criscuolo); the attractiveness (in terms of such factors as excellence, critical mass and mobility of researchers) and accessibility of the national research system, especially as regards the public research sector (universities and application-oriented institutes); ways to increase the 'embeddedness' of foreign subsidiaries within the innovation system of the host countries; and finally, ways to achieve the 'best of both worlds' in Europe, i.e. combining knowledge augmentation with a 'lead market' approach.

(v) Attraction race

As most countries view the increase of industrial R&D by foreign companies as a key means to enhance their domestic R&D, something of a 'race' to attract the limited number of large international R&D performers is underway. However, we do not know much about the dynamics of this race, about the direction of FDI, or about the 'winners' and 'losers'. In the worst case scenario, it may prove to be a zero-sum game with a growing concentration at those 'hot spots' that are already attractive locations, and with a 'race to the bottom' with regard to such factors as taxes and working regulations. However, it is far from clear whether such a race is indeed a zero-sum game, or whether there are mechanisms to turn it into a positive-sum game or at least to make the race more transparent and open. It would be beneficial not only to analyse the dynamics and driving forces of this 'attraction race', but also – from a European perspective – to conceptualise what are likely to be the most effective policy mechanisms to moderate it.

(vi) R&D side-effects of mergers and acquisitions

One dimension that is, to a large extent, responsible for the increase in internationalisation of R&D is, ironically, not driven by R&D considerations at all, but rather is a side-effect of merger and acquisition strategies. What in the short term is counted as more international R&D often involves – in the longer term – a withdrawal from networks as a deliberate strategy or as a consequence of turning into an outsider, a downscaling of R&D efforts or a shift in focus towards the country of the acquirer. We need to know more about the relative importance of such side-effects of internationalisation and the positive and negative consequences, in order to learn about management and public strategies that will help to minimise the detrimental effects.

1.5. IPR Issues in the Context of Innovation

Background

Intellectual property rights systems include many kinds of mechanisms to protect knowledge and intellectual products. These include patents, trademarks, trade secrets, copyrights, and design rights. Different forms of protection are often complementary rather than substitutes, though the importance of the different forms of protection varies by industrial field and type of product. Future work should concentrate on patents - albeit not exclusively - since these are most relevant for the protection of technological information.

Patent systems have diffused widely in the whole world and are converging. There exists a lot of information on the pros and cons of patents in knowledge protection. However, the degree to which patent systems promote innovativeness is not settled[4]. While they are expected to promote innovativeness by granting the inventor a monopoly right for the utilisation of innovation for a specific time, strategic use of patents by companies may delay the diffusion of innovations. This will affect the degree to which there are micro level benefits, but the macro level harm varies by sector and technology area. Patenting can adversely affect the progress of science by barring academic researchers, who have not taken a patent, from using the patented knowledge in their research unless the latter can afford to buy relevant licenses[5].

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[4] Ove Granstrand, The Economics and Management of Intellectual Property – Towards Intellectual Capitalism. Edward Elgar Publishing, Cheltenham, 1999.

[5] Jason Owen-Smith and Walter W. Powell, To Patent or Not: Faculty Decisions and Institutional Success at Technology Transfer, unpublished paper.

Patents have an impact on both the economic and innovation (and R&D) markets. Factors such as the size of the market, size of the company, and the technological field are important for the role of the patent systems in the business and technological development of a company. Patent protection may be more important for companies with small domestic markets when they enter larger export markets. Small companies may also benefit more from patent protection when competing with large companies. Overall, patents are important assets and companies use patents as competitive tools. This use gives rise to seemingly conflicting tendencies in patenting, such as the growing importance of patenting and securing IPR to the company in pharmaceuticals and biotechnology[6] – where patent protection of the central innovations is a prerequisite for the formation of a business firm – and a (highly contested) move towards open standards, cross-licensing, pooling and technology-swapping in telecommunications[7]. There is a concern that the current one-size-fits-all regime is not adequate and should be replaced by either a regime with variable patent length, breadth and duration or by one with built-in options on specific rights to ensure efficient use of knowledge, innovation protection and deployment of incentives.

The main challenges facing patent systems

There are a number of challenges for the patent systems arising from new scientific discoveries, changing public-private partnerships, and new socio-economic and political demands for the utilisation of the benefits from science. These include the following:

i) New research areas and new kinds of research outputs, such as software, biological substances, genetic codes and gene banks pose severe challenges to the existing patent systems as to the definition of a patentable innovation. Traditional patentable technological or technical innovations concern knowledge that can be used to manufacture artefacts. The new substances concern technological knowledge which can be utilised economically, though not necessarily to manufacture products. The limits to patentability are being changed, which leads to new ethical and economic questions:

ii) The patenting and economic utilisation of biological data, such as gene-banks consisting of genetic material of individuals, has highlighted issues related to ethics, rights to privacy, and safety. Regulations concerning such issues vary by

[6] E.g. Liebeskind J, J.P., A. L. Oliver, L. Zucker, & M. Brewer, Social Networks, Learning, and Flexibility: Sourcing Knowledge in New Biotechnology Firms, Organization Science, Vol. 7, No. 4, July – August 1996, 428-443

[7] Carl Shapiro, Navigating the Patent Thicket: Cross Licensing, Patent Pools, and Standard-Setting. University of California at Berkeley Working Paper, 2000.

country and raise the question of the influence on competitive conditions by ethical questions.

iii) Questions concerning the public-private divide and a just system of allocating economic rents accruing from innovations. How to allocate economic rents has arisen especially because of increased university-company R&D co-operation. Firm-university R&D alliances have become to be regarded as a model mechanism for technology transfer and economic utilisation of science. The division of IPR from publicly-funded research has become especially acute in the formation of spin-off firms from academic research, which are being actively promoted.

iv) There is in general an increasing awareness of the commercial significance of research carried out at universities and other public research organisations. In the USA, the Bayh-Dole Act of 1980 enabled the universities to patent inventions from federally funded research[8]. In Europe, the regulations concerning the patenting of research carried out at universities and/or with public funding vary. There is, however, a growing tendency for public research organisations, universities and research institutes to engage in patenting, or to encourage their researchers to engage in patenting. At the time of growing pressures on public funding, universities expect to obtain new revenues from patent income. Patents have even come to be regarded as an output indicator for publicly-funded research. While the patent system by definition provides protection in exchange for open disclosure, the intrusion of commercial considerations works against the culture of 'open science'. This leads to a change of academic culture and can have serious repercussions for collaborative research, access to results and teaching.

v) The threat to the freedom of research and the progress of research posed by patenting. If industry-university alliances lead to industrial patents, these may effectively block new research potentially being carried out by the university researchers.

vi) Growing political movements for open release of patented information in order to be able to manufacture medicines in developing countries. Recent agreement on AIDS-related treatments is a case in point. The overall consequences of

[8] For impacts, see R. Henderson, A.B. Jaffe, and M. Trajtenberg, The Bayh-Doyle Act and Trends in University Patenting 1965-1988, Center for Economic Policy and Research No. 433, Stanford CA: Stanford University, 1995.

compulsory licenses or subsidised drugs, particularly the problems caused by circumventing the new rules (e.g. selling subsidised drugs back to the US or western European markets), is a question for future study.

vii) In order to avoid problems related to dispersed patent systems in the Member States and to enhance the construction of ERA, one of the Lisbon objectives was to create a Community patent. This has now been under discussion for over 10 years and the recent attempt to implement this has once again fallen to pieces.

viii) This links with yet another problem, that of the enforcement of existing regulations, that is the downstream laws/measures for the concrete implementation of patent law, especially in the case of infringement. Questions to be studied cover the existence of effective courts to implement the rights, the predictability of jurisdiction, and the professional standard of courts.

Priorities for coming years

The members of the PRIME TN were conscious of the numerous efforts being developed by multiple groups and networks, not least the on-going EPIP network. They have therefore mostly focused on three issues that have not yet witnessed enough development and require further collective elaboration.

i) Revisiting motives for patenting and the evolution of patenting behaviors

There are now numerous 'national' databases and studies about the use of IPRs by firms, patenting behaviour, and the motives for patenting. The time is thus ripe for entering into a comparative and aggregation process that can better serve policy making, especially since negotiations and overall frameworks are a direct EU responsibility.

Analyses of differences between types of firms, sectors or countries require more in-depth analyses. But the interest would lie in the possibility of better addressing pending issues such as patenting strategies in different types of industrial environments, such as standardisation environments; the different roles of patents for start-up and existing firms; the interplay of protection strategies and knowledge management practices (including knowledge sharing), the use of patent portfolios for reasons other than protecting innovations such as to impede competition and the difference between small and large firms[9]; and relationships between patenting behaviour and the national

[9] Such issues would also require the study of patent disputes, litigation and settlement activities

implementation of patent systems (cost of patents, cost of defending a patent against infringement, effectiveness of enforcement and so on).

(ii) Public sector research and patenting

As mentioned above, we have witnessed an important movement of universities towards patenting with the development of patenting offices and other types of technology transfer offices. Studies both of the involvement of universities in patenting and of the performance of these offices are fast developing in Europe following developments in the US. But there are far fewer studies that look at this as adding new forms of codification of knowledge to the established ones (that is, scientific articles). How do the two complement each other? What transformation does it entail in the governance of the universities and in the definition of careers and rewards? There is a crucial need for in-depth work to analyse the extent and contradictions of these on-going transformations, and to understand the role of different factors affecting these.

iii) IPR as the basis for the co-operative management of a sector's technological assets

The third project originates from a question that cuts across different sectors and different types of IPR: how do collective institutions based on IPR develop in response to complex technologies (i.e. complementary, cumulative technologies exhibiting network effects)? This open formulation concerns forms of industrial institutions that are usually studied separately such as Patent Pools, Open Source Software or Biotech Platforms. Such institutions are built on IPR rather than suppressing it. IPRs are used to map a technological area where a collective rule (of these institutions) is enforced. Furthermore, they enable the creation of collective rules. The open source GNU license or the RAND licenses of patent pools are, for instance, based respectively on copyright and patent law.

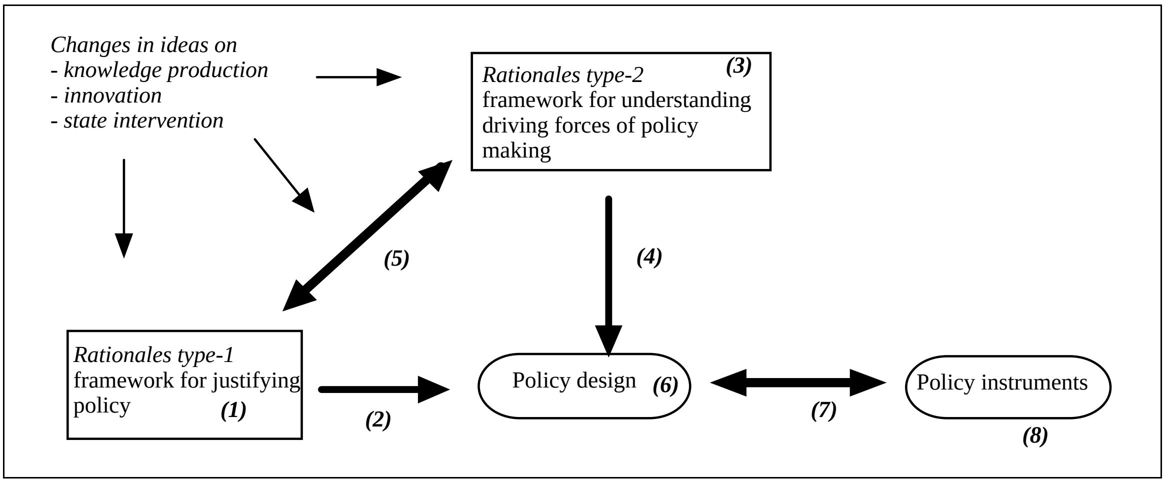
These collective institutions raise important issues of public policy, especially as regards anti-trust regulation. One issue, for example, is whether and when the collective rule should apply to new innovations that result from the pooled technology. There is a dual need for empirical studies (in relation to on-going developments, as in the agro-bio field) and for establishing a general analytical framework to provide a more accurate understanding of how efficiently collective rules can match technological features.

1.6. ST&I Policy Mixes

General framework

The overall objective is to compare policy rationales developed in different disciplinary fields with regard to their intellectual foundations and policy consequences. The aim is to provide a basis for assessing the extent to which these intellectual foundations have indeed influenced policy-makers in their research and innovation policy decisions.

Two types of rationales can be distinguished relating to two (interlinked) sets of reasoning and fields of research. First, 'type-1' rationales reflect theoretical and normative attempts to establish a coherent framework for state intervention. Secondly, 'type-2' rationales are linked to the practical actions of policy-makers and reflect different interpretations as well as the power struggles among diverse political actors. Both types of rationales should be taken into account in explaining the *policy design* – i.e. the causal beliefs that guide political action. The policy design is translated into the instruments that are set up, whether policy tools or mechanisms for monitoring, evaluating, informing and publicising the policy.



As regards type-1 rationales, during the last 20 years there have been significant changes in our ideas about knowledge production, distribution and use, about technological innovation and about state intervention. However, it remains unclear which of the different 'layers' of the belief systems (following Sabatier) are thrown into question by these changes, i.e. whether they affect: the 'deep core' reflecting "fundamental normative and ontological axioms" that government is following; the 'policy core' entailing "fundamental policy positions concerning the basic strategies for achieving normative axioms of the deep core"; or the 'secondary aspect' meaning "instrumental decisions and information searches necessary to implement the policy core". The work so far (especially the November 2003 workshop) focussed mainly on the evolution of perspectives and ideas with regard to **type-1 rationales** in some of the disciplines represented in the PRIME Network (especially economics and to a lesser extent political science).

Research questions and topics

With regard to the above chart illustrating the general framework, various issues emerged at different levels.

(i) About type-1 rationales – level (1).

There is a *clear need to go further into the analysis of Type-1 rationales*, comparing and contrasting the different approaches put forward by different disciplines. This includes the following aspects: (a) *adding to the range of disciplines (and sub-disciplines)* considered so far: for instance, work by sociologists merits further attention as does the theory of regulation; (b) *deeper analysis of the reviewed approaches*, for example, analysing the extent to which they are distinct from one another (for instance, endogenous growth theory as compared to standard neo-classical or evolutionary perspectives), and the soundness of their theoretical foundations (for instance, the National Systems of Innovation Approach is relatively 'under-theorised' and might benefit from introducing elements of modern system theory); (c) *seeking a better understanding of the changes in belief systems* at the three layers distinguished by Sabatier; (d) *improving our understanding of the boundaries between 'science policy', 'technology policy' and 'innovation policy'* (and also between these and other public policies such as those for education, competition and industry) and the criteria for these demarcations, looking at how these relate to different theoretical approaches; (e) *questioning the scope of each approach as regards the different dimensions of the paradigmatic changes* (knowledge production, use, distribution and access, innovation, and state intervention) and examining the extent to which each approach or discipline offers a comprehensive and coherent framework to address these various dimensions; (f) *examining how far different rationales go in defining specific policy tools* and how they should be implemented (by 'tools', we mean not only the type of measure adopted by the state such as R&D tax credit or an IPR regime, but also the associated institutional arrangements and accompanying monitoring, evaluation and information systems; for instance, a neo-classical perspective may give rise to evaluation tools that differ significantly from those inspired by a systemic or evolutionary approach); (g) *analysing similarities and differences in relation to the concepts drawn upon in each approach* (for example, notions such as system, history, uncertainty, risk and learning).

In relation to the above, there are at least three areas of overlap with other PRIME activities: the theoretical background to innovation systems which is closely linked to the work on multi-level governance; the international dimension of policy rationales which overlaps with the work of the subgroup looking at internationalisation (see Section III.1.4. above); and some of the theoretical aspects of policy tools such as IPR (see Section III.1.5.) or PRO actions.

ii) Influence of type-1 rationales on policy design – level (2).

Preliminary analysis by the PRIME team of how different rationales relate to the thinking of policy-makers and influence policy-design has identified certain constraints such as the need for cognitive simplicity. Another potential obstacle is that the political 'business cycle' of policy-makers may be in conflict with the long-term objectives of policy rationales. We also need to examine how the ideological assumptions or preferences of policy-makers influence their receptivity towards different policy rationales and how these are translated into policy design and practice.

Another important aspect that merits further research by PRIME is the normative content of policy rationales, for example, analysing the epistemological orientation of economists with their use of concepts such as optimality and social desirability. The normative aspect obviously influences the choice of particular evaluation instruments – for example, classical cost-benefit analysis or ROI tools.

iii) Use of policy instruments – levels (1) and (8).

Both at the theoretical and empirical level, there are several research questions relating to the 'mix' of policy tools or instruments employed. For instance, what are the similarities and differences between the tools proposed by different type-1 rationales? What are the complementarities between different tools within a given policy rationale framework and between frameworks? How can one allow for the different time-scales of different instruments? And how can new instruments (for example, 'systemic instruments') be inserted into an existing system of policy tools?

iv) Policy design – level (6.)

Policy design reflects the influence of both type-1 and type-2 rationales. The obstacles to integrating type-1 rationales into policy design have already been mentioned. Here, we merely highlight that there are few if any studies that try to take into account both types of rationales and how policy-makers respond to these different influences.

v) Other levels.

Thus far, this subgroup has focussed less attention on the type-2 rationale (level 3), its influence on the policy design (level 4) and its relations with type-1 rationales (level 5). Similarly, in a changing and uncertain environment, it is crucial to analyse, characterise and promote the learning and adaptive capabilities of policy makers and, more globally, of the overall policy system: the "earning/adaptive policy maker" (level 7) has also been given little attention so far.

Research Priorities for the coming years

The different levels outlined above provide a range of research opportunities. Future work is likely to involve a three-step activity as we attempt to address two of the basic questions of this work-package: How does policy-making happen in reality and to what extent is it in line with theory? Is there coherence in the policy tools and issues pursued by policy-makers?

i) More rigorous systematisation of type-1 policy rationales.

From the work so far, it is clear that there are a number of approaches used in different disciplinary contexts (although they may cut across disciplinary boundaries) that are worth pursuing. These include: evolutionary approaches; the neo-classical approach; the 'national systems of innovation' approach; a systemic approach; bounded rationality; rational planning; and the constructivist 'Mode 2' approach. These concepts seem to play a significant role in informing policy actions. Our task is to study each approach and highlight three things: (i) the normative contents (the deep core); (ii) the causal beliefs (the policy core); and (iii) policy prescriptions and the resulting instruments and other tools (second-order aspects). On the basis of a comparison, the similarities and differences will be systematised in future PRIME work. Of particular interest is whether the policy prescriptions are different or show commonalities. One possible approach to pursuing this could be 3-day workshop with experts on each approach who have received a prior set of specific questions and issues to address. On the basis of the discussion, a table relating to the above three dimensions could be developed.

ii) Analysis of actual policy designs in different countries – the type-2 rationale dimension.

The reconstruction of the world of policy-makers means that actual policies have to be screened according to (i) their normative contents, (ii) causal beliefs, and (iii) actual use of policy instruments. This could best be done when new policy instruments are introduced. The idea is to see how far the 'real world' corresponds to a particular type-1 rationale or if other normative contents and causal beliefs have been drawn upon. Another possibility is we may find that a mix of type-1 rationales tends to be employed. To address this issue, the most fruitful approach is likely to involve country studies providing an overview of type-1 rationales and examining for each country how the policy design has been developed. The effort required may be relatively limited if 'White Papers' and similar policy documents reveal this kind of information easily. One could then develop some preliminary answers that could be examined in one or more workshops on the topic.

iii) How type-1 rationales become reflected in the causal beliefs of policy-makers and how they are transformed in the process of adaptation to the 'real world'.

How, in practice, do policy-makers 'learn'? Here, a number of aspects are relevant, including the above mentioned structure of the policy rationale (whether it is simple or complex), and its 'fit' with ideological assumptions or political interests. Again, there is important research to be conducted in exploring this issue.

Together, exploring these three dimensions could begin to provide answers to the two questions of the WP1 mentioned above. In addition, they respond to the directions for research mentioned in the framework programme: (i) to theoretically understand why and how the state should intervene in these new S&T policy areas to achieve superior performance ('type-1 rationale'); (ii) to empirically understand the range and diversity of institutional arrangements and policy tools that are being used in different sectors and at different political levels within and across the EU in order to identify and analyse their strengths, weaknesses, overlaps and unintended consequences; and (iii) to understand to what extent rationales, policies and tools are coherent and complementary or contradictory.

1.7. Public Procurement and Innovation in Public/Collective Goods

Introduction

The focus of this subgroup, which has been co-ordinated by Ben Martin and Jordi Molas, is innovation in public or collective goods. Innovation in such public goods plays a key role in the economy, especially in industrialised countries such as those in the EU. As we indicate below, it may also (in the view of some, at least) be one factor accounting for differences in innovation performance and economic growth between the EU and the United States over the last decade. The starting focus of the reflection was thus on public goods in the defence sector. Security or defence is often cited in economic textbooks as a traditional example of a 'pure' public good on the grounds that it is non-excludable and non-rival (although in practice the specific outputs of a particular military innovation may not fully meet these criteria). Certainly, defence R&D is almost entirely government funded, mostly directly (through R&D programmes) and in a smaller but growing percentage of cases, indirectly (through the purchase of new weapons systems whose development has been partly funded by the supplying firms). Although government plays a role in research in many other areas, its central position in the defence area is unique. Governments are the only customers, finance most of the development of new systems, and in some European countries retain a substantial ownership share of the main defence manufacturers. Moreover, in countries such as the US, the UK and Spain, defence R&D accounts for more than a third of all government research and development expenditure.

Issues in defence R&D

The nature and role of defence R&D raises a number of issues. Some have been addressed in the literature for many years. The quantitative analysis of the impact of defence R&D (and defence expenditure) on economic performance has generated a long, if inconclusive, stream of studies. Another line of study concerns itself with the management practices related to the procurement of weapons systems, from project definition, to production and maintenance. Here the focus has been on the distinct practices that characterise the defence industry and that, some have argued, may hamper their diversification or the insertion of technologies developed elsewhere in the economy. Today, attention is shifting towards the management issues derived from the long life-cycle of defence systems and their increasing reliance on civilian components and sub-systems characterised by increasingly rapid obsolescence. Another strand relates more directly to the management of innovation in the defence area, for example, the role and reform of government research establishments, and the ways in which R&D priorities can be determined. Related to all these aspects is the interest in defence procurement reform; spurred by reform initiatives undertaken in the US during the 1990s, new approaches to defence procurement are being examined and implemented in most European countries. Closer to the political end, European defence procurement collaboration and the management of dual-use technologies will continue to require the attention of analysts.

However, the issue on which most interest has recently focused is the growing disparity between European and US efforts and capabilities. In 2001, EU defence expenditure was about ¤160 billion while for the US it was over twice this at ¤390 billion. In relation to investment, the gap is rather larger (EU ¤40 billion, US ¤100 billion), while for R&D there is a five-fold difference (EU ¤10 billion, US ¤50 billion) and the gap has been growing over recent years. Likewise, defence exports from US to EU are more than four times higher than from EU to the US. Considerable disparities are now apparent in relation to deployed military capabilities, with many arguing that the difference can lead to problems in interoperability between European and US forces in future joint operations.

Different interpretations are made of the gap and its implications; from the US it is common to argue that Europe should increase its expenditure and buy more (US) military equipment, while in Europe the gap is used to argue in favour of budget increases and support for the European defence industry. As an example of the latter, a recent EC Report argued that "Defence-related research plays a major role in innovation in the US; it benefits the whole of industry, including the civilian sector. This interpenetration of defence and civilian research has benefited both the American arms industry and civilian users in terms of market access and costs." (EC Communication, *Towards an EU Defence Equipment Policy*, March 2003)

The implication here is that the US economy as a whole has benefited significantly from the high spending on defence R&D, while Europe has been largely denied this benefit. This conclusion sits uncomfortably with earlier work in the 1970s and 1980s on the detrimental effects of defence research and production. Studies then by science and technology policy researchers suggested that defence R&D and innovation tended to encourage a culture in companies that was not well suited to civil innovations, as well as 'locking up' scarce R&D capabilities in institutions with few opportunities for spin-offs or for technology transfer to civilian products. Thus, at that stage, a relatively high expenditure on military R&D was used as one of the factors to account for the poorer record in terms of innovation and economic performance of countries like the US and the UK compared with Japan and Germany (each with little expenditure on defence R&D). Now, the US's high expenditure on defence R&D has somewhat mysteriously been transformed from a detrimental factor to a beneficial one.

At first sight, it would seem to be impossible to square these totally contradictory conclusions about the detrimental or beneficial impact of defence R&D on innovation and on national economic performance. One of them must surely be wrong. Certainly, one needs to treat with some caution arguments often emanating from European defence-related companies that US industry as a whole has benefited from high federal expenditure on defence R&D and that European countries should follow this route. One of the research tasks of PRIME researchers (preferably in collaboration with US researchers) would be to investigate systematically the advantages and drawbacks of heavy investment in defence R&D and innovation in military public goods.

However, it is also possible that circumstances have fundamentally changed – that whereas defence R&D in previous decades had a detrimental effect on the economy, now it may have a net positive effect. What changes might have brought about such a shift? One possibility is that previous generations of military technology were less likely to produce generic effects across the economy as a whole compared with new technologies such as ICTs, biotechnology and new materials. This is obviously linked to the PRIME interest in changing scientific and technological paradigms and 'search regimes' (see Section III.1.3.). Thus, a second task for PRIME work in this area is to explore whether there has been some fundamental change in scientific and technological paradigms, reflected perhaps in changes in the relationship between universities and industry or between science and technology more generally.

Beyond defence: innovation in public goods

The subgroup has identified a number of other issues on which research by PRIME might concentrate, issues which often overlap with the interests of other components of PRIME. One such issue is the shifting (or even disintegrating) boundary between the 'private' and 'public' sectors in the delivery of public goods. Another is to examine the consequences of various institutional changes that affect the role of the state in funding and conducting R&D. For instance, what are the effects of the increasing commercialisation of 'public' research organisations?

Lastly, there is scope for research that overlaps with the work on changing rationales for government intervention. For example, one rationale for government spending is to encourage the development of new *generic* technologies where the benefits will be felt across the economy. The research and development involved tends to be long-term and risky, and the benefits are, by definition, not easily appropriated by individual firms. Given that, for political and other reasons, European countries are most unlikely to raise their level of investment in military R&D to the US level, can one draw up a list of other public goods with similar characteristics and beneficial properties? One example that immediately comes to mind is medical and health technology. Here, the shift to a molecular/genetic paradigm for the treatment of illness would seem to fit the criteria of requiring long-term sustained effort and of yielding generic benefits. It might also be worth looking at medical equipment where thus far, despite advances in IT, we are still seeing cost escalation as opposed to the dramatic reductions in cost (and increases in productivity) seen in other sectors.

Other areas where greater government involvement in the production of public goods may be merited include improvements in quality of life and the environment, agriculture and rural land use, transport, education (there seems to be relatively little literature on innovation in education) and space. In each of these, PRIME might explore the nature of innovation in relation to such public goods, the arguments for government intervention, and the consequent benefits and costs.

1.8. Institutional Arrangements and Academic Research

Introduction

The subgroup preparing research activities on issues related to institutional arrangements and academic research brings together two communities which have interacted relatively little in the past – namely, researchers with a background in science, technology and innovation studies and those with a background in higher education studies. The mutual interest in Higher Education and Research Policy Studies has led to the establishment of an informal thematic subgroup headed by Jürgen Enders with two main objectives: (i) strengthening exchange and co-operation between higher education studies and science studies; and (ii) a focus on empirical foundations and theoretical elaboration to inform and challenge normative approaches in the field. The group organised a specific meeting in Enschede (November 2003). What follows represents a summary of the conclusions thus far. The overview arrived at on the key research problems led to the selection of three major research areas for immediate further investigation. These are presented below.

The implementation of public intervention in higher education and research

The challenges identified all point to a changing role for public-sector research, combining issues of higher education and of public research institutes, and putting universities and other higher education institutions in a more central position. Recently, the question of the role of the university in the 'Europe of knowledge' has been addressed by the European Commission. Usually, political responsibility and policies for education/training and science/research are separated, and European policy has tended to mirror this separation. The developments towards the European Higher Education Area (EHEA) and the European Research Area (ERA) overlap in aiming at the same (moving) target, the European university – a term of some historical significance. Nevertheless, they are actually at best loosely related, deriving from quite different political processes, focusing on different functions of the higher education system and related goals, and expressing quite different expectations as regards the future role of higher education in the EU.

It would thus seem timely to bridge the traditional gap between science policy studies and higher education policy studies – a gap that tended to mirror the separation in the policy field – and to address the implications and challenges of these developments for the European higher education and research landscape. There are numerous interrelated issues about the conditions, processes and possible outcomes that call for further attention such as: the multi-level governance of higher education and research between the European, the national and the regional level; the diversification of funding, growing competition for and concentration of resources; the bundling and unbundling of the teaching-research nexus and the basic-applied nexus in higher education and research; and the horizontal and vertical differentiation of universities and other higher education institutions across Europe.

The subgroup considered it critical to develop systematic comparisons of the very different institutional arrangements that govern universities and other higher education institutions across Europe and to identify emerging over-arching trends. This should be built on a framework enabling comparative analyses in examining policy dynamics and stagnation in the field, bringing together evidence for the (de-mobilising) impact of institutional arrangements and change, and providing examples of policy learning as distinct from simple imitation.

Higher education in Europe: organisational responsiveness

A major effect of the reforms of higher education in recent decades has been to devolve increased responsibility and procedural autonomy to the university and other higher education organisations, and to introduce elements of competition through deregulation of a formerly rather homogenised entity, through cuts in government support, and through the introduction of contracting for teaching and research. Universities are undergoing a process of change towards more emphasis on individual profiles and policies, managerial capabilities, incentive steering, quality assurance and evaluation, accountability and organisational learning. Consequently, universities are now struggling with the implications of this new environment in their internal structures and procedures, as well as their principal tasks of teaching and research.

The goals of responsiveness and meeting the demands of a diverse array of stakeholders lead us to focus on policy frameworks that encourage and reward the development of an appropriately entrepreneurial culture in which researchers and the various institutions collaborate among themselves, across the world and with other players in the innovation system. Policies to encourage collaboration encompass the sharing of knowledge, technology, expertise and research infrastructure and take varying forms.

At the institutional level, universities are developing policies and structures for facilitating the commercialisation of discoveries, with particular regard to regional spin-off firms. Studying the various initiatives (mapping and evaluating them) taken by higher education institutions to develop an entrepreneurial culture among graduates and researchers, and learning about their effects, both positive and negative, will be one focus of investigation (and one which will link with the work of the IPR subgroup).

The changing institutional environment also means that the university has the choice of which community – local, regional, national and international – it wants to address. Moreover, with the opening of the European higher education and research areas this choice has never been greater. At the moment, we know little about what external stakeholders – or what mix of stakeholders – they may deliberately or unconsciously target, nor why external stakeholders may choose a specific university with which to do business.

Such investigations into the border-crossing activities of universities and other higher education providers would, at the same time, allow us to have a closer comparative look at different organisational settings and how they create incentives and obstacles for exchange and mobility.

Research training-career trajectories in Europe

Quality and quantity of human resources are central to the European Research Area (ERA) agenda and are addressed as well in the context of the European Higher Education Area (EHEA – see the debates during the Berlin conference on the status of doctoral training in the Bologna process). Obviously, a systematic view on the labour markets and training-career trajectories of researchers is of growing political importance. Recent attempts to initiate explicit policies for doctoral training and postdoctoral employment underline this.

The international dimension of research training, careers and mobility are becoming more important. In times and fields where interest in research training at the national level is declining, recruitment of international students becomes ever more important – a phenomenon well known in the US. Overlaps and alliances between universities, public laboratories and various private organisations raise questions about supporting mobility and setting mechanisms for quality assurance. Last but not least, nowhere more so than in Europe are questions related to the national and supra-national responsibility more pressing.

A further challenge in the study of training-career trajectories in research derives from the conceptual point of view. Most frameworks developed for the study of education and careers of researchers tend to emphasise the complex nature of a scientist’s job trajectory that is governed by the ‘rules of the game’ of overlapping social contexts: the scientific community or speciality to which a researcher belongs; the characteristics of a particular higher education, science and employment system; and the formal and informal institutions that play a role within and across the different sectors and formal organisations of research.

Research into the overlapping institutional contexts of scientific labour markets and researchers' careers shows that the complexity of the social setting is not without contradictions and shortcomings. Moreover, changing conditions of academic and scientific labour markets challenge our conceptual thinking about what has been historically a relatively stable regime. Certainly, the co-construction of a new regime is under way – a regime that is still in a state of flux and not without certain tensions and contradictory elements that may well lead to the co-existence of several models.

There is thus a need for two complementary types of research efforts. The first one deals with a better appraisal of the situation and its dynamics, based upon labour market approaches and capitalising on existing surveys (see sections III.3. and III.4.). The second one deals with policy implications, with special attention given to traditional and new approaches in PhD training; comparative perspectives on the uni/multi-functional appeal of the PhD on labour markets; international and sectoral career mobility; and the links between these three.

1.9. Cross-cutting themes

There are themes cutting across several of the above-mentioned themes. An emerging issue in innovation policy and in the promotion of 'high tech' start-ups is the provision of risk finance. As referred to in the recent High Level Group on Competitiveness[10], "new entrants in Europe have greater difficulty in raising appropriate risk finance than in the USA, stemming from the traditional aversion to equity finance in continental Europe". At the same time, the importance of risk finance as an intermediation and selection mechanism for emerging innovations, has become evident. Policy planning has to take into account the framework conditions that promote the functioning of such intermediation mechanisms. This is, furthermore, an area in which the traditional boundaries between the public and private action are blurred since even public agencies have adopted some of the functions and mechanisms of private risk financiers. The incentive mechanisms in the public and private sectors differ, however, and will influence the outcome of each. A study of risk finance from the point of view of innovation policy is in its infancy, particularly, in Europe, and PRIME will therefore encourage initiatives in this area.

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[10] Compte-rendu de la réunion du Group à Haut Niveau sur la Compétitivé et la Croissance, Dublin, 26 janvier 2004.

1.10. Conclusions

In this final section, we draw a number of conclusions from the work under the PRIME Thematic Network.

The first conclusion is that, as this report has demonstrated, the PRIME Thematic Network has made significant progress in forging a research **community** interested in studying the subject of changing rationales and each of the six component themes. The advances have been particularly great (i) in areas such as IPR where there has previously been less of a tradition of European institutions working together, and (ii) in bringing together previously separate research communities such as those engaged in HE policy and S&T policy.

Secondly, the approach of the PRIME TN has involved a judicious balance between 'top-down' and 'bottom-up' processes. The former have been initiated by certain key players in the PRIME Network (identifying a key issue or volunteering to lead a specific activity), while the latter has involved the emergence of self-organising groups attracted by a particular theme. The success of the Thematic Network is probably due in large part to the fact that it has been able to find an approach that was neither too centrally imposed and constraining nor too decentralised and disorganised. Achieving an appropriate balance is far from easy, and it is significant that the various subgroups for each of the six themes have adopted somewhat different approaches in a process of natural 'evolution' that reflects such factors as the nature of that theme, previous work in the area and whether the participants had any prior experience of working together. Consequently, it is inevitable that some groups have got further with the specification of plans for PRIME activities and in certain cases have already submitted a proposal to the PRIME NoE in the first round (March 2004), while in others the plans are still being refined and proposals will be submitted in later rounds of the PRIME NoE.

Thirdly, although the activities under WP1 have been broken down into six themes, as we have seen from earlier sections, there is considerable overlap and synergy between these in terms of both subject matter and also participants. Indeed, most PRIME participants are involved in more than one theme. Likewise, there is significant interaction between the work described here and that being carried out or planned under the other PRIME Work-Packages.

Fourthly and lastly, this WP and the PRIME TN more generally have played a pivotal role in the establishment of the PRIME Network of Excellence. The achievements include:

- gathering together potentially interested partners;

- identifying common interests;
- building trust and a sense of identity and community;
- identifying key issues for PRIME;
- preparing the foundations for the successful proposal for the Network of Excellence;
- preparing plans for specific research projects and other activities such as workshops for submission to the NoE.

These achievements have helped to ensure that the PRIME NoE has got off to a 'flying start'. One consequence of this, however, is that it is virtually impossible to separate where the PRIME TN 'ends' and the PRIME NoE 'begins'. In this report, we have chosen not to go into detail of the specific proposals submitted to the PRIME NoE even though these originated from work conducted by the PRIME TN.

2. New Work Package 2 (ex WP2 and WP4) Multi-actor spaces and the governance of science and innovation in the ERA

2.1. Overall development of the work package

What has characterised this work package can be summed up by the three successive titles that he has been given. We started with a very operational focus about *the framing of research and innovation policies in a setting of overlapping public authorities*. It was considered from the start as not open enough to define a fruitful long term research agenda. Thus the working group focused on a first transformation on "*multilevel public intervention and new democratic requirements*" (Meeting in Strasbourg, November 29, 2002). It produced a clearly normative position paper which gave rise to intense debates in the Paris January 2003 TN conference. Could a research agenda be built on a normative stand? Should not it, on the contrary, remain more analytical, take hold of observed transformations and introduce a more in depth and distanced approach of the reshaping of "arenas" or "spaces" within which research and innovation policies were debated? This drove the core group in its April meeting (Karlsruhe) to propose a third title – *Multi-actor spaces and the governance of science and innovation in the ERA* – and to adopt a multiple approach of the different constitutive elements brought forward in the Paris debate[11]. It proposed first to consider specifically "new" actors (or actors which

[11] A third stream of research (beyond the two proposed below) was identified, dealing with 'new' instruments supporting policy-making, such as in particular foresight (after the wave on evaluation a decade earlier). For the time being (but this might be revised and build a specific stream later on), we decided to couple the reflection

were seen as newcomers in ST&I debates). BETA organised a specific working session in October 2003 on regional authorities. We enquired the possibility of another workshop on NGOs and 'concerned groups' (thinking of the role of patient associations in the shaping of research activities – see AFM in France and genomics research). However it was judged largely redundant with the second direction, since most cases would be reviewed there. The second direction was to consider these new "arenas" as such, to learn from existing cases about their emergence and structuring. A particular point of consideration was their labelling, arena linking to specific political sciences theories, like hybrid fora link to specific science studies theories, Should not the notion of "space" be preferred? All these preparatory steps delayed the meeting until December. It was organised by A. Rip based on a fully rewritten background paper in Paris with the support, as an external invited expert, of P.B. Joly from INRA (who hosted the meeting with the support of OST). The Madrid meeting drove to a more practical design of a research agenda on this still 'fluid' theme which is embedded in the final report, but still requires, to our point of view, further elaboration. Box 4 presents the main elements of the activity that took place.

The following sections present the results arrived at by the group in reshaping the issues and proposing lines of actions. Its present formulation shows the extent of the redefinition work that has taken place and still requires to take place.

Box 4. Work Package 2: Main activities

Initiation: internal Strasbourg working group meeting (November 29, 2002)

The group gathered 8 persons under the responsibility of the organiser, J.A. Heraud. The discussion was very broad and drove to adopt the following architecture for the position paper to submit to the Paris TN conference handled separately the issues of 'multi-level public intervention" and of "new democratic requirements" proposing directions for both.

The first TN conference (Paris, January 2003) asked for a full revision of the approach. The separation was considered formal since, in many ways, changing policy practices combine elements of both, while it was felt too normative for supporting a long term programme. What was at stake was more empirically based, that is, studying the emergence of

with this of new WP6 on the "forum experiment", since the Forum initiative derives from a state of the art of such instruments (see the final report from the ASTPP thematic network).

new practices at two levels: the growing role of given actors, the structuration of new ‘multi-actor spaces’, a term adopted for broadening the scope as compared with the developments of ‘arenas’ in political science.

This was confirmed in the core group meeting (Karlsruhe, April 28).

Seminar on the role of regional authorities in science, technology and innovation policies, Strasbourg, October 20, 2003, 15 participants.

Organiser: J.A. Heraud (BETA). Contributions from L. Cruz and L. Sanz (CSIC), K. Kotschatsky (ISI), C. Lyall (Edinburgh University), P. Shapira (Georgia Tech), D. Pinelli (FEEM), M. Gruber and W. Polt (Joanneum)*.

* background paper only.

Workshop on multi-actor spaces, Paris, December 10.

Organisers: P.B. Joly and A. Rip. Background paper by A. Rip, 10 participants.

Madrid meeting

There was a full session devoted on the theme based on a preliminary final report and presentation made by A. Rip and P.B. Joly. Specific sessions took place on the ST&I policies of regional authorities (Organiser: J.A. Heraud, BETA).

2.2. Positioning the issue

Ongoing changes and challenges are recognised and addressed (and resisted, and exploited), in a variety of ways, by different actors and at different levels. The usual focus is on the actors, their goals and policies/strategies, and how they attempt to realise their goals. But an important part of the dynamics and outcomes has to do with interactions and emerging patterns in such interactions. This is a general sociological observation.

What we add is the need to analyse interactions and emerging patterns as multi-actor, multi-level phenomena, and to recognise the emergence of new “spaces” (quotes because these need not be geographical spaces) which enable changes, as well as “localise” and thus contain them. For science, technology and innovation which introduce novelties in existing orders, the analysis in terms of new “spaces” is particularly important, whether these are new modes of knowledge production or 'search regimes', science districts, or experiments in participatory technology assessment.

The analysis in terms of new "spaces" is a way to understand change as a process with emerging structures, rather than just open-ended fluidity. Spaces open up (and existing spaces shift), can stabilise and institutionalise, bring together actors exactly because they are new spaces. And because they shape what happens in them, there is an aspect of governance: *de facto* governance deriving from the pre-structuring offered by the space, but also partly or wholly intended governance as when the new space is purposefully set up.

ERA itself would be an example at the macro-level, where the notion of a European Research Area is used to mobilise various actors and allow new initiatives to be explored. There are also concrete new "spaces" where various actors become involved with innovation, for example in ongoing university-industry-public lab interactions. And there is a variety of new "spaces", some emerging, others designed for a purpose, in discussing social and ethical aspects of new science and technology.

Some 25 years ago, Renate Mayntz discussed the concept of 'policy networks' which was then becoming important in policy analysis and political science, arguing that as an analytical concept it could be applied to all places and times. But the rise in importance of such policy networks was a historical phenomenon (which deserved study as such) that created and reinforced the interest in the concept. A similar dual status can be accorded to the concept of new, emerging (multi-actor) spaces: it is an analytical concept that should be articulated as such, but also refers to a phenomenon of interest. Up to a governance and normative interest, as when it is argued that opening up new spaces is important (e.g. for participation of further actors) or that one should try to understand what constitutes a "good" space.

The "spaces" we look at and discuss in this report are identifiable, more or less bounded spaces (thus, the plural is possible) opening up in various ways, allowing a variety of actors to assemble for deliberation, negotiation and aggregation, and which enable and constrain interactions and the aggregation of products (from new understanding to innovation to policy design). Institutions (rules) also enable and constrain but miss the aspect of extension, and of an infrastructure (and *référentiel*) within the bounds of the space. [Space and *référentiel* emerge together!] While such spaces are always full of intentionality, their emergence can just occur or be designed for a purpose – and most often, be a mix of those two extremes.

We have to come back to this first attempt at definition, if only because it seems to focus on what happens within the bounds of a space and not on what happens between and across spaces. First, we focus on the phenomenon and the longer and shorter term dynamics underlying its emergence.

Note: The analysis in terms of "spaces" may seem abstract and foundational. Indeed, it is, but we argue that it is a necessary detour to get a better perspective on practical and policy issues. We need to open up conceptual space in order to understand and address the issues of ST&I policies.

2.3. Phenomenon and underlying dynamics

This approach makes two strong claims about the phenomenon:

- The importance of emerging and shifting spaces for ST&I dynamics and for ST&I policy, as such and as an alternative way of public intervention (creating spaces and/or improving functioning of spaces, rather than defining goals and developing instruments to achieve them).

- The Dynamics of emerging and shifting spaces are the same for innovation/breakthrough on the one side, and public debate and controversy on the other side (cf. evolving arena-agenda analysis). Again, there is also normative and governance aspect.

An *inventory* will help us to delineate the phenomenon and its dynamics better, even without an operational definition allowing us to unambiguously recognise an emerging space when we encounter one. What can be done is to collect interesting historical and contemporary cases, and always specify why and how a case is interesting.

The key criterion might be the opportunity for new interactions, played out in what becomes recognised as a space geared to that purpose. These new interactions can start at the side of knowledge production (e.g. transdisciplinarity), at the side of changes in and across economic sectors (e.g. when innovation will be carried by suppliers), and at the side of civil society (e.g. risk and security issues transcending existing divisions of public and private responsibilities, or reconsideration of interaction with developing countries).

An interesting example is how the EU Framework programmes and specific RTD programmes within them like ESPRIT and BRITE/EURAM opened up new spaces, crossing levels, bringing actors together, articulating a *référentiel* (who belongs and who doesn't, what sort of interactions are possible and how can these be handled, etc)[12]. By now, the Framework Programme and the RTD programmes within them have become an established arena, with rules to be followed, and new rules to be negotiated. Work done in a very different area – the GMO debates – have shown the multiplicity of arenas and their intrication, giving rise to complex architectures of overlapping arenas, which we propose in a first instance to consider as "spaces" (See table 2).

[12] See the PhD thesis of J. Edler.

Table 2. The concept of arena, general characteristics

Arena	Setting	Resource [13]	Symbolic referential	Deviations	Dominant Actors[14] and specific identities	Productions
Economic	Market	Money Image	Efficiency, transactions	Domination	Producers Consumers	Products
Scientific	Laboratory, Scientific institutions (Expert committees)	Scientific proof, method, reputation	Truth, Rationality, Rigour, Impartiality	Lack of rigour, Fraude	Scientists, Experts, Lay people	Knowledge Expertise
Regulatory	Agencies, authorities	Rules, codes, procedures	Control, independen ce	Corruption	Experts, Regulators Producers	Regulations Norms
Legal	Courts of Law	Laws, procedures	Justice	Partiality Judicial error	Legislator Judges, Lawyers	Jurisprudence
Political	Parliament Street	Power, trust	Democracy	Autism Private interest	Politicians, Citizens	Laws, R&D trajectories
Religious	Church	Religious texts, Traditions	Absolute truth	fanatism	Priests, Laity	
Media	Newspaper, TV, radio	Audiences, sources	Information, Truth, Freedom of speech Truth	Simplified "storyline" Scoop, Lies	Journalists Audiences	Media stories, emotion, awareness, Scandals

Source: Joly, P. B., Assouline, G., (2001). Assessing Public Debate and Participation in Technology Assessment in Europe. ADAPTA PROJECT, European Commission, Final Report, Grenoble, INRA/QAP Decision (http://www.inra.fr/Internet/Directions/SED/science-gouvernance/).

Our diagnosis is that contemporary "new" emerging spaces differ from earlier ones (we might want to see this as a hypothesis to be tested). For a series of reasons, we consider that key changes which occur since the 1970s explain these qualitative differences (Pestre 2003):

[13] Although particular resources are attributed to each arena, an important aspect of this approach is to analyse the ways in which the same resource (e.g. money or scientific proof) is used *differentially* in different arenas, and how these resources circulate between different arenas.
[14] "Resident" actors in the arena in non-controversial periods.

1) Changes in scientific "search regimes" (cf. section III. 1.3.) create spaces where local and network co-ordination is more important than hierarchical co-ordination. What happens in such spaces determines the further evolution of such regimes. A further, but key point is that both scientific-technological breakthroughs (and promising developments more generally) and controversies (from GMO field experiments and use, the use of stem cells, to waste handling and new transport infrastructure) are occasions for such new spaces. Because of the focus on conflict resolution, the similarities with uncertainties in promises have been neglected. The lasting effects of such spaces, however, occur in both cases because of ensuing governance arrangements (take BSE as example).

As we can observe in Europe since the late 1990s, there is a link with the changing status of expertise (respected but also contested) and the attempts to condemn certain modes of knowledge production as non reliable by definition or pseudo-science. At the same time, one sees more positive evaluation of local knowledge, community- and practice-based knowledge and (world-wide) indigenous knowledge.

Changes in regimes of knowledge production have to do with shifts in dominance, as from physics to "new" natural history, but also with the emergence of new modes of knowledge production as with ICT (software, distributed). The Bonaccorsi et al. thesis combines the two, but appears to neglect the possibility that the new life sciences may represent a third search regime. If there is such a "new natural history" regime, it will link up with the increasingly recognised importance of local knowledge because this can be accommodated in natural-history focus on patterns, as has been visible in field sciences all along.

2) Changes of economic and political regulations: there is a shift from regulations centred on national states to multi-level and multi-actor forms of regulation. This shift is related to a series of changes: globalisation, construction of regional areas for market, science and technology (as in Europe), privatisation of some pieces of fundamental knowledge (namely: patenting of biotechnological inventions and software,...). Meanwhile, a changing political culture is revealed by a growing interest in dialogic and participatory approaches, decentralisation (often linked to new public management). This is not a homogenous dynamic. In political science/public administration, the concept of 'governance' (replacing 'government') is often used to indicate the shift. We use 'governance' as a general concept, covering hierarchical as well as non-hierarchical modes. To characterise the shift, we specify the changes that are visible rather than use an umbrella term.

3) A growing interest in and need to legitimise innovation, including larger influence of civic society in science, technology and innovation. This may be exemplified by the role of patients associations, but also the raise of "counter-expertise" and the frequent development of scientific controversies in public arenas. Indeed, "controversy spaces" are invested by various stakeholders to deliberate and negotiate the content and potential use of technology with knowledge holders. According to the changing role of Science and Governments associated with an era of reflexive modernisation (Beck 1992), such spaces are the locus of legitimisation of innovation. Compared to an era of primary scientifisation, "reflexive scientifisation" calls for new forms of knowledge generated as responses to public concern over various issues – global warning, pollution, genetic engineering, etc). These forms include risk analysis, technology assessment, specialisation in environmental sciences, etc.

Such transformations are visible in explicit attempts from various actors to introduce performative normative concepts such as multi-level governance, subsidiarity or public participation. The actual effects are produced by the interaction of such deliberate and normative attempts, and ongoing background dynamics with their own patterns. Although always important, these transformations do not impact the regulation of any single technological domain in the same way (Cf. Pavitt analysis on sectoral patterns of innovation). We assume that the key point is *how uncertainty is dealt with* and *how legitimacy for innovation is produced*. In order to analyse what is really "new" with these emerging spaces, the study of various historical and contemporary cases will be necessary.

This has *strong implications* for how we consider multi-level multi-actor approaches to science, technology and innovation etc (analysis) and how we think about ERA etc. Improved analysis allows better diagnosis and sometimes better intervention. What is the state-of-the-art here? Critical evaluation of the literature (and of inventions and their justification) is important, but will be done only with the help of some examples.

2.4. Conceptual framework

The general definition of 'space' to be used in this Report is "a locus for particular kinds of events, an opportunity for particular actions, and a gradient for, and thus a constraint on, the range of actions" (Van Lente & Rip 1998). The political-science concept of 'arena' can sometimes do the same job, but only if it is seen as having a 'grammar' or other shaping effect (see further below).

The concept of 'space' is broader than 'policy networks' because it does not necessarily refer to hierarchy and delegation. Multi-level governance, the original entrance point to this WP, suffers from the same hierarchical bias. Spaces can open up (and be opened up) in all sorts of ways.

Spaces can also get closed. There is a dialectic of opening up spaces (against existing arrangements) and closing spaces against further extension and interference (so as to be productive). [Cf. also H.S.Becker on moral entrepreneurs (opening up spaces) and moral custodians (taking care of such spaces once they are established).] The key point however is not open vs. closed, but the actual 'grammar' that emerges and stabilises. [Cf. P.B. Joly on grammar of arenas.] If this is a 'good' grammar, closure is OK. There is a second-order consideration as well: will good grammars (and thus good spaces) remain 'good' in changing circumstances? Thus, the idea of creating room for spaces to be opened up in new circumstances returns as a normative concept;

It is clear that analysis of spaces and their dynamics leads one into issues of governance. In the dialectic of opening and closing of spaces, normative questions are salient. But it is an integral part of the concept already, as is clear from the emphasis on the enabling and constraining role of 'spaces'. In that sense, they imply *de facto* governance. The governance aspect can be articulated (reflexive governance) and studied as to its applicability elsewhere and elsewhen. Actual designing and implementing 'spaces' as a policy intervention has further aspects to it, because actors will respond and shift/undermine.

Two attempts have been made to capture usages of the concept of 'space'.

1) <u>Nature of 'space'.</u> We do not refer to space in the mathematical sense (space with a metric, so as to locate items in). But topology? Networks and rhizomes? Space in the Aristotelian sense? Anyway, distinguish six overlapping meanings:

   1) Geographical space, as in a region or a district. Has cultural and symbolic components (cf. Harvey, Carter), an infrastructure and metrology to support interactions. Taking the latter as entrance point, one can have 'virtual' districts, where proximity (cf. also Frieder Meyer-Krahmer) derives from ICT rather than co-location.

   2) Space as an (emerging) arena shaped by actors and agendas, but having a life of its own in the sense that things will happen in the arena which shift agendas and status of actors. [Cf. arena-agenda analysis, as developed for explicit (Petersen and Markle, Rip) and implicit (de la Bruheze on

radwaste) controversies]. Thus, spaces/arenas may become institutionalised, recognised in terms of their nature and rules, and used on that basis (see for example the overview in table 2).

3) Having space or room to do certain things, and as an entrepreneur create a boundary between inside and outside to be able to continue doing it. Cf. 'niche' in co-evolutionary approaches, including the studies of designing such niches. Overlap with Constructive Technology Assessment, which focuses on emerging irreversibilities in technological developments and their contested embedding in society. Also idea of 'strategic space' created for new and promising sciences and technologies (Van Lente & Rip on membrane technologies; in their 1998 article they define 'space' as "a locus for particular kinds of events, an opportunity for particular actions, and a gradient for, and thus a constraint on, the range of actions").

4) Space ('espace' in French, 'ruimte' in Dutch) as room to move about, and look around. An outward look, not obstructed. In this sense, borders of the space are not yet known.

5) Organised interaction and/or shared use which creates a space, and the creation of such a space has its own dynamics and effects. Example of UK Foresight providing a <u>shared space</u> which enables development of strategies [by the various actors] under reduced uncertainty (cf. Luke Georghiou). FORMAKIN has offered a similar view when showing that uptake of Foresight is linked to its co-ordination effects, and thus also to the extent of prior co-ordination (cf. Andrew Webster).

6) Symbolic space, often diffuse (and hard to pin down empirically). An example is the mandate given to scientists and technologists to do their own thing as long as it can be seen as working towards progress.

<u>2) The concept of 'space' has three aspects (dynamics):</u> within a space, across spaces, and interstices. Multi-actor is always visible. Multi-level should be added to understand overall dynamics (historically, and in terms of differences at different levels [e.g. macro-level spaces, e.g. for nanotechnology, are rhetorical, built on promises and their acceptation]).

<u>- within space:</u> Maria-Eduarda Gonsalves identifies the ambivalence of closure of a space and the concept of multi-actor as opening up existing spaces. Indeed, this ambivalence should be kept alive, also conceptually. What

happens within emerging and more or less established spaces is (1) negotiation, (2) some deliberation, and (3) aggregation. Aggregation as an outcome is what we are interested in. Aggregation refers to a variety of aspects: robustness of a technology (cf. J.J. Deuten), standardisation in its various guises (cf. J. Stewart), articulation of values and interactive consensus building (cf. also iTA). Such aggregation is precarious in the sense that is based on the trajectory that was followed (including the grammar of the spaces). It can be undermined by other (broader) considerations and actors, and by changing circumstances. Still, it is the best we can do.

- <u>across spaces:</u> processes of translation and appropriation are important as part of intermediation more generally (carried by various intermediaries). 'Trading zones' (Galison) can emerge, and 'transaction spaces (Nowotny et al.). This is mixed with intentional action, up to management of interfaces (Ruud Smits). "Interspaces" may emerge with a dynamics of their own (cf. also Van den Belt & Rip on 'nexus' [between variation and selection in technological development], e.g. test laboratories). Galison suggests that trading zones work partly because of the emergence of a pidgin. This could develop into a creole, and perhaps a new language.

- <u>interstices:</u> it is in (and from) the interstices between existing spaces that new spaces can be opened. Cf. empowering, giving voice. For ST&I, one can also think of empowering old technologies, modest technologies, which might otherwise be eclipsed by fashionable high-tech enthusiasm. Agriculture/farming is an interesting domain to study such dynamics, because of the increasing concern about the limitations of the modernist paradigm.

These considerations imply the need (and possibility) of an overall picture and a diagnosis of overall dynamics. Inputs will be the idea of 'multiplicity of loci' (Alain d'Iribarne), the dynamics of multi-level change and possible lock-ins. Cf. quote from the conclusion of a paper by Arie Rip:[15]

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[15] Arie Rip, 'Fashions, Lock-Ins, and the Heterogeneity of Knowledge Production,' in Merle Jacob and Thomas Hellström (eds.), The Future of Knowledge Production in the Academy. Buckingham: Open University Press (2000), 28-39. Reprinted: Arie Rip, 'Fashions, Lock-Ins, and the Heterogeneity of Knowledge Production,' in Andre Kraak (ed.), Changing Modes. New Modes of Knowledge Production and its Implications for Higher Education in South Africa, Pretoria: Human Sciences Research Council, 2000, 56-69.

My storyline emphasised a three-level dynamic: (i) varying, heterogeneous practices of knowledge production, (ii) meso-level organisations, institutions with their inertia and openings for change, and (iii) possible lock-ins when interactions with environments are (re)structured as a protected space. I then argued for opening up such protected spaces, or at least be reflexive about them and keep their boundaries permeable. (…)

My concern about a too rapid lock-in need not be shared by the reader, but the analysis I offer of trends and indications of a lock-in remains important. It depends on the nature of such a lock-in whether one should be concerned or not. Heterogeneity (disturbing and innovative) is important, and that was why I have (diffidently, because as an outsider) criticised the African Renaissance movement for its monolithic character. The melting pot of Renaissance Europe, out of which modern science emerged, appears as important as the academies and societies of the incipient institutionalisation of science in the seventeenth and eighteenth centuries. Present-day multiculturalism, if taken seriously, might be the key to the new science of the twenty-first century.

What is important here is the possibility to add an overall picture to the consideration of dynamics of various spaces and interspaces as such. This point returns in the discussion below about the functioning of spaces: as such, and as part of overall patterns and changes.

2.5. Spaces allow a variety of actors to assemble for deliberation, negotiation and aggregation

In this Report, we focus on situations where there is uncertainty about promises and concerns, and their further articulation including reduction of uncertainty. This is not just a pragmatic decision; there are basic issues involved (in general, and because of the way science and technology tend to introduce novelties of which the nature and impact is not immediately clear). Work to reduce uncertainties (cognitively, socially, materially) will span up a space, and the outcomes of the work (in context) will be shaped by the space in which they are achieved.

The key feature of 'space' is allowing a variety of actors to assemble for deliberation, negotiation and aggregation, in situations which enable and constrain interactions and the aggregation of products (from new understanding and articulation of values to innovation to policy design). This is a starting point to analyse the productivity of interaction in the spaces as they occur. Literature about deliberation, about negotiation, and about aggregation, while abundant, is also segmented. In practice, however, all three types of interaction & production occur together. Thus, analysis in terms of spaces allows integrated approach. This does require reformulation of the issues involved!

To begin to do so, we should recognise how the dialectic of opening and closing spaces and their partial institutionalisation[16] is always part of (evolving) modern societies which are highly segmented, in terms of divisions of labour, in divisions of responsibilities, and in the way voice can be taken and given. Without embracing a standard social system analysis (which cannot accommodate the emerging phenomena that we try to capture), there still is a point in basing the analysis on more or less recognisable, more or less stable social sub-systems in which the modes of production and justification of the various positions are conditioned by formal and informal rules which are specific to societal sub-systems. We propose to use the concept of *arenas* which comes from political sciences to design symbolic spaces of confrontation[17] which influence collective decisions and public policies (Cf. Table 1 in the appendix for a characterisation of arenas) (Joly 2001). The concept of 'space' thus remains available as the more general category.

For a single technological field, several arenas may exist in which actors have to be present in order to influence the policy process. As shown by various theories on public mobilisation, the framing of a given issue is very much associated to the social form of the public debate[18] -and therefore in our terms to the kinds of arenas within which the confrontations take place-; to some extent, the context and the content of the process are co-determined and have to be analysed as such[19]. Accordingly, the construction of the cognitive (what is the problem about? Which kind of knowledge do we need?...), normative (which general principle conditions the decision?) and pragmatic (How can we decide? Which are the instruments?) dimensions of a given issue is very much related to the type of arena within which controversies and debate take place.

A further implication is then that emergent "spaces" may be confined to specialised arenas or, alternatively, actors' interactions may overflow and develop through intensive *trans-arena interactions* which challenge the dominant socio-technical networks. As we noted, such spaces are always full of intentionality, their emergence can just occur or be

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[16] It is therefore important to trace the dynamics of finding room (space) for novelty and change inside or outside existing arrangements, regimes, institutionalized spaces (then, interstices are important), followed by emergence of new (or shifted) spaces which themselves stabilize and institutionalize and then constrain further change.

[17] Symbolic space means that arenas are neither geographical entities nor organisational systems.

[18] We refer here inter alia to the theory of agenda setting Cobb, R.W & Edler C.D, 1983, "Participating to American Politics", John Hopkins University Press, to Hilgartner, S., Bosk, C.L., 1988, "The rise and fall of social problems: A public arenas model", *American Journal of Sociology* 94(1): 53-78.and to the theory of mobilisation Snow, D. A., Rochford, E.B., Worden, S.K., Benford, R.D., (1986). "Frame alignment processes, micromobilization, and movement participation." American Journal of Sociology 51: 464-481.

[19] Cf. the analysis of public controversies by Limoges and Cambrosio Limoges, C., Cambrosio, A., Anderson, F., Pronovost, D., Charron, D., Francoeur, E., Hoffman, E., (1993). "Les risques associés au largage dans l'environnement d'organismes génétiquement modifiés : analyse d'une controverse." Cahiers de recherche sociologique **21**: 17-52.

designed for a purpose – and most often, be a mix of those two extremes. This also implies strategic action and *effets pervers*.

The arena framework provides a heuristically important perspective on multi-actor spaces:

- innovation *and* controversies may be analysed in the same frame. The issue of the boundaries of the space is a key one; the model helps to focus on the analysis of the processes of inclusion/exclusion and closure of the emergent space;

- this frame is dedicated to a pragmatic sociology of actors' interactions and thus to the analysis of innovation through collective action (negotiation, deliberation, but also collective learning and design). Compared to other analytical frames (ANT, concrete action system[20], "OSE"[21],...), it bridges micro and meso analysis and thus it is more adapted for comparative analysis (countries, technologies);

- this frame allows to take into account the interactions of a variety of actors, with different worldviews, playing with different game rules (...) and not only the perspective of the innovators. As pointed by Garud and Ahlstrom, different positions (Insiders v. Outsiders) also mean socio-cognitive differences in the way a given technology option is assessed (enactment v. comparative-selective thinking) (Garud 1997).

We can assume that trans-arena interactions, diffuse hybrid forums (Kirejczyk & Rip) or 'trading zones' (Galison, Nowotny) become as important as delineated spaces (cf. also above, 'across spaces'). A further entrance point is the analysis of productivity of 'hybrid forums', especially mandated hybrid forums (see Kirejczyk, Rip et al.) This concept can also be applied to advisory councils, to standardisation committees, to platforms, to FORUM as envisaged in WP6.

The type of articulation that occurs in mandated forums and delineated spaces, but also in diffuse forums and emerging spaces, even if in a more diffuse manner (especially when there is no forceful focus) can be called 'tradeability' (as when new products and services get a value) but is often better seen as 'decideability'. Perhaps the two are varieties of a general category referring to the creation of co-ordination and order.

[20] Crozier, M., Friedberg, E., (1977). L'acteur et le système. Paris, Seuil.
[21] Aggeri, F., Hatchuel, A., (2003). "Ordres socio-économiques et polarisation de la recherche dans l'agriculture: pour une critique des rapports science/société." Sociologie du Travail **1/2003**: 113-134.

2.6. Towards a research programme

A first objective is an improved protocol for studying cases of 'spaces'. This would enable the development of comparative case studies. Cases should allow for historical as well as international comparisons. The cases should be chosen in various science-based sectors in order to take into account a focused diversity of sectoral patterns. Often, secondary sources offer sufficient data and insights (for instance, using the various studies which cover GM technology). The longer term objective is a comprehensive analysis which will pursue two complementary objectives:

1) what is really new with the phenomenon of "emergent spaces" (What are the changes and continuities? What are the factors of variance? What are the new challenges for the ERA?)?

2) which are the relations between the morphology of emergent spaces and governance property (plurality, openness, decideability,...)?

To progress towards this objective, five 'blocks' have been identified:

1) Develop the overall framework.

2) Regional multi-actor spaces: multi-level dynamics and new roles of regional authorities.

3) Multi-actor spaces: learning from earlier case studies through secondary analysis.

4) Emergence and construction of spaces in the domain of nanotechnology.

5) Governance and expertise in multi-actor spaces: new actors claiming rights to expertise, boundary struggles, and knowledge production and use in the real world.

Block 1: Develop the overall framework

The following building blocks were identified during the last Madrid meeting:

- *A reasoned dictionary (or glossary) of concepts.* Compared with the other work packages, WP2 (and also WP6) introduce many new concepts, often for good reasons. It is important to be clear and operational about these concepts, and link them with existing concepts (tentative equivalencies and contrasts). Such a dictionary could evolve into an overall PRIME dictionary.

- *A protocol for studying cases of multi-actor spaces in their evolving contexts*, including a rationale for why they are interesting as cases. The protocol will draw on background analysis as well the learning from doing empirical work in the domain of nanotechnology.

- *A library of interesting cases*, as to their dynamics and the governance issues involved. Some of these cases will have been studied already (e.g. in the STAGE project), others will only be identified. Such cases can be of interest retrospectively (as when biotech/GMO cases are to be studied again from the perspective of multi-actor spaces), or in real time (following cases in nanotechnology as they evolve). There is overlap with the WP6 proposal to develop a Thesaurus (actually, a database) of cases of FORUM activities; Forums, one could argue, are a special, intentionally constructed, kind of multi-actor spaces.

Block 2: Multi-actor spaces: learning from earlier case studies through secondary analysis

Block 2 would be an important way to enrich the development of the overall framework, and is probably the departure point of the whole process. The idea is to learn from a secondary analysis of existing cases. The selection of case studies will be driven by the general consideration that our interest is in spaces enabling and constraining the handling of uncertainty about new science and technology, and the production of legitimacy for innovation (see previous sections). Thus, biotech and genomics is an important domain, also because many case studies are available which can be used for our purposes. Other domains, or specific case studies can be included, for example by using the thirty or so case studies done in the STAGE project (Egil Kallerud and Peter Healey serve as links).

The guiding lines of such a secondary analysis would be

a) to analyse the "outputs" in order to discuss normative approach: efficiency, diversity (and intensity of interactions), robustness, governability,… (trade-offs between these dimensions,…);

b) work on some key analytical dimensions, such as: role of "leading actors", role of the users (first users, prescribers,…), role of some features of the spaces of interaction (rules of entry, symbolic referentials, key « epreuves », organisational and technical devices,…), dynamics of framing and overflow, questions of conflicts, convergence, heterogeneous closure, learning effects, positive returns,… and role of deliberate multi-actor spaces (consensus conferences, ITA, cTA,…).

It should help to further elaborate a research protocol (concepts, analytical grid, rationale for choice of cases, guideline for comparative analysis). But it should also produce preliminary results on the question of governance of innovation in multi-actor spaces (and context of multi-spaces for actors)

Block 3: Emergence and construction of spaces in the domain of nanotechnology

Our interest in spaces enabling and constraining the handling of uncertainty about new science and technology, and the production of legitimacy for innovation can be pursued further by studying, in real time, a domain in which such spaces are emerging and being shaped[22]. We propose to choose Nanotechnology (to converge with work proposed in WP3 on science districts, WP4 on indicators to follow the emergence of new fields and in WP6 on nanotechnologies as a possible theme for experimenting the Forum approach). Other domains might be explored for contrasts, in particular fuel cells and the so-called hydrogen economy, because we expect that their link with energy/infrastructure will lead to different dynamics.

One sees new arrangements (local, regional, networks of various scope) emerging to capture the promise of nanotechnology – even while the content of the promise is quite uncertain. Public research, different governmental actors, global industry players and spin-off firms and other actors are involved. The emerging 'poles' can be compared and contrasted with 'poles' in other domains of research and innovation. At the same time, there is (now rapidly) increasing societal questioning about the direction of the research and innovation, and the risks and societal aspects. Legitimity of the innovation is not automatic, and negotiations are emerging which will delineate new spaces or shift exiting ones.

For real-time study it is important to identify focused questions, and ones that allow comparisons in order to draw better conclusions. We list some here, but expect that more can be identified, and will emerge during the empirical/comparative studies.

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[22] The enthusiasm for high-tech possibilities as in nanotechnology should be analysed as such, and be contrasted with other dynamics of spaces: new spaces opening up for old technologies (examples from cork technology in Portugal), new spaces in old domains, especially agriculture/farming systems (e.g. studies in the Netherlands, Italy, South-Africa), and thus the general idea of spaces for "modest" technologies (their dynamics and the normative notion of need for such spaces).

- Which actions and interactions (including Leitvisionen or shared visions of the world), up to interventions, "nudge" a fluid situation into an emergent path? This can be observed and analysed, but the transformation into advice to policy and other interventions is not immediate: explicit intervention will raise reactions which may shift the dynamics that were observed before. There is a paradox here for the relevance of analytical insights.

- Can differences in dynamics of emerging spaces versus designed ('dedicated) spaces be identified? Including the *effets pervers* involved in dedicated spaces? If so, the paradox may be understood, and partially resolved.

- How do high-tech spaces emerge, and how are governance arrangements articulated? Up to socio-technical arrangements like standardisation. A historical comparison with earlier high-tech, esp. electricity at the end of the 19th century might be interesting (e.g. Carolyn Marvin, When Old Technologies Were New).

- In the domain of nanotechnology, the interest is in innovation (so: promises), and thus "enactment". At the same time, concerns are emerging and actors mobilise to give voice to concerns, or address them. The focus on innovation in this domain introduces a bias, compared with other domains like biotech/GMO where embedding in society and the debates that go with it nowadays are visible. On the other hand, the emergence of concerns can now be studied in real time, with the benefit of our understanding of what happened with biotech/GMO. This does require a second look at biotech/GMO in terms of multi-actor spaces (see also Block 3). It also requires reflection on possible differences (cf. concerns about chemistry and biotech as 'dangerous intruders' and the contrast with how ICT is generally embraced).

- In nanotechnology, both ad-hoc emergence and considered design of multi-actor spaces can be followed and evaluated in real time. At the same time, it is important to extract learning from cases in other areas, especially if there are enough data (as is the case, for example, with INRA's iTA-vignes project in 2002-2003). In such evaluations and comparisons, the distinction between (primarily) deliberative and (primarily) aggregative spaces must be taken into account.

How to go about it concretely? In the long term, one can think of a large empirical-analytical project, and a diagnosis-oriented project. It is important to outline a long-term project, so that the short-term projects will add up to overall insights.

For example: There are lots of data floating around on networks and centres in nanotechnology, which can be collated and analysed in terms of actors that are visible. To find out about spaces and interactions and the processes of uncertainty reduction and legitimacy of innovation requires (1) a few in-depth case studies to design an instrument for such a study, (2) a telephone survey based on the instrument, and (3) study of interactions and dynamics in a few selected sites. There can be collaboration with the informal network for TA of Nanotechnology in Europe (through personal unions).

We can also identify key policy issues to be discussed in terms of our approach of new spaces and governance. The US investment in military and security nanotechnology (and the way converging technologies are positioned as human enhancement, not in the least enhancement of soldiers) is a major challenge for Europe. A specific challenge in the ERA is the coupling of nanotechnology and life science; cf. also the idea that a third 'search regime' of life sciences and technologies is emerging. We can reason back from a few of such key issues to what we have to do in terms of data and analysis to be able to say something interesting after one year, about the issues of spaces and governance, and the ERA.

Box 5. Some hints about Nanotechnology

Nanotechnology is about phenomena and manipulations at the nano-scale, and thus an umbrella term for a variety of mechanisms and techniques. It carries promises (hype), up to the idea of a new industrial revolution for the 21st century. There are now also actors voicing speculative concerns – which shows how strong the repertoire (expectation) is that there will be opponents to a new technology.

Nanotechnology (whatever it is) is still at an early stage, which implies that it lives on promises rather than actual performances. In addition, the promises of nanotechnology have to be realised through their uptake in other products and services (from better chemical analysis to sunscreeners to drug delivery). Its impact depends on what happens there, and is in that sense co-produced, even if one might consider that it is nanotechnology which has made the difference. (Thus, the well-known problem of attribution of impacts to earlier actions.) The analysis must therefore focus on expectations and how these evolve and set an agenda, and on the parallel emergence of alliances and networks and how these support particular directions of development.

One must then inquire into the spaces in which this happens, how these are shifted, and whether new spaces are emerging. One interesting entrance point is to look into materials science: many of the early applications of nanotechnology will be in materials, and depend on materials science – but this context is pushed back in the attempts to foreground nanotechnology as such. (Cf. also general issue of scaling-up of nanotechnology to real-life applications.) Another important area is bio-nano, from DNA-chips to drug delivery, from lab-in-a-cell to bionics. So-called molecular manufacturing (and nano-robots assembling materials) is mostly speculation. While there is also a lot of speculation about the NBIC converging technologies, there might be something happening as well, not in the least because of the military interest.

With the military interest, but also with the increasing concern about specific and general risks and societal aspects, there may be political measures, up to a partial moratorium. Thus, spaces will be defined from the outside in.

An example, with a point: Interestingly, nanotechnologists refer to biotech as an example where societal debate has gone awry, and they want to avoid this at all cost. They are willing to create new spaces, or let them being created for them, to have legitimacy for their innovations. In the USA, Vicki Colvin, Director of the Centre for Biological and Environmental Nanotechnology (Rice University, Texas), appeared before the US House Committee on Science to give testimony in regard to "Nanotechnology Research and Development Act 2003", and offered a 'folk theory' about how things go:

"new developments in technology usually start out with strong public support, as the potential benefits to the economy, human health or quality of life are touted. At our centre we call this the "wow index". (…) At present, nanotechnology has a very high wow index. For the past decade, nanotechnologists have basked in the glow of positive public opinion. We've wowed the public with our ability to manipulate matter at the atomic level and with grand visions of how we might use this ability. All this "good news" has created a growing perception among business and government leaders that nanotechnology is a powerful platform for 21st century technologies. The good news has given nanotechnology a strong start with extraordinary levels of focused government funding, which is starting to reap tangible benefits to society.

However, every new technology brings with it a set of societal and ethical concerns that can rapidly turn "wow" into "yuck". [example of genetic manipulation of crops, public backlash crippling the industry despite the lack of sound scientific data] The failure of the industry to produce and share information with public stakeholders left it ill-equipped to respond to GMO detractors. This industry went, in essence, from "wow" to "yuck" to bankrupt". *There is a powerful lesson here for nanotechnology.*

In contrast, the Human Genome Project provides a good model for how an emerging technology can defuse potential controversy by addressing it in the public sphere. (…) they wisely welcomed and actively encouraged the debate from the outset by setting aside 5% of the annual budget for a program to define and address the ethical, legal and other societal implications of the project.

I sincerely hope that we can learn from this example. (..) In effect, early research into unintended consequences redirects the wow-to-yuck trajectory. (…) We seek to avoid the path travelled by the GMO industry by encouraging the industry to answer the tough questions about societal and environmental impacts while it is still developing.

We need partners in this endeavour. (…) A tangible symbol of your commitment to this kind of research would be to set a target research funding for the area; the 3 to 5% rule used by the Department of Energy in the Human Genome Project would be a good starting point."

By November 2003, US Congress has accepted the "21st Century Nanotechnology Research and Development Act" which includes (among other things) provision for a centre on ELSI and environmental issues about nanotechnology. *The Scientist* (24 November 2003) quotes David Berube, of the University of South Carolina program funded by NSF to study ethical implications of the new technology, as recognising the defensive role of their program: "I think the legislators are concerned that people from the anti-globalisation groups and the anti-[genetically modified organisms] groups will get on the bandwagon and fuse together into some sort of anti-nano group." Clearly, the spaces that are opened up are closed prematurely by expectations about pro- and anti-groupings.

In Europe, the concerns are similar, but the configurations and ensuing interactions are different. There are initiatives from various actors, at the European and national level, by NGOs, and by nanotechnologists themselves. This might be seen as distributed, and possibly productive, co-evolution of nanotechnology and society. The evolving configurations are determined by interests, initiatives, earlier experiences, possibilities of nanotechnology to link up in various ways with industries, with actors, with social issues.

Block 4: Regional multi-actor spaces: multi-level dynamics and new roles of regional authorities

There is a clear interest in looking at "new players" or "old players with renewed roles" within emerging multi-actor spaces. This is clearly the case of regional authorities, in particular now that they add (although to various extents) science policy to their earlier interest in innovation and wealth creation. While regions have always been studied as multi-actor spaces, the role of regional authorities was often taken as given. We focus on their strategic adaptation to new governance structures imposed by upper-level political systems or by the global socio-economic environment. Regions and regional authorities are interesting as such, and provide an entrance point to study complex multi-actor spaces.

Whatever the way we look at regional governance (regions as new actors, as new spaces, as objects or instruments of policies, etc.), considerable evidence has been given of the increasing weight of regionally rooted development processes, everywhere in the developed world. But the dynamics and outcomes are different across cases. The emergence of new modes of knowledge production (search regimes that are specific to new S&T fields for instance) is taken up differentially. The general articulation of multi-level governance structures works out differently, for example whether or not decentralisation or devolution processes take place in centralised or decentralised (federal) national systems. Subsidiarity and new democratic requirements are important, often in relation to the new upper level of governance created by the European institutions and the EC policy.

A large documentation exists on subjects like regional innovation systems, regional S&T policies, etc. But we need an up-to-date *comparative analysis* of the *evolution of the role of regional authorities* in the various national contexts, *within the same methodological* *framework* (using the *multi-actor space* approach) and focusing particularly on the policies of *science*.

Our focus on regional institutions with political or at least administrative power, even if the description of their new roles and strategies implies of course to consider the other actors of the regional scene, allows us to consider territories not only as specific contextual environments in the field of S&I, but as local *arenas* (spaces where decisions are taken, political or economic influence exerted, social and cultural preferences expressed and various actors commit themselves in specific games).

A set of issues has been identified about the characterisation of a regional authority, concrete forms of multi-level governance, articulation of actors with different outreach capabilities, spectrum of intervention (innovation? Technology? Science?) and to differentiate between governance of spaces and governance in spaces, The idea is to delineate these issues by selecting interesting, often contrasting, cases rather than comprehensive surveys (still, analytical generalisation will be possible). There is both an analytic purpose (understand the interactions and effects) and a diagnostic aim (to capture the recent evolutions and foresee the future trends).

Block 5: Governance and expertise in multi-actor spaces: new actors claiming rights to expertise, boundary struggles, and changing knowledge production and use

Life sciences and medical research highlight the growing role of NGOs/NPOs both as important stakeholders, as quasi policy makers and as research performers. We however have very little accumulated knowledge about their forms of action, internal dynamics and respective roles in different fields and countries. What should be emphasised is that such new actors in STI policy are particularly interesting when there are knowledge claims involved, in addition to an interest (which by itself would show well-known phenomena of conflict and negotiation, lobbying etc). Such knowledge component (e.g. of patient associations arguing that they have privileged knowledge) are not like traditional claims for expertise, and creates other dynamics, and dynamics which are important for the substance of STI policy. Thus, expertise (traditional, contested, interactive) becomes an issue. In other words, *it is important to take socio-epistemological challenges as the entrance point, rather than particular actors and their claims to be heard*. This will create an innovative approach to knowledge & governance.

Expertise – itself a boundary-bridging phenomenon, as will become clear – is significant in at least two ways.

1) In institutional terms a new layer of experts is being established between academic science and policymaking. The number and organisational variety of expert knowledge for policymaking is expanding and supports the thesis that a new mode of knowledge production that is not identical with the traditional universities and research institutions has emerged. It can already be observed that new professional roles, new structures of professional practice and interests as well as codes of conduct emerge.

2) In epistemological terms expert knowledge is markedly different from academic knowledge in several respects. These differences can be alluded to by pointing to the proximity of this knowledge to decision-making and to the inclusion of values and interests, on the one hand, and to the resulting problems of validity, reliability, credibility, and legitimacy as well as issues of the stature of the producers/bearers of this knowledge and its users. The knowledge produced in the context of expert advice differs from purely curiosity and theory driven academic knowledge production as well as from purely applied knowledge as it is known from industrial contexts. While the problems of the traditional order of knowledge were: What is the epistemological quality of knowledge that constitutes its superiority over other types of knowledge and secures its credibility and reliability? How is the legitimacy of the bearers of this knowledge assured? Now the questions are: In the tension between a universally oriented academic science and expert knowledge (expertise) that is oriented to the specific contexts of decision-making the credibility and reliability of this knowledge is subject to politicisation and commercialisation. Likewise the legitimacy of expertise is subject to conditions of democratisation and ethical considerations.

Descriptively a multitude of different configurations and arrangements for knowledge production as expertise can be observed that suggest to conceive the organisation and epistemological quality of expertise as the *result of negotiation* into which both the conditions of political and economic contexts as well as the methodological standards of scientific quality enter. The nature of the 'multi actor spaces' in which these occur will shape the legitimity and to some extent the content of the eventual expertise. Conversely, the nature of the knowledge claims will also shape the spaces, for example in terms of disciplines or other professional expertise involved, but possibly also creating openings for local knowledge.

The nature and dynamics of the spaces is thus clearly a governance issue. Governance issues of expertise have been studied already in terms of the use (and status) of expertise in regulation and policy making, and recent studies drawing on the notion of 'boundary work' (e.g. the 'Rethinking Expertise' research programme of Rob Hoppe) link up with the issue of spaces. The spaces themselves, how they are created, emerge, are battled for, to articulate expertise and have it heard, are an underlying governance issue that should be taken up.

3. Work Package 3 on public sector research

3.1. Overall development of the work programme

The focus was on the organisation and dynamics of Public Sector Research. It was organised as a complement of the issue addressed in WP1 about the reasons why there is a public investment. Still the theme was no doubt this which attracted the greatest involvement and participation. As soon as November 2002, we had to turn the first working group meeting in a de-facto workshop (including for the first time our Swiss counter-part, the REPOL network. 20 persons participated in 3 sessions. We considered that the notion of "public sector research" was not enough to justify the combination done while keeping aside the "rationales" approach (see WP1). Thus the development of a set of key assumptions presented in the positioning paper made afterwards and the identification of a set of entry points for further reflection. The debate which took place at the Paris conference (January 2003) endorsed the overall framework and proposed an enlargement of the relevant entry points. 6 themes were then specified along which to organise the workshop planned. The latter took place in La Cerbana (Italy) and lasted 3 days (July 10-12, 2003). Over 50 persons participated driving to the establishment of a rich research agenda, that has been confirmed in the Madrid meeting (January 2004). The details of the meetings are mentioned in box 6 below.

Box 6. Work Package 3: Main activities

First working group meeting, Pisa, November 26, 2002.

20 participants. It was organised in 3 sessions with half of the speakers being invited, and 2 invited discussants: J. Cave (Warwick University) and M. Balconi (University of Pavia).

* Session 1 - Institutional change and governance in public sector research. Interventions by Maria Nedeva (PREST) on institutional change in PSR, B. Van der Meulen (Twente) on the transformation of funding agencies, M.J. Santesmases (CSIC) on issues about linking PSRs in Europe, and M. Benninghoff (EPFL) on the results of the international

comparative analysis of research policies conducted in the Swiss REPOL network.

* Session 2 - Organisation and productivity of public sector research at the microlevel. Presentations by B. Poti and E. Reale (CNR) and P. Laredo (LATTS) on research collectives, and by A. Bonaccorsis and C. Daraio (SSSUP) on comparative productivity analysis. This was complemented by two background papers by: P. Mustar (CSI, Armines) on start-ups as a major output from University research, and A. Webster (York University) about IPR issues in PSR.

* Session 3 - Mobility and competence constitution in labour market for research. Presentations by I. Recotillet (LEST) on PhD trajectories, V. Mangematin (INRA) on the career of academics, C. Musselin (CSO, FNSP) on the unsolved paradoxes in the organisation of academic labour markets, and J.F. Perellon (EPFL) on quality issues and accreditation in Higher education. This was complemented by a background paper produced by Jurgen Enders (Twente University) on the articulation between "higher education" and "research".

La Cerbana workshop (July 10-12, 2003).

The conference, organised by A. Bonaccorsi and the SSSUP team, lasted 3 days (July 10-12, 2003) with 5 parallel sessions and two general sessions, one of which was devoted to the six issue identified, the "university observatory". The 5 other issues were organised by "theme responsibles" who had freedom to invite experts to present papers on key aspects of the topic. The objective in each session was to deepen each of the themes, and, as the purpose was to develop a wide research agenda, it was decided not to organise an overall prioritisation exercise.

We expected 30 persons with 2/3rds from TN members (and from REPOL, the Swiss equivalent of PRIME TN) and 1/3rd from non Prime TN institutions (including invited experts). But the organisers had decided to keep the door open and the audience was finally over 50 persons, most of which coming on their own funds. The TN also wished a high level external overview and took advantage of the presence of Professor Paula Stephan in Europe to invite her to reflect on our approaches and comment on most topics.

* Session on Labour markets: 14 participants, Background paper by H. Nohara. Presentations by I. Recotillet (LEST) on existing surveys on the career of PhD students, V. Mangematin (INRA) on the study of the trajectories of PhD students from the Grenoble University, P. Moguerou (IREDU) on the comparison done between France and the US, and by A. Ekeland on the preliminary results of the EC thematic network on international mobility of researchers (ENMOB).

* Session on Intermediary organisations. 16 participants. Background paper by B van der Meulen (Twente) and D. Braun (University of Lausanne, REPOL).

* Session on University or research spin-off companies. 25 persons. Background paper and presentation by P. Mustar (CSI). Presentations by E. Munoz (CSIC); N. Moray, J.J de Groof and B. Clarysse (University of Gand), A. Lockett and M. Wright (Nottingham University), and M. Fontes (INETI).

* Session on the dynamics of micro structures. 20 participants. State of the art based upon presentations by Bianca Poti (Ceris) on the relation between individual productivity, pattern of mobility across the career, scientific fertility, and the organisational factors at the level of labs and institutes, by Paula Stephan (Georgia University) on individual benchmarking and collective research, by Philippe Laredo (LATTS) on laboratories profiles within the Human genetics scientific community; by Cinzia Daraio (SSSUP) on new techniques for assessing scientific productivity of research groups, by Michel Zitt (OST and INRA) on the use of bibliometric data for qualifying excellent research organizations, by Vincent Mangematin (INRA) on longitudinal research: lessons for building laboratories strategy profiles, by Michel Zitt and Ghislaine Filliatreau (OST) on the use of bibliometric data for studying researchers mobility, and by Emanuela Reale (Ceris) on eexperience of longitudinal research: identifying research teams and research institutes profiles.

* General session on the "Observatory of university research activities" chaired by Andrea Bonaccorsi.

* A second general session discussed orientations and next steps (mostly within working groups, to prepare more in depth topic analyses for the TN general meeting.

Madrid meeting (January, 8-9)

The session devoted to the theme was based on the results of La Cerbana sessions and the 6 directions identified. The discussion was introduced by on a recapitulative presentation by A. Bonaccorsi, while the session responsibles commented. The debate was useful in clarifying certain aspects of the proposed research agenda and on the ways to address it. This was followed by a set of parallel sessions on given topics: intermediary organisations, spin-off firms, emergence of science districts, University research observatory.

3.2. Key assumptions for the comparative study of PSRs

We explicitly take a dynamic view and study how the Public Sector Research system (PSR) is influenced and in turn shapes the dynamics of science. We distinguish between **institutional dynamics** and **search dynamics**. They are conceptually distinct, although they are intertwined in a way that makes it almost impossible to study them separately, requiring a comparative, cross-sector and cross-country approach, combining analytical insights and detailed empirical evidence with broad interpretation.

Institutional dynamics

Most public research sectors strongly depend on public funding and are regulated by public regulations and procedures. Institutional dynamics are driven by their own internal logic. Up to now they are still highly responsive, on one hand, to the political and representative system (in terms of allocation of resources and collection of consensus), on the other hand, to the bureaucracy.

In turn, both elements of the system are increasingly influenced by a number of external forces: (a) market forces, i.e. potential private users of knowledge generated by the PSR system and/or partners in its production (industry), adopting different goals and evaluation criteria than public research; (b) user groups and interested parties, that are directly interested in particular outcomes of research (e.g. patient groups in chronic diseases, environmental groups) and may try to shape the research agenda towards localised (as opposed to universal) and interested (as opposed to disinterested) lines of research; and (c) society at large.

These shaping factors not only create a challenge in terms of financial resources and adaptation in organisational arrangements. They ask for a rethinking of the characteristics of Mertonian science, which has been the prevailing and inspiring model in the XX century, even though the fundamental properties of open science must be confirmed and strengthened. This rethinking about conceptual foundations of science policy should always be complemented by careful empirical analysis.

On the other hand, institutional dynamics does not follow simply from changes in conceptualisations. Institutional dynamics has its own pace. Its clock is not necessarily co-ordinated with the one of scientific research and its reflexive elaboration; quite the contrary, it is normally much slower and contradictory.

As in any complex institutional system, there are many decision makers with different goals. An important characteristics of science as a publicly regulated system is that agents (i.e. scientists) have superior information and knowledge not only with regards to the ways of achieving desired goals, but also to goals themselves. As a result, those that are regulated are usually much involved in the political and regulation processes and often become themselves policy decision makers.

In general, policy decision makers in institutional systems are dominated by a problem-solution type of practical rationality, which allows for ambiguity, compromising and ex post rationalisation. Nevertheless, decision makers normally use (and occasionally are really influenced by) rationalisations of their policy decisions.

Search Dynamics

A key element of scientific enterprise, on the other hand, is its self-regulation within a community whose functioning rules are stabilised by the institutional framework. These rules provide a peculiar way of organising, co-ordinating, recognising and awarding the research activity. They give to the scientific activity a certain degree of independence with respect to the specific institutional framework, although in the long run institutions matter. Even in extremely different institutional settings, scientists share a common core of rules for search.

By search dynamics we denote the abstract dynamical features of the research activity carried out by scientists in their respective field.

The intrinsic dynamics of search may be described with reference to its **direction** in the space of possible discoveries (divergence vs. convergence), to the degree of **complementarity** (physical infrastructure, human capital, or institutional complementarity) needed to perform the activity, and to the **pace** of search (steady state vs. transition/acceleration).

These elements differ across fields and also may change over time within the same field. A useful characterisation, which combines the elements discussed above, is given by the notion of *search regime* (see section III.1.1. for a further elaboration).

The notion of search regime suggests that research has its own intrinsic ways of movement in the scientific landscape and "timescape", that are influenced but not ultimately determined by the institutional context. It suggests to look at the *content* of research by trying to isolate abstract properties (with important social, economic and organisational implications) that apply to different fields and different stages of scientific evolution in the same field.

As an example, it is interesting to ask what happens to an institutional research system (e.g. Europe vs. USA) when a cluster of scientific disciplines undergoes a transition in the underlying search regime, so that the rate of production of new results dramatically increases, or the number of divergent and mutually incompatible research directions explodes.

As another example, it may be important to ask whether divergent regimes (e.g. with many mutually incompatible research directions, such as in biotechnology or information technology) as opposed to convergent regimes (e.g. with one or a few clearly identified goals, such as in particle physics or nuclear energy) should be regulated institutionally in the same way.

At the same time, the intrinsic dynamics of scientific activity is subject to some broad tendencies, that cut across all fields and search regimes: internationalisation, emergence of networks of scientific collaboration, increase in the real cost of research, increasing dependence on technical infrastructure, although not always centralised (e.g. a synchrotron) but also decentralised (e.g. a genomic database). None of these dimensions is entirely new, as can be stated by the history of the various public research sectors, but they are gaining increased attention and recognition (even becoming criteria in the quality assessment of research activities) and thus develop.

A research agenda at the interplay of both dynamics

Thus we will study how these two powerful types of dynamics influence each other: the institutional dynamics, as driven by its own political-administrative logic and influenced by market forces, user groups and societal needs, and search dynamics, as driven by scientific communities working within search regimes and subject to internationalisation, networking, cost and technology constraints.

The interplay between the two types of dynamics generates pressures and adaptive reactions in PSR systems, but also activates the reflexive and purposeful attempt to anticipate and produce change.

We also recognise that PSR systems are multi-layered and inherently complex. We agree to describe such systems at three interrelated levels:

1) the **macro level** (rules and norms of the national system, further articulated at EU level, country level, and regional level)

2) the intermediate level (which includes two types of institutions: (a) intermediary agencies for evaluation, monitoring, and resource allocation (b) institutions governing and administering the research activity, such as large public research organisations, and universities

3) the **micro level** (lab functioning and organisation, and labour markets for researchers).

There is a relation of mutual interdependence but also under-determination between these levels of the system.

Debates during the different meetings has driven to select a **limited number of priorities for the coming years** that are exposed below. They deal with researchers labour markets, intermediary organisations, new forms of university outputs and inter-relations with the economy (here only spin off firms will be presented, IPR issues having been addressed in section III.1.5.), the characterisation and performance analysis of microstructures, the research activities of universities (overall governance aspects being already addressed in section III1.8.) and the emergence of new poles or "science districts".

3.3. Labour markets

The presentations and the further debates that took place in La Cerbana (see box 6) enabled to identify two main research lines (that complement those mentioned in section III.1.8.) while a long discussion developed about the possibilities to compare existing large scale surveys and the need for ad-hoc tailored surveys.

Labour markets for Ph.D, post-doc and young scientists

The first line of research focuses on the issues of PhD Formation – Job transition. These issues imply a large range of study subjects: modes of doctoral training (academic, industrial); conditions of financing and realisation of theses; transition of doctoral students to the labour market; career trajectories in postdoctoral activities; size of labour markets for scientists (academy, industry, non profit etc.), situation and trends; determinants of academic careers; selection procedures for young researchers by academia and by industry (Models adapted in each sphere).

Hybridization of labour markets for researchers (scientists and engineers)

The second line of research aims to investigate the hypothesis of an "hybridization" of labour markets between academia and industry or across nationals borders. The following aspects were identified: changing academic workplace (tenure, type of contract, stability etc.); mode of recruitment and promotion in public and private sectors; spin-off activities in the scientific career; mobility of researchers/engineers between firms and academia and vice versa; temporary (but long) mobility across Europe; permanent mobility across Europe (incentives to move, effects on careers, effects on scientific production); legal problems from mobility (differences in salary, benefits, and pension schemes; legal status; compatibility of academic status with external activities); national configuration/articulation between external or internal labour markets.

It is worth noting that the debate remained limited on international labour mobility, if only because of the wealth of methodological problems exposed by Anders Ekeland and the accessibility of data. It remains to be further investigated.

Which work on surveys?

There was an agreement that it would be fruitful to compare the existing large surveys in terms of overall positioning of similarities and differences in first employment after the PhD thesis. However the assumption that the PhD formation is the same everywhere should not be taken for granted, and account should be taken of the heterogeneity of institutional arrangements around the PhD formation and its influence on the academic/professional trajectory of PhD recipients. A first list of institutional indicators, only based on the existing data sources, which could reveal such institutional differences, was made in order to take this aspect into consideration. However, due to the content and methodological choices of such large DBs, the capability of handling this topic and others in depth (such as longer term trajectories, role of embedment of PhD thesis in industry-university contracts,…) require *de novo* surveys. Both CSIC and IREDU discussed the advantages of small targeted web based surveys to explore the importance of such issues and delineate the key indicators. This type of survey is more research oriented and there would be a great interest in sharing them more widely between research groups from different EU countries. At the same time it can be conceived as a preparatory phase to a new generation of large scale PhD surveys.

3.4. Intermediary organisations

Positioning the notion of intermediary organisation

In several articles on the Dutch research system, Arie Rip and Barend Van der Meulen have pointed to the importance of the intermediary layer to understand science policy and science policy making in the Netherlands. The relation between government and the research performance level is *mediated* by a large number of organisations and institutional structures. The Netherlands, because of the density of the intermediary layer, is a typical example, but other research systems have a similar layer with some typical organisations. Research councils as funding bodies, and –increasingly– as body for research programming, national research strategy building, evaluation body etc, are operating in most research systems. Innovation agencies are also functioning in many research systems. But other, temporary or more enduring organisations can be found as well. e.g. for activities like foresight and evaluation of research, for linking science and technology efforts to societal and industrial needs, and for representing interests of scientific actors in political and other arenas.

They have claimed that through these intermediary functions two main processes are performed, *steering* and *aggregation.* Steering refers to hierarchical institutions by which a principal can direct the efforts of one or more performances and implement its own objectives. Aggregation refers to processes by which interests of heterogeneous actors get linked and at a higher level of social aggregation create new meanings to activities at lower level. The two processes are often complementary in research priority setting and implementation.

Nor in science policy studies, nor in social theory in general, the notion of intermediary organisations is well developed. The organisations referred above are either seen as bodies of national governance, as examples of self organisation of the research system, or as organisations performing a typical function. Intermediary institutions, by definition of the concept, always assumes at least two other actors or activities of which the interaction is mediated. Any theory of intermediary organisations therefore necessarily should take these actors/activities and their relation into account.

The notion of mediation also implies that the two actors/activities are of a different kind and that some translation of the meaning, results, interests of one of the actors/activities is needed for the other actor and vice versa. Political objectives have to be transformed in e.g. research programmes before research performing actors can cope with them. Research performance have to be translated in quality criteria and peer judgement before accountability towards the political system can be realised.

Two bodies of theory on research and innovation systems can be helpful in conceptualising the notion of an intermediary body. The first one is the theory on national systems of innovation – or of innovation and science, which assumes that the performance of an industry or any other actor in the system is depending on the organisation of key innovative activities at the national level (or any other meaningful geographical space) and the inter-organisational relationships by which the actors gets involved in these activities. Within national systems of innovation theory applied to S&T policy, intermediaries are seen as those organisations link the industrial system to research systems.

This is only one role and position of intermediaries. Van Lente has elaborated intermediary roles in the innovation system (Van Lente 2003), and gives a first typology of intermediaries with a basic distinction between vertical intermediaries and horizontal intermediaries. The first kind mediates the relation between the state and private firms in a vertical relation, and is like an agency. The second kind mediates between private firms and research institutes, and strategically intervene in the networks.

While from a NIS perspective the (positive) functions of intermediaries to bridge the activities of actors are emphasised, Principal Agent Theory emphasises also the tensions and ambiguities in the position and role of intermediaries. Recently a number of authors have developed principal agent theory, conceptualising either the intermediary as an agent, or the intermediary as mediating the relationship between government as principal and the research sector as agents.

Research councils and 'reflexive bodies': issues raised

Research councils are one prominent case on the intermediary level of research policy. Another are what one may label the "reflexive institutions" designed to advice government, research organisations and funding councils about best practices, problems, new designs etc. Both raise a set of issues:

- What kind of institutional changes have occurred and occur within the existing intermediary organisations as a result of new tasks put upon them by governments, as a result of the emergence of new fields of research and as a result of other external pressures especially the development of the European Research Area? This is a particular relevant question given the few "inside observations" we have on the functioning of research councils.

- There is literally no comparative study on 'reflexive institutions' though – in times of rising complexity and evaluations – they may have a decisive role in policy formulation. What kind of reflexive institutions do we find and how do they differ between countries in their nature, organisation set up and functional role? What are their relationships with other organisations on the intermediary level as well as with government and the scientific community? What relation between organisational settings and learning capabilities?

- Government intervention has undergone significant changes during the last years. Key words are for example new public management, moderator and facilitator etc. These changes have led often to a new way of organising the relationships with funding bodies. Though there is some research, we need more systematisation and, above all, conceptual frameworks that grasp at the changing "governance" context and explore the influence this has on the relationship between government and funding bodies in the organisation of research.

- A still underrated and underdeveloped topic is priority-setting within funding agencies. Without any doubt, a certain professionalisation has been developed during the last 20 years by often creating strategic bodies. On the other hand, we find the influential role of multiple scientific advisory committees and other bodies working in the context of funding agencies. One would like to know how, finally, research priorities of research councils are adopted? Who is influential, what are the decision-making procedures etc.?

Which intermediary organisations?

However the discussion very rapidly questioned this categorisation: first the two categories were not enough to account for the variety of existing situations; second it did not capture the numerous new 'innovative' creations developed to address the link not only between researchers and government, but also with an enlarged set of new actors which could no longer be simply assimilated to "mecenes" and had a say both in priority setting and on research practices. On top of supposedly classical models, we were thus faced to a variety of institutions "for organising knowledge production and the translation of public issues and needs in research" (Van Der Meulen). Could we work with a third category then? There were doubts about it and the idea of a taxonomy emerged based on functions and types of relations (see preliminary attempt in box). It is probably because it is a very ambitious aim that we could not record any previous attempt of a comparative analysis with this aim. Should it thus be a preliminary or an end-result to aim at?

Box 7. Elements for a taxonomy of intermediary organisations

> 1) Functions that might be considered as being of relevance to intermediary organisations: allocation of resources, instrumentation, organise competition, priority-setting, evaluation of performance, impact, foresight/strategy, facilitate institutional change, communication across institutional borders, internationalisation,, interface with industry, interface with society
>
> 2) Types of relationships: Hereby is asked what intermediary organisations are linking in terms of systems or "social worlds". For example, intermediary organisations linking the political and the scientific system are subject to other influences than intermediary organisations between the scientific and the economic system.

Research directions

There was a clear agreement upon the need to develop projects about change and not just structure, about the *drivers of change*. In the discussion we fell back on the "holy trinity", i.e. interests (who are the stakeholders with what power resources within intermediary organisations, who are other actors with power of agenda-setting or veto-power), ideas (which highlights the function of "reflexive organisations" but also in general the dimension of "discourses on governance" that are of influence in the building and rebuilding of governance arenas) and institutions (here we think of path dependency as a retarding moment of change and facilitating institutions (legal regulations for example) that have influence on the functioning and politics of intermediary organisations). How then to put it in perspective? The answer was: by reconsidering entry points, i.e. thanks to a careful selection of areas of change. The preliminary discussions highlighted two:

- One clear entry point would be to study a new priority field for the last 10 years and see how this has transformed the landscape and redefined roles and positions. In this flux, what is interesting is the tension between the old and the new organisations facing transitions (especially coping with rapid growth and changing search regimes). One entry point should be to study comparatively the flexibility, adaptation, transformation of existing councils or agencies to cope with new fields (taking, may be, cases within NBIC).

- Another critical dimension would be to study the transformations brought by EU initiatives on existing intermediary bodies at macro level (ERA implementation and all the benchmarking activities developed under the OMC approach), meso level (especially with the debates on the ERC) and micro level (via the new instruments of FP6).

There was however a general conclusion: No long term work can be undertaken without coming to a general conclusion on the functioning of intermediary organisations and their efficiency in terms of productivity and innovativeness of research. The empirical preliminaries are a first step of understanding, the review on our knowledge on intermediary organisations is a second step and theoretical approaches will fill in as a third step. A functional assessment of intermediary organisations (why do we use them, when do we use them, in what combination with other actors; in what types of interaction, built in what kind of games, with what kind of resources) is an important contribution to the policy output of our projects: it helps to understand policy-makers under what circumstances and in what forms they can expect what kind of results from these organisations. And only by understanding the pro's and con's of intermediary organisations are we able to discuss the conflict between "old and new intermediary organisations" (first focus) and reflect on a suitable organisation for a "European arena".

3.5. University or research spin-off companies

Extent and diversity of the phenomenon: the need for a typology of spin-off firms

The phenomenon is not new, what is new is its extent, the fact that is now recognised as one mission of universities and that new policies appear to promote it.

Still the studies done raise a set of questions: about the scope of the phenomenon (should we have a narrow or a broad definition, depending of the degree of involvement of the University), about the nature of firms (what do they produce - and especially what is the share of services and based on what - and for whom?), about the conditions of creation (which creators? who bear the costs? etc.), about their networks (scientific, commercial with users, with suppliers and co-developers), about their dynamics (what is survival rate? is being bought a criterion of success? etc), about their role in the circulation of knowledge, in industry dynamics, in regional dynamics... and the very different set of criteria linked to these different objectives), about the boundary between public and private. Work done in Portugal (M. Fontes) helped in complementing the issues raised. She insisted on the relative importance and dynamics of local vs. distant relationships (thus the critical role of the environment in which the Spin-off firm emerges, whatever the terminology is: cluster, technology park,...) and on the factors that enable project maturation: local science base; foreign mobility & exposure; extended networks. She also considered that the role of spin-offs in the transformation of scientific knowledge should be better emphasised, as well as, in the motivations for creation, the career path or trajectory within university. P. Mustar's conclusion was on the very different configurations observed and the need to build DBs, metrics and typologies to better understand these configurations.

Public policies and the mythical view of THE spin-off firm

Ph Mustar explained the focus observed on spin-off companies as the convergence of two phenomena in public intervention: a switch from large firms to SMEs as only the latter are net producers of jobs, and the growing emphasis put on university/industry relations and transfer policies. He locates the development (at least in Europe) in the fact the Venture Capital only addressed the 'deployment phase' once the feasibility of the project is there. Thus the role of seed money and incubators to promote the initial phases. There has also been a snowballing effect which makes it a widespread policy at any level (national and regional) as demonstrated by the numerous measures taken in all EU countries. The policies all organise around 6 main directions: researcher's status, IPR, training future entrepreneurs, use of competitive processes for selecting projects, incubators and structures to support projects, seed capital funds. When looking at their implementation and performance, one is struck by the very linear fashion in which they assemble, while at the same time actors abound on any of the proposed segments with even coo-competition between private and public initiatives (can we speak of hybridisation?). The conclusion was that public intervention has been built on an "exceptional" business model (not to say a mythical view): a firm created by a scientist, often in partnership with a businessman, on the basis of a licence or a patent owned by a public sector institution, and which grows steadily, a growth that is boosted by the entrance of venture capital and will lead the firm onto the stock market.

Research Avenues: focus on the knowledge gap

The group identified 5 'classical' research avenues: on the creation process, on dynamics (need for longitudinal studies, need of common metrics to measure performance and to relate it to key factors, need for typologies), on the role of spin-off firms in the overall PSR for fostering/hindering the circulation of knowledge and on university governance (and attractiveness), on the comparative analysis of policy instruments, all these being linked first and foremost to the development of research tools (common definitions, DBs, longitudinal analysis, metrics and indicators, typologies).

However, for a long term agenda, the group proposed a shift in emphasis in the analysis of the phenomenon. Most of the work done addresses the financing gap, while the group considered that the knowledge gap could be a more powerful entry point to understanding the dynamics of the overall phenomenon. They consider as a knowledge gap "the difference between a venture knowledge endowment and the knowledge required to create sustainable returns". It can be scientific/technical, linked to technology transfer or to entrepreneurial aspects. This definition takes hold of the fact that the KG changes over time (linked to the phases of spin-off development). It also enables to consider different units of analysis (the university, a venture capitalist, or an individual project/firm). Which means that the KG may be affected by different university contexts and different country/regional contexts, enabling rich comparative work to be developed.

3.6. The dynamics of micro structures

The 9 presentations made in La Cerbana did a large review of existing work on the topic. The debates on presentations highlighted three main research avenues. Two are methodological: (i) develop methodological work on the analysis of CVs., and (ii) test the relevance of the non parametric efficiency analysis (as developed by C. Daraio and A. Bonaccorsi) to another data set of labs. (iii) The third one follows from the conclusions of the European comparison done on labs in Human Genetics, it concentrates on the emergence of research collectives.

CV analysis

Most of the work done on the relationship between lab and individual trajectories and the ways they mingle, face a strong methodological difficulty this of following researchers. Pioneering work has been done by M. Gaugham and B. Bozeman in their work on "social capital" and the role of networks in the performance of labs. While until recently it was difficult to access CVs, many are now on line and thus extensive work can be done both to study careers beyond early stages (cf. labour market track) and to link individual and collective performance. However this faces strong methodological problems. So that there is a need to develop a common methodology which will progressively enable comparative analyses to be developed between specific datasets built. The interest was all the more important that quite a few groups participating to the meeting had developed datasets (INRA, two sets with over 4000 researchers in life sciences since 1992, SSSUP on computer science, around 2000 from 1950 to current, CSIC on biochemistry…). Review of literature would help to gather other researchers being involved in such a process in order to discuss approaches, concrete data handling and coding and establishing a "coreset" for fostering comparisons.

Performance of public research

The group considered it important to develop more robust quantitative methods for "benchmarking" or efficiency analysis. A debate was open around the non parametric efficiency analysis developed by C. Daraio and A.Bonaccorsi, ad applied to a set of CNR and INSERM institutes. Due to the very aggregated nature of factors used, the frontier was less considered as a measure of performance than as a possible source of characterisation of different strategies. The idea was put forward to try and use more refined dataset on labs (such as this on human genetics[23]) so as to define not one but different performance dimensions, to compare it in relation with the profiles identified and to complement it by an experimental development of the relation between collective and individual performance (mobilising results of the CV analysis).

Emergence of research collectives

One of the major results of the Human Genetics survey conducted in 1996-98 was that, once created (i.e. after their early stages), labs were on a given trajectory, translated by their activity profile, and had difficulty to change. Similar results have been obtained on the longitudinal analysis of labs in the Anjou region over 10 years. However emergence is not a one-off decision, but corresponds to at "fuzzy" period that can extend over a few years, entail trial and error (with attempts at a first format and rapid reformatting…). The debate showed the interest of continuing along the lines set in previous workshops on the topic (especially Paris 1998 and Sigtuna 1999). The dates of the previous meetings are there to highlight the difficulty of developing long term projects that go beyond the local level of analysis and enable both comparative work and aggregation so as to build a critical mass of both in-depth case studies (that nurture the definition of relevant indicators) and of large enough datasets to follow the issue raised. There was an agreement to focus on fast growing fields of research and to articulate to other work done in order to capitalise experiments and knowledge. The idea of working on both life sciences and nanotechnologies (more linked to IT, material sciences and chemistry) was pushed forward.

3.7. New leading sciences and the emergence of science districts

In more and more sectors we are witnessing a geographic polarisation of scientific and technical production. These clusters can be a concentration of local actors who are sharing facilities like in technopoles. It can also be a concentration of "global" actors in

[23] It however proved impossible to access the full DB on Human genetics which, due to reasons about the handling of confidential data in France, had to be deleted.

which "global" firms (firms operating in global markets and with internationalised R&D), world-wide renowned academic labs as well as a large number of high tech start-ups are involved.

There is a long history of geographic concentrations which has been documented in a large number of researches, from the Silicon Valley (Saxenian, 1990) Cambridge (Cooke, 2001; Cooke, 2002), biotech clusters in US (Powell *et al.*, 2002) or Öresund region in Sweden (Stankiewicz, 2002). Different critical surveys point out the agglomeration dynamics: Breschi *et al.* (Breschi *et al.*, 2001a; Breschi *et al.*, 2001b) underline the limits of localised knowledge spillovers analysis which needs to be enlarged in terms of labour markets and markets for technologies (Feldman *et al.*, 2001). Rip (Rip, 2002) emphasises the main dynamics of the constitution of geographic clusters: national and regional top-down policies to encourage the emergence of specific clusters on the one side and local bottom-up dynamics based on localised knowledge spillovers. In these approaches, strategies of large firms to localise their research is often under estimated as well as the dynamics of evolution of the geographic agglomeration.

The recent work done on the geography of innovation (Feldman, 1994; Feldman *et al.*, 2002; Krugman, 1991; Pfirrmann, 1992) and on clusters and localised networks (Gulati, 1999; Kalnins *et al.*, 2003; Kukalis *et al.*, 2003; Martin *et al.*, 1999; McKelvey *et al.*, 2003; Paci *et al.*, 2000) do not consider the composition of the cluster, the nature of the technology nor its stage of development as major factors.

The debates showed first that composition mattered, and that there was a need to go beyond existing typologies of clusters (e.g. Markusen, 1996) and to focus on a particular type of agglomeration (as is observed in Grenoble for micro and nanotechnologies), that is (1) Geographic aggregation of world-wide standard actors that localise their research in the region; (2) Investment over a long period to build up a public sphere of "excellent" teaching and research in partnership with the private sector; (3) strong involvement in emergent fields ("research universities" are generally excellent in all areas and prefer to remain broad in scope); (4) "entrepreneurial" public laboratories or universities (that is, oriented towards industrial relations and start-ups); (5) and a large number of research spin-offs. It was proposed to label these "science districts" (as compared to the original use of industrial districts by Marshall).

They also highlighted, following the hypotheses made on search regimes (see section III. 1.3.) that the nature of the technologies involved and the stages of development of the industry were two key variables to consider. Indeed, the very nature of technology influences the modes of circulation of knowledge and technological artefacts. It can also induce concentration mechanisms, when large-scale research facilities like synchrotron or nuclear experimental reactors are required. The stage of the development of the sector also matters (Afuah *et al.*, 1997) because it influences the relative power and strength of actors involved. During the emerging stage, when technologies emerge, incumbents are challenged by new entrants, barriers to entry are low. Markets have to be identified or built. The market powers of suppliers and of consumers remain low. During the exploration phase, ideas and especially knowledge ate the frontiers of cutting-edge science have a strong tacit dimension (Nelson, 1982). When knowledge is more tacit, face-to-face communication and interaction are important (Von Hippel, 1994) and knowledge circulates on a local basis. Because of its tacitness, new scientific advances have a form of natural excludability (Zucker *et al.*, 1998) that encourages geographic concentration. As the industry matures, the existing knowledge base grows and the accumulation of knowledge generates higher barriers to entry in the industry (larger and more expensive instrumentation like large-scale research facilities, clean rooms, new division of work which generates co-ordination problems, etc.). Existing firms adapt themselves to the selection process. Diversity is reducing and competition is increasing and incumbents become more powerful.

Such hypotheses require in depth testing. It requires first that there are quantitative tests about the assumptions made of the relationship between certain types of search regimes and agglomeration of scientific and technological capabilities (especially at the phase of emergence of the new paradigm/field); it requires, second, that hypotheses about life cycle are better appraised; and it asks thirdly that the implications for public policies (on research and innovation, but also on competition) are better analysed. The conclusion was that there should be a mix of quantitative and qualitative work done and that, for the latter, comparative analyses of the different forms of agglomeration observed rather than individual case studies should be preferred. Finally there was an agreement that nanotechnology might be a good candidate for future work, especially since it links both with IT (especially in electronics) and biotechnology ("nano-bios" being an important focus for research).

3.8. Observatory of University research activities

This theme had been identified in the preparatory activities as a key issue. This was confirmed in the debates in Paris beginning of 2003. The debates that took place in La Cerbana and in Madrid, reinforced the need to consider university research as a major topic in any long-term research agenda of the field. We see four main issues which justify such a development: (i) there is an on-going movement of hierarchisation of universities based on limited external indicators (publications and citations in ISI DB), (ii) enlargements such as the use of patents face complex retrieval problems (not withstanding issues related to private life) as demonstrated by the work done by BETA on the Strasbourg university, (iii) there is a growing need for university management and governance to enrich their knowledge about research activities, beyond the sphere of papers and patents. This requires both the development of internal DBs (e.g. on contracts) and more sophisticated tools such as those developed for characterising 'activity profiles', but it also requires to relate these to expenses and costs so as to develop performance measures that are relevant for strategy analysis and decision making. And (iv) there are overall key issues that require such a bottom-up process to be built if one wants to go beyond the present limitations faced by existing statistically based datasets. The following aspects were emphasised: the transformation of the financial structure of European universities, the third mission and the tensions generated with teaching and research activities, the role of research in the international attractivity of universities, the diversity of university strategies and "profiles" (towards a more elaborated taxonomy than the present opposition between teaching only and research universities).

3.9. Other cross-cutting issues identified

The discussion in Madrid agreed that the main aspects of PSR components and dynamics had been covered, with perhaps the exception of two cross-cutting aspects. The first deals with "non-university research performers" which were not addressed in the intermediary organisations approach. The work done by the EUROLABS project was mentioned as one possible reference for helping in the definition of research priorities, because it highlighted not only issues of management of government laboratories, but also showed the emergence and rapid growth of a not-for-profit sector about which little is known, even in countries where they have been long established. A second point put forward dealt with the overall arrangement of PSR and the evolving balance between types of operators. The PSR project (see Senker 2001 SPP issue) as well as the recent comparative study on research policies (Laredo and Mustar, 2001) demonstrate the wide differences between countries in both organisation and balance, the very path-dependent nature of their evolution, and at the same time common features in their evolution. There would therefore be significant interest in developing a research programme on the dynamics of PSR in Europe as such, especially within the framework of ERA, and of the possible impact of new FP instruments and in the light of the creation of an ERC.

4. New Work Package 4 (ex WP5) on training activities

4.1. Positioning training in the overall framework of the field

Training was considered by all members of the TN as a critical infrastructure to harmonise and foster at the European level. We face a specific situation: (i) the age and gender structure makes it very important for the field to be attractive for students, (ii) after a difficult period, the situation has improved again with a growing number of doctoral students present in our labs, (iii) as an interdisciplinary field, as soon as we wish to develop dedicated programmes, we face particular problems to attract students and to develop curricula and diploma that fit within the traditional more disciplinary based landscape (this is all the more difficult that we are a 'small' speciality, having difficulty to make our voice heard in the on-going debates about quality aspects and accreditation), and (iv) we should take advantage of our strong European base to offer European trajectories for training that go beyond the traditional exchange pattern that is now general to most fields.

4.2. Overall development of the work package

These points explain the very practical orientation that was taken by the working group. The group gathered researchers from the University of Oslo (K. Bruland), PREST (K. Barker), SPRU (E. Millstone), the University of Twente and members from the WTMC doctoral school (A. Rip, B. van der Meulen, W. Bijker and J. Messman), Ecole des Mines (P. Mustar), UAM (P. Sanchez, C. Chaminade) and BETA (P. Llerena). The president of ESST (L. Box) joined and became very active in the management of the group.

Altogether the group met 5 times (Paris November 28, 2002, Paris January 15-16, 2003, Maastricht, September 16, 2003, Utrecht December 10, 2003 and Madrid January 7-8, 2004).

In order to prepare for the future, it initiated a review of on-going training capabilities at European level which was under way, according to schedule, at the end of the present project, and will be pursued under the framework of the NoEs (the plural here is important, since we consider that training addresses the whole field, and not only one or the other NoE).

This important activity enabled the group to outline the main characteristics of a coherent and complete training programme at the doctoral level, the master level and of shorter courses. During this process it became clear that the existing ESST programme (a European-wide Masters programme for Education in Society, Science and Technology

– comprising 17 universities), might serve as a structural feature for the training infrastructure the group was aiming to develop and proposed.

4.3. The approach adopted

Training, considered as one of the structural activities of the TN, could provide for the building of a European infrastructure for research and innovation policy studies. Training and education would therefore take a proactive role in this field, and would need to be co-ordinated at the European level. Co-ordination, that is, through the involved institutions themselves – not in first instance through governmental arrangements or agencies.

The TN started from the premise that competencies needed to be identified and grouped. In a subsequent stage the competencies could be integrated into joint programmes of action. The TN therefore aimed at inventorying and proposing potential programmes, to be realised in the NoE.

One network, ESST, has functioned since 1992, but was only partially policy oriented. A few top institutes have been engaged in relevant training programmes for years. Yet their activities were hardly co-ordinated at the European level, thus not contributing to making the continent fit for the type of competition foreseen in the Lisbon declaration by EU Heads of State.

The TN therefore attempted to expand relations between the existing ESST Network, a few large institutes and a number of smaller ones, especially in Southern and Eastern or Central Europe. The motto was: build on what exists and improve training opportunities accordingly. Maintain quality-standards and develop innovations where possible. Do not duplicate, but transform existing centres of excellence into European training networks.

Programmes were to provide a linkage between research and policy. Some of the training programmes could be more policy oriented, others more directed at research interests. In this way the TN attempted to answer the key question of what can be contributed to improve human resources engaged in research and policy making at the European level.

Therefore we present the results of the TN under two headings:

- training for *research*, including PhD and MPhil programmes, PhD conferences, summer schools and Marie Curie Multi-site exchange programmes;

- training for *policy*, including a professional Master, Virtual University and Networked Training Programmes, as well as short courses for policy makers.

For each of these activities it is proposed that Mapping exercises take place. These result in inventories of existing collaborative activities and review student, staff and curricular exchange as well as the development of such exchanges.

4.4. Training for research

The aim is to provide a coherent set of training activities at different levels and for different conditions. Some countries, like the UK have a long-standing tradition in science policy studies; others, especially in accession countries are in the process of establishing research groups. The TN aimed at taking the best research training as a starting point and providing for linkages at the European level. Such training needs to address the Master's and the Doctoral levels, and needs to deal with providing skills at the early doctoral level (as through Summer Schools) as well as at the later level (as through Doctoral Conferences). Schematically, this looks as follows:

Box 8. Training for Research

Proposed programmes and activities by level	
Level	**Programme**
Masters	Research Master, (MPhil)
Doctoral 1st-2nd year	Summer Schools
Doctoral 3rd – 4th year	Doctoral Conferences
Doctoral general	Marie Curie Multi-Training sites

Research Master

The TN proposes that a research-master programme be initiated, to start operations in September 2006. On the basis of a small group of core-institutions, a programme could be designed which aims at providing theoretical, methodological and other skills needed for science, technology and innovation studies. Students could be recent graduates with a relevant bachelor diploma, mid career professionals or students aiming for the doctorate. An initial group of about 30 students could follow the programme in the core institutions between 2006 and 2008. Practical preparation could start in late 2004 with the formation of a planning group of half a dozen institutes with ample experience in the field. The TN recommends linkage with national doctoral networks like the Dutch WTMC, given the overlap of research masters and doctoral training. The initiative to be co-ordinated through ESST, which already runs a European programme in Science and

Technology Studies involving both theory and methodology. Over 2005 a core programme could be designed, preferably involving institutes in North, South, Central and Eastern Europe.

The objective should be to have the pilot programme operational in 2006. The budget would include line items for at least 6 meetings of the core-group, the development of about 10 training modules and the costs of a central training co-ordinator.

Doctoral training – an analysis of the situation

It is self evident that joint activities in the training and production of PhDs are an important element of the development of the academic area of 'policies for research and innovation' at European level. For many of the participants, the development of such an initiative can be a new vehicle for their doctoral students to become part of a European body with critical mass, gaining access to specialised advanced research training and mobility.

The objectives should be better integration, for example through defining shared training programmes for PRIME PhD students (even while they remain PhD students of one institution). This would naturally push deeper inquiry into comparative policy studies and analyses and developing analytical tools, often the concern of doctoral theses.

A first review of the issues raised by the Europeanisation of Doctoral training was made by the group. Two main points were discussed: who is concerned and what do we know of training places for doctoral students in our field, items for sharing and exchange (there is a long list).

Who is concerned? There are both 'dedicated' doctoral schools (that is covering the field of research and innovation, most of them in one disciplinary background), and many doctoral students undertaking their PhD in a wider PhD framework (where this is at best one speciality). This is why the group considered the experience of the Dutch WTMC doctoral school as an important landmark which should support reflection about possible directions (see box).

Box 9. The example of the WTMC doctoral school

The Dutch Graduate Research School WTMC (Science, Technology and Modern Culture) has a structure, parts of which might be used as models for development at the European level.

The major responsibility is local, with the Department and the PhD Supervisor ("promoter"). But institutional members of WTMC have committed themselves to let their PhD students participate in training activities at the national level. In addition, the Director of WTMC (= Arie Rip for the period 2000-2004) has a responsibility to monitor progress of the PhD students (because the School will be assessed also for its productivity in PhDs awarded) and advise PhD students when there are problems, or even intervene with their supervisors.

Briefly, PhD students have to attend a set program in their first two years, consisting of two three-day workshops and a five-day Summer school each year. In their second and fourth year, they can (and most do) attend a two- or three-day Winter school where draft chapters of their PhD thesis are discussed, also by invited commentators from the Netherlands and abroad. These meetings are residential, and quite intensive intellectually and socially. They are organised by a WTMC training co-ordinator in consultation with the Director.

There is no standard curriculum, but there are recurrent elements, and there is a set of goals for the training, a list of core literature (in STS), and a list of skills to be trained. Since WTMC is interdisciplinary, there is no full-blown training in methods, but there are general skills, for example interpretative analysis of texts, how to develop a research design (this element is often done by asking students to critically comment on PhD Theses of earlier students in the School).

The workshops are set up around a theme which is drawn from the overall research profile of the School (= the sum of ongoing research of participants in the school, arranged under three convenient headings) or interesting recent developments in STS and science & technology in society (these two will overlap). One such theme would be 'diagnosis of the modern research system' (heading 1), another 'technology, regulation and standardisation' (heading 2). These are very broad themes, and are further specified on the basis of ongoing research of participants of the School. We have also had themes like 'time' or 'norms and normativity in science and technology and in STS'.

The Summer schools are built around an anchor teacher who is teaching three of the five days. The anchor teachers are invited for what they have to offer, but we follow a schedule in which the three components of WTMC (science studies, technology studies, philosophy and culture studies) will be addressed in a three-year cycle; the choice is also linked with the themes of the workshops in the same year. This has to do with the need to cover more or less the whole field of WTMC for the students who spend their first two years following the set program. Recent anchor teachers were Steve Woolgar, Aant Elzinga en Tom Gieryn. The Summer schools have been organised in this form since 1987.

ECIS, the Eindhoven Centre for Innovation Studies, has a training program for its PhD students which is carried out mostly in house. Part of the group (ECIS 2, led by Bart Verspagen) is now institutional member of WTMC. Their PhD students will follow the set program of WTMC, and relevant parts of the local training will be offered to PhD students from other groups. This (together with some other developments) may lead to a more à la carte type training program in WTMC. What needs to be assured is that students get a good overall view of the field, as it were to compensate for the more narrow cross-section they will look at for their PhD thesis. One way to do this is to require students to get approval from the Director before they can exchange a component from the set program of WTMC for a more or less equivalent training activity elsewhere.

Concerning the directions for sharing and exchange, the following items were discussed:

- advanced specialist research training (method and subject based courses): inventory what is being offered by members already and accessible to PhD students from elsewhere, identify lacunae and organise activities to fill these lacunae if deemed necessary;

- doctoral conference (following SPRU experience);

- summer schools;

- student exchange and mobility (open up existing training courses, periods of doctoral research spent in other institutions, co-tutoring), following the experience gained by some PRIME TN groups with Marie Curie Programmes;

- short visits (to use research libraries, work with other people on data sets, undertake short field trips);

- It also fostered the idea a "virtual graduate" school.

Discussions drove to focus for the coming years around three main actions: doctoral summer schools, annual doctoral conference and mobility of PhD students. They are addressed below.

Doctoral Summer Schools

Summer Schools are training activities centred around a particular theme, allowing students to acquaint themselves with the theme, under the guidance of expert teachers in a relatively short period (one-to two weeks). Summer schools may involve young PhD students, and in certain cases young post-docs. The focus of summer schools may change by the year, thus allowing flexibility and adaptation to prevailing Prime interests and research themes. In one case, the School is built around one anchor teacher, who is teaching three to five days. The anchor teachers are invited for what they have to offer

The TN identified Doctoral Summer Schools in the UK (SPRU) and in the Netherlands (since 1987, now in the WTMC context). Summer Schools appear to be lacking in Southern and Central Europe.

The TN proposes that the next WTMC Summer School should accept young doctoral students from Prime Partner institutes. This could be done through providing fellowships to a limited number of participants, covering the additional cost. Starting in 2004 WTMC could run a pilot programme for a number of students to be agreed, allowing for exchange at the European level.

Given the lack of a Summer School in Southern or Central Europe, the TN recommends one to be held on a pilot basis in 2004 in Madrid. It could focus on the challenges for Southern European and Accession countries. Costs could be based on 30 participants and 8 teachers during 6 days, plus coordination, lodging and travel.

Summer Schools in later years could be held in other PRIME institutes, thus facilitating staff exchange and programme integration. In 2005 a Summer School could be planned in Budapest or Prague to conform the importance of accession countries.

Over the years, a self-sustaining system of Summer Schools will provide for greater mobility among European doctoral students. It will also bring Prime researchers into contact with each other. Last but not least, Summer Schools may stimulate non-Europeans to become aware of trends in science, technology and innovation studies. Prime Partner institutes are recommended to include the costs of the Summer School in regular Doctoral Fellowships or Grants.

Doctoral Conferences

Whereas Summer Schools aim at 1st and 2nd year doctoral students, Doctoral Conferences aim at the later years. Students having completed their research need to learn how to present this work both in written and in oral form. Doctoral conferences allow such presentations under the supervision of experts. Expertise needs to be provided both regarding content and presentation skills.

The TN identified the Doctoral Conference at SPRU and proposes a joint activity with PREST. The first Prime Doctoral Conference could be held for some 50 participants, building on the regularly scheduled event in June 2004. The responsibility for announcing the Conference would be with the organisers, and they need to also select the candidates from Prime Partner institutes. It is recommended that some staff members from Partner Institutes also be invited. This allows on the one hand for staff exchange, and on the other hand for staff capacity building.

The TN proposes that in subsequent years Prime Doctoral Conferences be held in Southern and Eastern or Central Europe to provide for differences in themes, language and presentation styles. Prime Partner institutes are recommended to include the costs of the Conference in regular Doctoral Fellowships or Grants.

The mobility of PhD students and Marie Curie Training Sites

The group considered the mobility of PhD students and post-docs as a critical issue. Many groups (such as BETA or PREST) were highly involved in the Marie Curie Programme and underlined that it should provide a privileged alley towards addressing the issue.

Marie Curie Fellowships provide European placements for pre and post-doctoral researchers, usually up to the age of 35, and for experienced researchers. Fellowships are available in any scientific discipline that contributes to the objectives of the Framework Programme. Applicants to this activity are young and experienced researchers and host organisations in academia and industry. Marie Curie Actions include both host actions and actions of the individual student or staff member. *Host Actions* refer to Research Training Networks, Early Stage Training Sites, Conferences and

Training Courses and Fellowships for the Transfer of Knowledge. *Individual Actions* are covered under Intra-European Fellowships and other Grants, Awards and Chairs of Excellence. Some features of Marie Curie Actions in FP6 are that it is opening up to 3rd country nationals.

The Marie Curie programme offers thus interesting opportunities for our field, allowing for sustainable funding. Advantages include the fact that it would enable to build up a large activity. Most importantly, it can be done as a multi-partner site.

This is why the TN proposes that, beyond and above present applications to NoEs, that a first proposal be made for a Marie Curie Multi-Site Training activity, in the form of a Research Training Network. The TN is conscious that the programme is heavily oversubscribed (making the chances of success 'erratic') and that the connection with NoE applications is a real (though hidden) subject of debate between policymakers).

The main ambition is to develop exchanges mostly for PhD students in their second and third years for a six month period in the framework of a co-directorship (the receiving group having one senior researcher directly interested in the topic and ready to invest him/herself into co-tutorship).

4.5. Training for policy

Although no sharp distinction can be made between training for research and training for policy, the demands for each are different. Training for policy is rather practically, or professionally oriented, whereas research training has a stronger theoretical and methodological focus. Training for policy is also focused on the Professional Masters and Short Course type of programmes, whereas research training happens in the framework of multi-annual Master or Doctoral programmes.

The aim of these training activities is therefore to provide practical skills in STI policy formulation, programme development, monitoring and evaluation. The various activities proposed are mentioned in the following box.

Box 10. Training for policy

Proposed activities by type and programme	
Type	**Programme**
Master	European Research & Innovation Policy
General	Virtual Teaching Campus
Short course	Democratisation of technological culture
Short course	Controversy courses

Professional Masters – an analysis of the situation

There are few established master courses that focus on S&T policy, Technology and Society or on innovation dynamics/management (the best known being those of PREST, SPRU and Strasbourg). Furthermore it was considered that, in many countries and especially in the Netherlands, there will be very few openings to have a Masters in the area of research and innovation (or STS), the strategy is then to be visible in the curriculum of other Masters (compulsory or as an option), Cupertino between options being then critical to offer adequate training.

This is why the ESST Masters in Society, Science and Technology in Europe(see Box) was considered as a model and a major support for future action.

However, whilst initiatives at masters level should form a critical part of the Europeanisation of the field (in particular because masters level training is important for recruitment into the PRIME area), there are nevertheless several difficulties in establishing concrete proposals. Those difficulties stem in part from the heterogeneity of existing programmes (content, structure, time-tabling, course and university requirements). They also involve considerations of funding. On the latter, the UK universities tend to obtain a greater proportion of their teaching income from student fees at masters level than do universities in other Member States, and schemes in which money does not follow students are usually problematic for UK institutions.

The options discussed focused thus on components that could help the progressive framing of a European space. They concerned:

- The exchange of students: one possibility is for specific Masters modules provided by member institutions to be made accessible to students from other PRIME institutions. One barrier relates to the structure of existing masters courses which tend to run over one term or semester rather than being short intensive modules where it might be easier to organise exchanges of students.

- The pooling of teaching and of pedagogical tools: one option is for modules within existing or future Masters programmes to become more mobile (i.e. teachers to take Master's modules with them to other institutions for short periods, rather than asking students to attend different institutions).

- Information on training opportunities throughout Europe in S&T policy: It was noted that unlike the USA, for example, there was no single and comprehensive source of information of masters level training in S&T policy in Europe.

- Finally the development of an inter-institution PRIME Professional Master programme was privileged (see below).

Box 11. The European inter University Association on Education in Society, Science and Technology (ESST)

ESST runs a Masters in Society, Science and Technology in Europe. ESST has 17 member universities, is organised as a non-profit making association in Belgium, and has run the masters course for nine years.

The objectives of ESST have been to expand the study of science and technology by using social, economic, cultural and historical perspectives, and to address current problems and policy issues. The association has established a common framework for post-graduate teaching, as well as a number of specialised teaching programmes within the member universities. The teaching programme is based on regular meetings of teachers. It is designed to provide post-graduate training for academics of all backgrounds: social scientists, engineers and humanities scholars. Students study a common core course at their home university during the first semester, and then (most of them) travel to another university for supervision on specialised topics on which they write a thesis. More than 300 students have now been through this programme and have been awarded degrees within it.

The first semester course is outlined below. Here follows some examples of second semester specialisations which have been offered by some of the universities:

- Innovation Systems, Social and Ecological Change (University of Aalborg).

- Building and Maintaining Life in the Development Process (Istanbul Technical University).

- Systems of innovation, Public innovation policy and Innovation strategy (University of Linköping).

- Bridging the technological divide (Maastricht University).

- Technical change and the new economy: economic and social aspects (Maastricht University).

- Strategic management of technology and innovation (Universidad Autónoma de Madrid).

- Globalisation, innovation processes and innovation policies (University of Oslo).

- Innovation, regional integration and globalisation (Roskilde University).

- From theories of innovation to technological policies (Université Louis Pasteur, Strasbourg).

First semester

During the first semester all ESST students follow a common curriculum. They are taught at their home university. Teaching is provided by local staff, supplemented with guest lecturers from other member universities. The language of instruction is the local language. The course is organised around five themes:

(i) European problems of society, technology and science. The first module discusses different conceptualisations of the relationships between society, science and technology. Furthermore, attention is given to some of the important challenges facing Europe today.

(ii) Scientific and technological change in historical perspective. The second module offers an historical overview, with focus on the major technological transitions and scientific developments which have shaped modern Europe.

(iii) Science and technology in the making. The third module discusses the production of scientific knowledge and technology, and their institutional settings, such as the laboratory.

(iv) Globalisation and regulation of science and technology. The fourth module presents a spatial perspective on the economics and politics of science and technology, in the context of globalisation, localisation and regulation.

(v) Politics of knowledge. The fifth module addresses aspects of science and technology policy and related ethical, intellectual and philosophical issues.

"Prime" Professional Master

A European professional Master's programme could facilitate the training of prospective policy-makers in the European Research Area, both those at the level of the European Commission and the Member States. Although a variety of Master programmes exist in Prime Partner institutes, no networked Master exists as yet (like the ESST Master). It is felt that a European professional master programme is essential to realise common policies in the European Research Area.

The TN proposes that such a Master be operative for the academic year 2005-2006 and a pilot programme be developed. This could be done through a core group of half a dozen institutions with experience in such policy oriented training programmes.

The TN proposes that the development of the programme be co-ordinated by ESST, along the same principles as the present one-year Master programme. This means that a first semester be developed in which the core concepts and skills are presented, to be shared with all participating institutions. A second semester could provide for diversity, allowing specialisations to be developed at the European level. Students would therefore start in one institute, and have the option to do their specialisation at another Prime Partner.

In 2004 a planning group needs to be established, on the basis of the results of the Mapping Exercise mentioned before. The group will define the institutional setting, the educational aims and principles, the curriculum and the technicalities of diploma allocation. The Group will present its proposal for a curriculum towards the end of 2004, to be discussed in a larger circle. Definitive arrangements for the core-curriculum need to be agreed upon, and a set of pilot specialisations established, so the first group of students can be admitted in early Fall of 2005.

The Professional Master therefore should start one year before the Research Master.

The budget will include line items for at least 6 meetings of the planning-group, the development of about 8 training modules and the costs of a central training co-ordinator.

Virtual campus

The aim of a virtual campus is to make better use of *e*-learning facilities. Given the Prime network structure, it is relevant to consider the feasibility of creating such a campus. The TN therefore proposes to engage in 2004-2005 in a feasibility study of the virtual teaching campus, capitalising on the wide-ranging experiences of PRIME participants.

This will involve the following activities: Inventory and review of experiences among PRIME universities, inventory of expectations and wishes for a virtual campus, specification of requirements, assessment of selected cases, design atelier to produce sketched blueprint, and assess and report feasibility.

Short courses

Short courses are important because they allow public policy makers and practitioners to take some distance with their "every day life" (it is the same of course for university managers and research administrators). Another specific value is to allow researchers and especially those in charge of research teams, groups, units or centres, to get some input about Public research and innovation policies. Another important audience is made of students in management or engineering, for them to get some ideas of what is research and innovation.

How to see short courses? It is important to position clearly what type of short courses we, as researchers (and not consultants making it for a living), consider useful. Such courses should emphasise the combination of policy and societal challenges and background analysis and understanding (including longer-term dynamics). Our (simplified) message to the professionals would be that they could tell us about the challenges but would learn from us about analysis and understanding. While PhD students working on analysis and understanding would profit from being exposed to the discussion of challenges. The experience with the international course on R&D evaluation, with heterogeneous participation, supports the feasibility and productivity of this approach, but you have to work to reach the audiences and convince them (see box). Similar insights may be gained from the other short course with a Europe wide experience, that is the PREST course in Foresight (see PREST website).

Box 12. The Twente international course on R&D evaluation

> Originally (circa 1990) set up with a strong emphasis on R&D program evaluation, and taking professional practice of an R&D evaluator to structure the course. This is still visible, even if the topics discussed are now broader than programme evaluation (see draft course outline, in separate attach). The course is intended for people who want to be (further) trained for a professional career or have a refresher course, and for people in government departments and agencies who have to commission evaluations and read the reports. While we inform participants about methods, this is not what we train them in. Our goal is to enable them to design an evaluation study, conduct it, and report on it.
>
> The course is taught by an international team, and members of the team are available during part of the course, or the whole three-and-a-half days, for interaction over meals and in the evenings. Its success can be gauged by the responses of participants, and by the fact that we don't have to advertise widely to get 25 participants (the maximum for this type of course).

There was extensive discussion about short courses directed towards master students both at CSI and with Twente/Stellenbosch Universities (see boxes).

Box 13. The CSI Management and innovation cours for engineering students

> It is a full week course in Paris, the goal of this module is to give an introduction to the innovation process for 20 engineering students maximum. The week is organised as follows:
>
> - Monday: lecture 'Theory of innovation' (the main results of the social sciences on this topic)/conference with a practitioner.
>
> - Tuesday: morning lecture R&D in large companies, tools/afternoon: groups of 4/5 students have to prepare an enquiry/conference with a practitioner.

- Wednesday and Thursday morning: each group meets 10/12 people in a large company laboratory (interviews). The goal is to understand what is the research work, how a lab is organised, who choose the research topics, what is a R&D programme, what are the production of a lab, the network of Cupertino inside and outside of the firm…

- Thursday afternoon/Friday morning: each group prepares a report…

- Friday afternoon: each group give a paper + general discussion (2/3 weeks after the course a report is sent to each lab.).

The module was done with the collaboration of Rhodia (2000), PSA Peugeot Citroën (2001), Thalès (2003)… Each group met people in a different «lab» of the same large company. The main difficulty is to find a company not for a 'two hours visit', but for a two days enquiry in 4 different labs of the same company. The students meet around 50 researchers. The general idea is to combine: courses, conferences, field work (preparation of an open questionnaire, interviews, to write a report, to prepare a conference…). At the end of the week, the students get a theoretical and practical view of the R&D and of the innovation process in large firms.

Box 14. The Twente/Stellenbosch experience

- 'Managing/steering R&D from the top and from the bottom' – a three-and-a-half day teaching module offered by Arie Rip in an STS Masters at the University of Stellenbosch in South-Africa. Parts of this module have been used in other courses. The basic approach is to take the multi-level analysis seriously, and look at the different levels and their interactions. At present, it serves an academic audience, but it can be used to develop more dedicated courses for professionals (because it then includes overall understanding of the dynamics of research systems and policy and management games).

- 'Management of Technology in Society' – a teaching module offered in Twente (as a regular extended course) and in Stellenbosch. It introduces understanding of the dynamics of scientific-technological developments and their embedding in society into the question of handling/managing technology in society. Constructive TA is one concrete application. Dedicated courses for managers of RTD projects might be developed based on the EU-FP5 project SocRobust led by Philippe Larédo.

- 'Management in Higher Education' – a training course with several modules, under development by CHEPS/University of Twente. CHEPS has good access to university managers and administrators.

The recommendations are that short courses are important and that there are two directions a European level approach should foster: the first one is to support the emergence of subject targeted short courses, the second one being to foster the "transportation" of experiences so that they can be reproduced in different contexts (especially awareness courses for non specialist Master students in Engineering and Management).

4.6. Next steps

The reader will have noticed the very practical choice made by the group, to be selective about what should and what can be done, proposing a limited number of clear priorities for the establishment of a Training European Platform in science and innovation policy studies: (i) developing a multifaceted action for promoting PhD training at the European level (Doctoral conference, doctoral summer schools, mobility of PhD students, access to advanced specialised training modules), (ii) giving a clear priority at the Masters level by initiating a inter-institution professional Master; by promoting exchanges (more of material and teachers than students), and by studying the conditions for developing a research Master; and (iii) promoting short courses focused on practitioners (in the wake of the existing specialised courses on evaluation and foresight). This requires the support of a lasting "infrastructure" both institutional (via an enlargement of ESST?) and operational (studying the conditions of a virtual postgraduate school).

5. New Work Package 5 (ex WP6) on ST&I indicators and infrastructures supporting data handling

5.1. Overall development of the work package

The group held three one day meetings: December 13, 2002 in Paris, July, 9, 2003 in Pisa, and December 18, 2003 in Paris. It discussed its proposed research agenda in the Madrid Prime TN conference (January 2004).

The group was composed of a core group of members from ISI (J. Edler and U. Schmoch), OST (L. Esterle, G. Filliatreau, M. Zitt), Armines (P. Laredo), SSSUP (A. Bonaccorsi and F. Pierrotti), SPRU (B. Martin), CSIC (L. Cruz, I. Gomez and L. Sanz) and

UAM (P. Sanchez). B. Lepori and Crettaz Von Rotten (from the Swiss REPOL network) joined the core group.

Preparatory work done for these meetings led to a number of invitations based on specific issues that the group wanted to further discuss. Presentations were made by V. Mangematin (INRA), C. Lanciano and I. Recotillet (LEST), J.J. Paul and P. Moguerou (IREDU), T. Santos Pereira (CISEP), B. Poti and E. Reale (CNR/CERIS), N. Liron and D. Getz (SNI), A. Inzelt (IKU) and A. Ekeland (STEP).

The **first meeting** (Paris, December 2002) addressed the needs of policy makers (new indicators required) and of researchers (especially access to experimental DBs).

- For new indicators, the objective was: (i) to identify topics to be deepened, (ii) to map existing competencies in Prime network and more generally in the EU, and (iii) to identify tools and methodologies to be developed. The building of linkages between the scientific community, indicators producers, and stakeholders was also discussed. The following points for new indicators were discussed: indicators at 'regional' level, sectoral indicators, including emergent sectors such as nanotechnology and biotechnology, and innovation indicators.

- The second part discussed the needs of the scientific community involved in science policy research. Taking some existing 'research data bases', the discussion focused on the general conditions for building, storing and accessing data bases.

- The conclusions of the workshop highlighted the extent of the work to be done in order to effectively build a network of European indicators producers; it stressed the effort required (human manpower, duration and cost) to develop new indicators. The conclusion was to concentrate the work on a few highly critical new indicators which would demonstrate the usefulness of the creation of a European infrastructure.

The **second meeting** (Pisa, July 2003) aimed at deepening the question of data handling (accessibility, aggregation, and desegregation), especially for human resources. This meeting was organised just before the PSR workshop, so that it allowed participants to examine the conditions for building indicators that would give answers to important research questions in the PSR field. Two areas were considered central – indicators for university research and on human resources – while funding aspects were pinpointed as an important area to revisit in order to test the relevance of other approaches (at the meso level) for building EU level indicators. The discussion also considered articulation with other activities (and in particular, the different directions envisaged by the EC indicators unit).

The **third meeting** (Paris, December 2003) was dedicated to the synthesis and the deepening of previous issues: 1) the conditions and means for building a European platform for S&T indicators and a European network of indicators producers; 2) the conditions required for building a "European University Observatory", 3) the Indicators on emerging sectors and 4) the indicators on labour markets.

The **final Prime TN meeting** (Madrid, January 2004) allowed the group to report on the directions proposed, to draw conclusions and to identify the key priorities for the coming years.

Besides these core activities, two other aspects are worth noting:

- First, the working group has done an important identification effort, so that there is now a thorough knowledge of existing competencies in indicator production in all EE member countries.

- Second, thanks to an active participation in the Sofia UNESCO conference on S&T indicators, (November 2003), preliminary contacts were taken with most persons from candidate countries involved or interested in indicators production and use.

5.2. National comparisons of S&T indicators

National S&T datasets exist but they are often not very well known and not accessible at least for the scientific community and research policy makers. Databases are built on the models of the Frascati and other OECD manuals but they have several disadvantages:

- they widely differ in the way they are collected and aggregated at the national level;

- they mainly concern input indicators but not output indicators, not allowing the comparison of the efficiency of research policies among countries;

- the OECD rules are not systematically applied in some countries (in the EU, this is especially true for some candidate countries).

This leads to a situation where even for well known input indicators (such as expenditures, human resources) the comparability and the aggregation are very difficult.

The WG identified needs for: (i) the identification of primary sources (there were long discussions about how to do an inventory) and (ii) the critical assessments of DBs to evaluate their comparability, and address the issue of the adequate level of their aggregation. What came out from the given answers was to consider the work as being a "structural" one, in the sense that it requires data producers and/or direct users of these data producers to network and discuss/compare their respective practices.

It thus requires to get into details of data collection, handling and aggregation of indicators in the different EU countries. The objective is not to foster an homogenisation but to master conditions for comparison and to define the adequate level of aggregation at national level that will enable wider aggregation at the EU level both globally and on the main indicator driven issues. This is why the group considered it is central to network EU indicator producers first in an extended thematic network with clear goals about a "qualified" inventory of datasets and indicators, and about experiments on already well established indicators to strengthen the knowledge about comparability and aggregation. The question of public funding has been considered as being one of the most essential to be addressed in the following years.

Are the chances of success real for such a network since the OECD and Eurostat did not succeed in doing it? We think so for two reasons. The first reason lies in the relationship with data collection systems. The purpose is not to collect data but to identify questions that are scientifically defined and go from there to characterise useful datasets. These datasets do not need to be fully exploited as such at the national level, but they need to be developed in order to enable comparisons and aggregations. Cupertino with statisticians is thus essential to be able to identify existing data and the conditions to build such datasets. It will be strongly helped if Cupertino with policymakers recognises these as a policy priority. The general idea is thus to be able to develop strong arguments and to prepare requirements in order to make data collection systems evolve at the national level. The second reason deals with output data (scientific publications, patents, …), for which several databases of international data exist and where the question of comparability of analyses should be easier to deal with. It is eventually towards that direction that a possible network should structure itself, especially to face the growing need for evaluations of public policy

5.3. Critical issues requiring new indicator developments

The problem encountered when dealing with overall comparisons for supporting policymaking should not underestimate the problem faced by researchers when they are in need for developing quantitative analyses of new issues addressed. As highlighted by V. Mangematin in the following quote: "One of the main problem is to describe the current situation and the environment of the firms, of the organisation or of the networks to define a relevant strategy in a complex environment. Indicators suppose an agreement on the aim of the study and on the point of view. Researchers in industrial economics (including economics of innovation) and researchers in strategic management need to be able to elaborate their own indicators based on accessible primary data. In the present time, the only way to produce new knowledge is to make a new survey. This is costly and most of the time, the relevance of such survey is limited because of its imperfect coverage. Thus, primary data covering the evolution of economic sectors (including emerging sectors like NTIC or biotech), scientific fields like life sciences, biotechnology (including emerging fields like genomics or proteomics), public policy and public policy tools (general ones and the ones dedicated to specific areas like biotechnology) are essential for social scientists to be able to define, to implement and to evaluate strategies for growth and employment."

When researchers in the US develop a new indicator (adapted to new policy issues) on an experimental basis, its generalisation is "only" a question of up-take and extension. In Europe on the contrary, extension is at best national and there is a long process of negotiation that usually takes one decade before … the OECD proposed set (generally derived from the US one) is adopted.

There was an agreement that the pace of innovation as far as indicators were concerned had dramatically slowed down in the last decade and that it was important to launch a significant research programme. The list of issues raised was paramount. It has been gathered under 4 main topics:

- indicators of overall dynamics;
- indicators linked to innovation dynamics;
- indicators related to the research workforce;
- improvements in scientometrics.

A fifth point was raised about next steps on 'centres of excellence'.

Indicators of overall dynamics

Three main issues were identified by the working group:

- How to develop so called "systemic" indicators focussing on the connections, relations, synergies between components of national system of innovation.

- Which relevant geographical reference at the European level: how to take into account regions? How to deal with countries that have the size of regions? How to identify and analyse "research and innovation" poles or clusters?

- How to develop indicators that are specific to public sector research, such as the balance in public funding between core and competitive funding, or the public investment in research partnerships.

They are further elaborated in the boxes below.

Box 15. Development of systemic indicators

Policy exercises at the European level increasingly rely on comparative indicators at EU-wide (and some other countries, notably US and Japan). However, an over reliance on the simple comparison of figures can often hide important contextual information that characterise those same figures. Besides the wider diversity across EU Member States in relation to their research and innovation systems, individual indicators often reflect specific institutional structures and dynamics, which are not reflected in existing performance indicators. Furthermore, the boundaries of the systems also limit quite diverse structures which are often not comparable. Are countries always comparable units, or only for specific indicators? Are regional levels (as well as limits) similar or should other boundaries be drawn for indicator development? These issues are particularly important for comparison purposes and often relate to policy structures and their dynamics. The institutional histories and policy trajectories of different systems have important implications in related indicators. For example, the definition of a post-doc varies greatly across Europe. Such definition has implications in indicators relating to the scientific workforce. If the diversity across systems can be better characterised this will allow that existing indicators, as well as the development of new ones, provide greater insights in comparing and benchmarking systems. It can also contribute to groupings of research systems that are drawn with different boundaries for different sets of policy objectives to ensure greater comparability of experiences, and that do not simply go along the traditional dimensions of size or geography.

Box 16. How to develop a European S&T geography

> The existing diversity of European countries has an impact on the harmonisation of S&T indicators across Europe and on the interpretation of Europe wide exercises. It is necessary to take into account the dynamics of policy structure, and the diversity of the European research and innovation systems, of the size, history and culture of the European countries. One major issue will be then to build the pertinent RDI space in Europe: to establish criteria to rebuild geography (allowing comparisons between European countries, European regions). The specific situation of the new member states has to be particularly taken into account.

Indicators linked to innovation dynamics

Problems that were identified are the following:

- what kind of indicators other than patents: can marks act as innovation indicators?
- how to take into account the "intellectual capital" of firms;
- how to match company/industry databases with S&T databases and indicators;
- how to develop indicators for innovation in the "service" industry;
- how to follow emerging, not yet established industries (e.g. biotechnology);

Box 17. Indicators for innovation in services: marks as indicators?

> Innovation is not only based on scientific and technological activities in manufacturing sectors, but is also driving competition in services. The analysis of services is difficult, due to a lack of appropriate statistical data. In this context, service marks prove to be an interesting novel indicator, showing a significant correlation to innovation. They allow the examination of structures and specialisation in service sub-sectors, in particular with regard to knowledge-intensive services. Furthermore, it is possible to analyse the area of product-accompanying services in more detail. The recent introduction of European marks has considerably improved the opportunities for country comparison. As the use of service marks as an innovation indicator is still in an early phase, it will

be necessary to get more experiences with regard to sectors, countries, and offices of registration.

Box 18. Issues about the match of different data sources

The matching of different data sources also requires major methodological developments. The analysis of the economic dynamics in Europe needs, among other things, to be based upon micro-economic, company specific data matched with S&T indicators and public policy indicators, defined with comparable level of aggregation (sectoral, geographical and temporal). However, due to increased merger and acquisition activities, especially across borders and including extra-European companies, the attribution of R&D activities to single companies and – in aggregate – countries – is more and more difficult. Due also to different level of public interventions (local, regional, national and European), the consolidation of data on public policy measures is uneasy. Without forgetting the above mentioned problems, specific focus on the best ways to match these different sources is required to allow a better understanding of intra-European flows and their articulation at the international level. This also requires an important methodological work, especially in cross-assessing existing sources and the "smallest level" at which data could be matched.

Box 19. Emergent S&T based industries

There is a need for coherent and relevant indicators for emerging S&T sectors (e.g. biotechnology, nanotechnology) and scientific poles and to build temporal series to perform longitudinal analyses. One of the main problems with emerging sectors such as biotechnology is the definition of coherent and convergent indicators across different fields: economic fields (enterprise, innovation and R&D survey as well as financial linkages etc.), S&T indicators (publication, patent, coherence and divergence of knowledge base) and finally public policy (direct and indirect public policy). It is also important to identify the linkages and their evolution amongst the different fields, economic, S&T and public

Box 20. How to build relevant indicators of "intellectual capital"

> There is now a wide agreement on the idea that the resources and activities related to knowledge management may be gathered under the umbrella of "intellectual capital". This intellectual capital is made of resources (stock variables) and activities (flow variables) related to human capital (mostly tacit knowledge, difficult to be held by the employing institution); structural capital (part of codified knowledge; databases, software, IPR's, RD activities...) and relational capital (agreement with other institutions, marketing expenditures, relationship with suppliers and customers...). More in depth research is needed to learn how to reflect adequately all these issues in indicators and the types of resources. These indicators would have two types of end users; first, the managers of the institutions; second, all interested stakeholders (policy makers, capital markets, funding organisations, employees...)

Indicators and data sources about the research workforce and the emergence of a European job market for researchers

The construction of the European Research Area lies on the mobility of the workforce, especially of academics. However, this objective cannot be reached directly taking into account national specificity which slows down temporary and permanent mobility of researchers. The objective is to build statistical tools to understand career paths and professional trajectories of academics within each country and across Europe. Such database should be built for academics as well as PhDs. The expected shortage of trained scientists in the next few years pleads for an open tool for academics and PhD to evaluate the determinants of scientific trajectories within and outside academia. For this question, surveys and tools aimed at tracing scientific careers must be tackled.

As an example, two types of surveys could be implemented in a comparative way: tracer studies of young graduates and longitudinal surveys of researchers recently admitted in companies and public labs. These two surveys are complementary and respond to different questions. Tracer studies can allow assessing the training policy. Surveys with young researchers can allow to study the policy of companies for the recruitment (preference for specific degrees, experience or nationality) and for career paths within the company

Scientometrics

One central area of improvement has already been mentioned but should be highlighted: it deals with the correspondence between classifications. There is already on-going work on articulation between science and technology, and between technology and industry. The issue, however technical it may look is of paramount importance.

There is a lot of room for “improved” bibliometrics (see main points identified in box). But there is also a far more fundamental issue about Europe devising another data source taking more into account the diversity of European activity.

Box 21. Improved bibliometrics: a short review

- At high-level, disjoint classifications in large academic disciplines are suitable for long-term "macro-"comparisons; at low-level micro-studies rely on document selection by bibliometric-mining techniques, which benefit from recent advances in data-mining tools; but at the intermediate level, midway between these rationales, the classification problem is rather unsettled, with derived issues of field-normalisation procedures.

- Human and social science (HSS) is rather heterogeneous, and publishing habits are quite different in the related disciplines. Articles do not necessarily represent the main mode of communication (role of books in some areas). Moreover, ISI databases (SSCI, A&HCI) show a very strong US bias that completely jeopardises international comparisons. Nevertheless they can be exploited in some disciplines, such as psychology and economics, with proper warnings (e.g. SSCI-economics is much more selective than Econlit). All other HSS disciplines need a particular assessment, especially with respect to European production. A systematic experiment is currently carried out in France to list the journals representative of national production. Comparisons with other European countries would be interesting.

- Scientific communication increasingly uses the web channel. Bibliometric techniques have been hastily transposed to networks of web-sites/pages especially academic ones. This extension is based on the analogy between web-pages and documents - and between citations and hyperlinks. At this time, qualification, calibration and selection of data are imperative, and it is not clear whether this chaotic and unstable web data-warehouse can help the construction of robust indicators.

Mapping of excellence: next steps?

This was complemented by a debate about the work done on centres of excellence which requires a thorough assessment on the definition of excellence, the definition of centres, and the approach used (ranking vs. profiles). At the same time this was taken as an example where indicators-developers and producers should improve their methodologies and also their pedagogy in order to discuss more efficiently with decision-makers.

Box 22. Comments made by the group on the EC on-going exercise (December 2002)

The identification of excellence has become an issue of central concern for policy-makers world-wide, and within the European Union. This has implications both for policy initiatives (such as the development of 'centres of excellence') and for related indicators (as shown with the current experience with the 'mapping of excellence' exercise). Currently a pilot study is under way to develop a methodology to map excellence in Europe in order to define centres of excellence throughout ERA.

These initiatives are an important and promising area of research. Different issues need further research. First, how can excellence be identified and what type of indicators can be used? Can traditional indicators such as publications in the SCI be used as the sole element of excellence, when the production of knowledge is said to be changing, according to some authors?

Second, the definition of units of analysis is crucial here. The identification of centres of excellence relies on the definition of a centre. But what is a centre in current networked research? It can refer to single institutions or to networks of institutions, larger or smaller, with limited or broader missions. These characteristics are often related to the institutional characteristics of the local research system, or as mentioned in the above considerations, to its context.

The mapping of excellence can be translated in different ways, in terms of geography – local poles –, of linkages - centres of a network -, of the attraction exerted on others.

It seems clear that the challenge ahead is to develop indicators, particularly at the micro- and meso-level, that can contribute to the characterisation of excellence according to different vectors of analysis, rather than to identify institutions that conform to specific criteria. This relates to different functions, and different objectives of research, that can be identified for a given unit of analysis, and that therefore can provide its 'profile of excellence'. It also relates to addressing excellence in relation to available resources. These two aspects are particularly important for a dynamic perspective over excellence. There is a crucial need to go beyond a static characterisation of the distribution of excellence according to one definition, and to contribute to recognise and integrate the different research activities and to identify the EU potential accordingly.

5.4. Priorities for coming years

Building new indicators requires both support from research to develop the conceptual framework and the methodological background, and extensive involvement of data/indicator producers to develop operational gathering and treatment methods that allow for aggregation at the European level, this latter point being crucial in the experience. It means that the usual process where there is first a local experience cannot work, and that the prototype/demonstrator must already operate at inter-country level. It also means that there must be "political" support (translated into financial means) of the topic selected; Said otherwise, such an experiment has to be linked to present (and hopefully lasting) EU priorities.

The different directions envisaged by the EC indicators unit were analysed as one way to express EU priorities. The conclusion was that the calls envisaged left little opportunity else than "business as usual", especially on critical topics such as human resources or indicators of university production. So that no short cut was really visible at the end of 2003 for a meaningful experiment, leaving the present fragmentation prevailing.

We were then left to an internal definition of the actions which should be given priority at the European level. We did so, taking into account the needs expressed by science policy makers (PRIME members being a privileged source thanks to their on-going relations with them) and the existing competencies available. This drove to emphasise **three priority areas and two complementary activities**.

1) The building of a **European network of indicators producers** in order to gather existing competencies and prevent fragmentation. The integration of

such a network into a more vast research network on science policy is a requisite if we want the network to succeed, to develop itself and to reach its goals.

2) The development of a **full-size experiment** as a major support to the concrete building of this network. An agreement was reached, considering that the question of **government funding** was a central one in a short-term context.

3) The concentration of new indicator development for the coming years on two major questions:

   - the emerging sectors, not only because the need is strong in this area but also because they are becoming remarkable case studies in order to address the few issues discussed in the TN: especially innovation dynamics and development of bibliometrics;

   - human resources, and especially a better knowledge on young researchers career paths, which becomes a major challenge while building the ERA.

Next to those priorities, two complementary activities were judged critical for building the European research of tomorrow:

4) The preparation of an "observatory of the European University" in order to support universities in the elaboration of their R&D strategy, and give the possibility to self-evaluate/benchmark their competencies and their efficiency in R&D. This action clearly requires an exploratory phase before any development can take place.

5) The support to new and incoming members to identify and reinforce their capacity in building S&T indicators.

If we are to answer to the evaluation requirements and the research and innovation policy follow-up requirements, it would be essential that, in the coming years, those priorities are seriously looked at by the science policy and S&T indicators community as well as by policymakers, both at the national and European levels.

6. Work Package 6 (ex WP7): the design of a forum for strategic intelligence in research and innovation policy

6.1. Positioning the "forum" activity

Interaction with stakeholders is a day to day work of most teams involved in the field of science, technology and innovation policy. Most of the specialists in the field participate in numerous working groups that policy makers, especially at the EC level, organise. They are also often involved in the numerous working groups and events that OECD organise. Many enter contractual arrangements with policy makers, undertaking tailored surveys, studies and research work. There are also a number of 'thematic networks" developed under the EU STRATA framework that specifically aim at organising relationships. One could add to these, the 'upgrading' of stakeholder capabilities with the professional short courses developed by some teams at the European level on specific topics (with the two well established courses on evaluation in Twente and on foresight in Manchester).

These remain in the classical frameworks of 'dissemination', 'expertise' and 'advice' (not to say consultancy), for which there is even the development of good quality consultancy firms (most of them being de facto 'spin-offs' of academic research labs).

This is however not enough to cover the spectrum of stakeholder involvement. In particular it does not address one feature which turns more and more central in the construction of policies, that is the wide enlargement of 'concerned' parties and the multi-level nature of public intervention. This was highlighted in a previous thematic network (ASTPP) and it was felt that, besides research issues raised (and progressively shaped in WP2, see section III.), there was a need for more practical orientation and the exploration of the feasibility of a new approach. Thus the focus of this very specific work-programme on "the design of a forum for strategic intelligence in research and innovation policy".

6.2. Overall development of the work package

At the inception, an internal debate took place about the ways to undertake a review of existing practices and experiences. It was decided that the best approach was to have an extensive background paper produced by the WP leader to support discussion (ISI, S. Kuhlmann and J. Edler). A preliminary draft gave rise to a discussion meeting (December 3, 2002) between ISI, Armines (P. Laredo) and the University of Twente (A. Rip). A fuller version was then issued by ISI and discussed in the Paris meeting (January 2003, 15-16). The discussion drove to a third version which was considered as a "targeted state of the art" which is presented in the next 3 sections. The PRIME TN Core group meeting (Karlsruhe, April 2003) pushed the promoters to go beyond the argumentation and to design and make a concrete proposal for a full size experiment. The aim is to define the conditions for a feasible experimentation that would demonstrate the interest of building a quasi European facility. This was prepared by the ISI team and discussed at the Madrid meeting. The conclusions are presented below.

6.3. Rationale: Why do we need a complementary organisation of interaction?

1) In research and innovation (R&I) *arenas* or *"spaces"* of policy-making – in particular arenas characterised by multi-level, multi-actor governance – negotiation is at the heart of decision making. The actors negotiating have different responsibilities, pursue different and often contradictory interests, have different kinds of resources at hand, represent different stakeholder perspectives, refer to diverging institutional 'frames' and construct different perceptions of 'reality'. Given the different power structures, the shape of arenas may vary considerably across national states, regions or issue areas. Under such circumstances, normative R&I policy rationales are employed as one among several means of acquiring legitimation, and 'successful' policy-making means making compromises through 're-framing' stakeholder perspectives and the joint production of consensus: In arenas or spaces of emerging and recognised intermediation, actors communicate, translate information and appropriate knowledge from others, thus preparing the ground for policy-making and decisions.

2) Given that R&I policies are to be developed under increasing complexity and uncertainty, they are also tending to become more evidence-based and increasingly rely on scientific and analytical input provided by sources of *strategic intelligence*. We define 'strategic intelligence' as a set of sources of information and explorative as well as analytical (theoretical, heuristic, methodological) tools employed to produce useful insights into the actual or potential costs and effects of public or private policy and management. Over the last two decades, considerable efforts have been made to improve the design and conduct of effective R&I policies to analyse past behaviour (evaluation), to review technological options for the future (foresight), to assess the implications of adopting particular options (technology assessment) or to compare different practices (benchmarking). Strategic intelligence is being produced both by *research-based* groups (like many PRIME members) and by an increasing

number of *semi-public specialised* institutions like the Dutch Advisory Board for Science and Technology or the European network of Scientific Advisory Bodies (EURAB).

3) Both *non-traditional arenas or spaces* and related *strategic intelligence* exist within a wide variety of institutional settings and at many organisational levels (see for instance the case of the German Futur process, **box..**). This situation involves both positive and problematic features. The diversity and the bottom-up character of initiatives may be seen as a source of creativity and innovation. On the other hand, many initiatives are weakly inter-linked and are not easily accessible even between member states. In a previous project[24], several PRIME members have highlighted the need for an architecture and infrastructure of *distributed intelligence* which would allow access to these multiple spaces, create inter-operability across locations and types of intelligence, limit the public cost and strengthen the 'robustness' of intelligence exercises.

Box 23. The German "Futur-Prozess", an attempt to create a new "space"

> The German foresight process called "*Futur*" is run on behalf of the German Federal Ministry of Education and Research (BMBF) as an attempt to create a new "space" for priority-setting with respect to future innovation-oriented research policies. *Futur* is oriented towards the identification and inclusion of societal needs in future research agendas. "Lead visions" (*Leitvisionen*) are supposed to be the major outcomes of the process which shall be translated into funded research programmes or projects. The participation of people from research, industry and other societal groups – including "non-experts" – in various kinds of workshops and the combination of different communication and analytical methodologies are key characteristics of the process. *Futur* started out in 2001 and has been generating priority suggestions for ministerial research funding until the end of 2002; afterwards the process may be re-iterated.

[24] Kuhlmann, S. / Boekholt, P. / Georghiou, L. / Guy, K. / Héraud, J.-A. / Laredo. Ph. / Lemola, T. / Loveridge, D. / Luukkonen, T. / Polt, W. / Rip, A. / Sanz-Menendez, L. / Smits, R. (1999): Improving Distributed Intelligence in Complex Innovation Systems. Final report of the Advanced Science & Technology Policy Planning Network (ASTPP), a Thematic Network of the European Targeted Socio-Economic Research Programme (TSER), Brussels/Luxembourg 1999 (Office for Official Publications of the European Communities) (www.isi.fhg.de/ti/Final.pdf).

Futur is intended to introduce "fresh ideas" into the research-funding portfolio of the BMBF, by way of opening up the traditional mechanisms for agenda-setting and prioritisation. The conventional process is characterised by a close and rather intransparent interaction in "old spaces" between research institutions, industry, programme agencies (*Projektträger*) and ministerial bureaucrats in charge of research funding. Strategists within the ministry were increasingly concerned about the risk of *missing important new issues on the funding agenda if it were solely made up on the basis of traditional mechanisms*.

Futur is directly linked to BMBF priority setting. So far four "Lead Visions" (Leitvisionen, desirable visions for the future) have been worked out in such a way that they can be directly translated into projects or programmes: "Create Open Access to Tomorrow's World of Learning"; "Living in the Networked World: Individual and Secure"; "Healthy and Vital throughout Life through Prevention"; "Understanding Thought Processes".

The participation of persons from outside BMBF (experts and "non-experts") is a crucial component in order to bring in new ideas and link them with BMBF programmes. The outcomes of *Futur* are supposed not only to be linked with disciplines and technologies, but to be *more systemic by character* and interdisciplinary by nature. This implied that the exercise had to be more need-driven and problem-oriented, but at the same time open to future developments.

6.4. What fora should be – and do

In order to help meet these new requirements for advanced interaction, experiments should be developed to *stimulate and help to establish issue-driven 'fora'*. A *forum* should have mediating and facilitating functions, supporting the articulation and debate of structural issues of R&I policy, the mobilisation of distributed strategic intelligence, and the establishment of new interactive 'spaces'. Such fora should thus add value to existing R&I policy-making approaches, meaning that they should operate in a complementary manner not as an alternative, taking full advantage of the heterogeneity of European interaction.

The first fora should be designed as 'collective' experiments aimed at the identification of robust models of interaction. These experiments will first seek to integrate relevant multi- and inter-disciplinary *analysts*. However, analysts are only one group of actors concerned with research and innovation policies. The experiments should thus also actively involve *policy makers* from the regional, national and European levels as well as *societal groups* (like NGOs) and economic and scientific stakeholders. Through a systematic organisation of various complementary channels of exchange, the experiments will aim to bring together actor groups who have been working in parallel but not together.

Through previous work, PRIME members have identified several concrete requirements for the operation and design of such experiments. The first one is the development of an 'infrastructure' that allows for multiple vertical and horizontal links across regional, national, sectoral, and transnational facilities (*networking* requirement). It requires *active nodes* that foster access by all stakeholders to key resources (e.g. a 'foresight bank' or a 'directory' of concerned actors). This access must be *transparent* (i.e. based on clear rules especially when it is not free of charge) and information provided must answer to *quality standards* (this raises a difficult issue about such certification and/or accreditation that experiments will try and address). Finally a critical factor of success lies in its durable establishment and its independence (requiring both *public support* and clear rules about its allocation).

In order to give a more precise image of what is meant, Box 24presents a fictional case illustrating how such fora in the future may contribute to the mobilisation of distributed intelligence and the creation of new spaces.

Box 24. "Multi Inno" – a fiction in the year 2007

In the year 2007 a forum on "New governance of multilevel policymaking for research and innovation (MultiInno)" is in existence and supporting new policy approaches.

MultiInno is facilitating interaction, information exchange and "co-operative competition" amongst Europe's leading high-tech districts (e.g. biotech districts like "Oxbrigde", Munich, Paris), linking industries, research organisations, local, regional, national and transnational policymakers, NGOs.

Distributed strategic intelligence (e.g. foresight exercises, evaluation efforts) has helped to identify district's specialisation patterns, market prospects, complementary strengths and weaknesses, NGO concerns, insights into the needs for multilevel policymaking, including a change of legal frameworks and for public policies reshuffling related institutions and governance mechanisms.

In order to achieve effective policy concepts, MultiInno participants have established new ”spaces” for co-operative competition of diverse actors, coping with identified issues, e.g. EU-wide public-private working group on public support for complementary specialisation of biotech districts, thereby drawing on strategic intelligence.

A backcasting effort reveals that the successors to the PRIME TN network have contributed significantly to the emergence of MultiInno by its following activities in 2003-06:

- Provision of a summarising analysis of actual multilevel governance impact on hightech districts

- Stimulation of a major conference, including actors from hightech districts, followed by a series of targeted workshops with diverse actors (industry; regional, national and EU policymakers)

- Initiation of a targeted foresight exercise (co-funded by selected districts)

- Provision of training schemes accessible for young key regional R&I policymakers.

It should be a major objective of the coming years to develop at least one experiment on an emerging theme to learn from it, relate it to the analytical context of multi-actor arenas or spaces, and propose further steps for wider implementation, the latter depending upon available complementary sources of funding.

6.5. Directions for a first implementation

The core group of PRIME TN having asked the group to be more practical and to design the conditions of a first experiment, the group presents his views on how to develop it (section II.), this being prepared by a review of existing “forum-like” experiments, the initiation of the experiment (section I.) and accompanied by a complementary experiment on the possibility of supporting research & innovation policy related expert-stakeholder networks, like the “Science Policy Network” (section III.).

A review of forum-like approaches

In order to develop, monitor and spread the results of a first experiment, it is important to take hold of existing experiments, develop a joint conceptual framework and involve as many as possible of specialist teams in our field. We thus foresee two actions for this review.

The first action will progressively develop a *Thesaurus* of forum-like concepts, the activities undertaken by related organisers and the role of strategic intelligence. To analyse the features of the forum concept, it is best to start with what we already have in Europe and elsewhere. As a starting point, a *seminar on selected experiences with forum-like experiments* (like consensus conferences, participatory foresight exercises,...) will be organised: Organisers of related exercises will be invited to report on their concepts and managerial experiences. The aim is to identify central conceptual and managerial issues, as well as good practices, to be gathered as a first input into the Thesaurus. In the medium term the Thesaurus will include details of the nature and function of different fora, and the individual and institutional competencies associated with them (in particular, the strategic intelligence offered by researchers or semi-public institutions). We suggest that the *Institute for Prospective Technology Studies (IPTS)* acts as the host and organiser of the Thesaurus. We expect that the realisation of a first pilot version of this Thesaurus should take 18 months.

In parallel and based on an analysis of the first Thesaurus inputs – and in order to make the Thesaurus a *learning database* – a Forum task force will explore conceptual issues about the functioning of fora. Based on a *comparison* and *assessment* of existing fora-like activities, it should help better understand the preconditions for, and characteristics of, effective fora, and may be develop *guidelines* regarding the shape and functioning principles of fora and the characteristics of the issue area they are addressing (in terms of the actors involved, the nature of the issue, the specific demand for discourse)[25].

Organisation of a first forum

The first experimental forum serves at least three purposes. It must be exemplary and visible, meaning that the selection of the issue addressed is important. It must help us to devise robust solutions, meaning that at the same time we experiment we also need to be reflexive. It must define a clear target for further developments: our choice here is

[25] These elements should build stepping stones for dedicated modules in the professional teaching and traing courses discussed (see section 34).

first and foremost to serve other networks of excellence, meaning that we position it well in advance of first materialisation, in the emergence stage of potential problems.

General structure and activities of first forum

A Forum *task force* will be set up consisting of members with demonstrated expertise in the field. Its role is to *define major issues in the area concerned* to be tackled in an open and transparent manner, including bilateral and multilateral consultation with stakeholders. These issues will be tested and focused with a *small survey among major stakeholder groups* across Europe and accompanied by further analytical work within the PRIME network. For the process of defining or testing the issues, we shall consider to utilise the novel 'policy laboratory' of the Copernicus Institute at Utrecht University. This is an ICT-based decision-support system that assists consensus development and mediation for heterogeneous groups and is especially geared towards innovation and innovation policy issues. The combined results of the various issue-defining exercises will support the development of *Internet discussion fora* and the organisation of a series of *focus groups* and *targeted workshops with clearly defined membership.* By the end of the first work-programme, we expect a first set of *recommendations* – or specified problem areas – to be formulated. These should help focusing the debate and assessing the degree of robustness of proposals made.

Forum (Bio-) Nano-science and nano-technology

At a PRIME TN Forum working group meeting (Utrecht, December 11/12), after an intense discussion, the following candidate theme has been favoured: *Societal aspects of new emerging science and technology – Focus on (bio-) nano-science and nano-technology*. There is no doubt that new technologies categorised as "nanotechnologies" are getting ground; the potential for all kind of breakthrough innovations appears to be enormous, e.g. taking publication and patent applications as an early indicator. Europe holds a good position in nanoscience and nanotechnologies so far (see Box [26]).

The history of biotechnology and of genome research tells us that we should anticipate on other new emerging technologies. Such is already the case in the US for nanotechnology. The network will consider whether it would not be a unique opportunity to foster debate at the EU level. Nanotech is about phenomena and manipulations at the nano-scale, and thus an umbrella term for a variety of mechanisms and techniques. It

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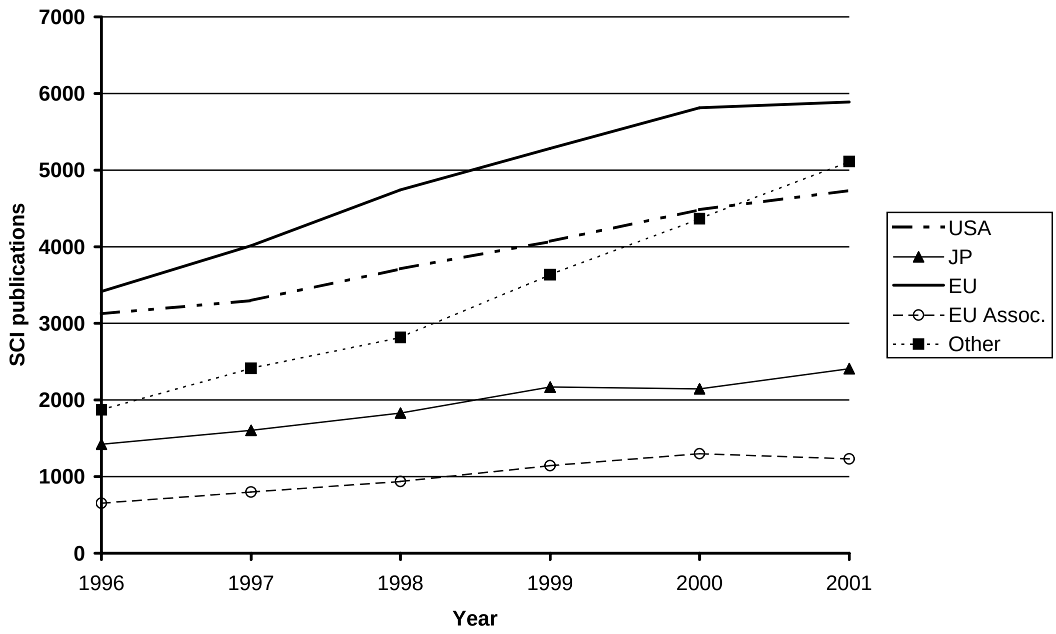
[26] Data drawn from E.C.M. Noyons, R.K. Buter, A.F.J. van Raan, U. Schmoch, T. Heinze, S. Hinze, R. Rangnow (2003): Mapping Excellence in Science and Technology across Europe, Nanoscience and Nanotechnology, Brussels (EC-PPN CT-2002-0001).

carries promises (hype), up to the idea of a new industrial revolution for the 21st century. There are now also actors voicing speculative concerns – which shows how strong the repertoire (expectation) is that there will be opponents to a new technology.

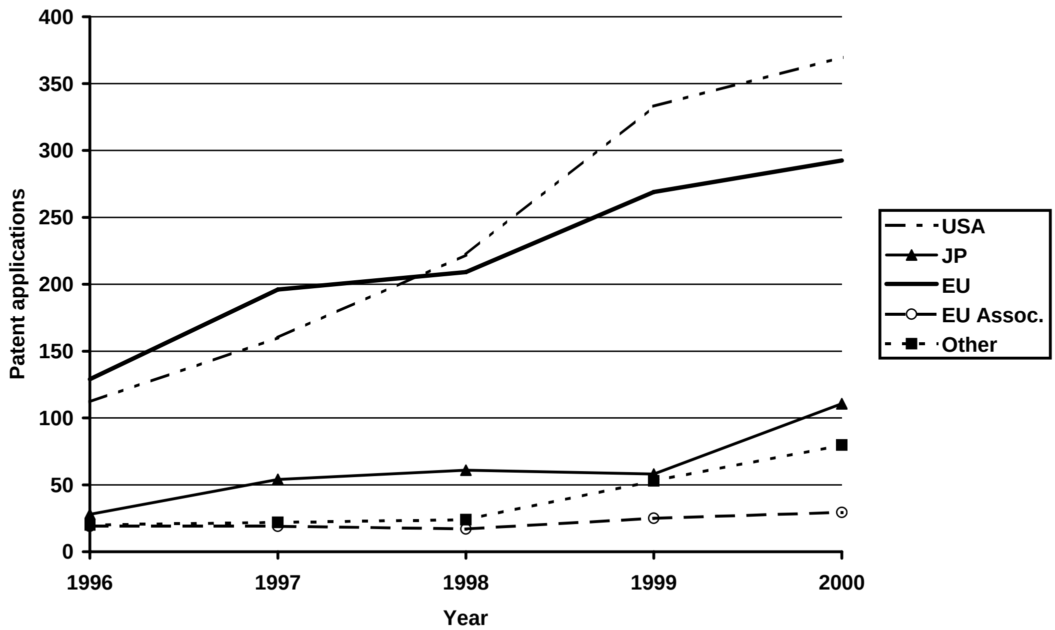
Nanotechnology (whatever it is) is still at an early stage, which implies that it lives on promises rather than actual performances. In addition, the promises of nanotechnology have to be realised through their uptake in other products and. Its impact depends on what happens there, and is in that sense co-produced, even if one might consider that is nanotechnology which has made the difference. (Thus, the well-known problem of attribution of impacts to earlier actions.) The analysis must therefore focus on expectations and how these evolve and set an agenda, and on the parallel emergence of alliances and networks and how these support particular directions of development.

Box 25. Publications and patent applications identified by the search term "nano" in the Science Citation Index (SCI) and in the World Patent Index WPINDEX (STN), 2002; Source: CWTS/Fraunhofer ISI

SCI publications, computed by CWTS Leiden



EPO and PCT patent applications, computed by Fraunhofer-ISI



The focus of the forum should be on *ethical, legal and social aspects (ELSA) in public programmes* promoting nano-science and nano-technologies (see box below on possible entrance points). There are major funding programmes e.g. in the Netherlands and France, and also the 6th EU Framework programme, which contain significant ELSA elements: How are such ELSA issues taken up on the project level? How are they operationalised? What kinds of future scenarios are inscribed in the ELSA projects – technologists' or stakeholders' hopes and concerns? Could Constructive Technology Assessment procedures help to make ELSA approaches robust and effective?

The following working steps will be initiated by the Forum task force:

- Task force organises a short *survey* of relevant programmes with relevant ELSA elements.

- Based thereon *key actors* (projects managers, policymakers, programme managers, organised stakeholders, including NGOs) will be identified.

- A first *brainstorm* with key actors and PRIME members will be held, presumably using the Utrecht Policy Laboratory, specifying relevant topics and issues.

- A *guideline for robust, learning-oriented ELSA initiatives* in the area of publicly funded nano-science and technology-development will be drafted, debated, refined, and finally published – as a stakeholder-relevant product.

- *General lessons* will be derived from this experimental forum initiative for other forum activities.

Box 26. Three possible entrance points for a FORUM experiment on nanotechnology

Not only is nanotechnology an umbrella term, under which a large variety of sciences and technologies, actors and interactions, interventions and concerns are present even for more clearly articulated technologies it also makes a difference whether one focuses on dynamics of emerging trajectories, on issues or on actors when making selections in setting up a FORUM experiment. Knowing the differences between the entrance points allows better design of FORUM experiments and their evaluation.

Areas (within nanotechnology) and emerging trajectories

Based on the idea of 'endogenous future' (which can be traced, see CTA, SocRobust) and emerging irreversibilities as the basis for building socio-technical scenarios (by the analyst) which are input into reflection and articulation of strategy of nanotechnology actors. These techniques (of the analyst, and of how to set up and do workshops) together can be seen as a 'support system', even if it is not a decision-support system.

Dynamics will be different in different areas, because of their configuration and links. Also, different issues will be raised. For example, the difference between nano-machines, nano-materials, and nano-diagnostics (and other bio-nano). The issue of a moratorium is on the agenda for nano-machines (and for human enhancement), but not for diagnostics. For nano-materials there is little concern (except health and environmental risk of nano-particles), but there is a curious distancing with respect to regular materials science going on ("we are new and different") which may create problems in realising actual innovations and their uptake.

Types of issues raised, or to be raised

Risks (to health and environment): at the moment, only nano-particles are considered under this issue. Nano-robots and grey-goo scenarios are considered speculations.

Moratorium (for ethical and/or political reasons, or to create a space for experimenting and learning): can be discussed generally. Concrete proposals for US military development, for human enhancement.

IPR and new 'divides' between those who have and those who have not access to nano-tech.

Social and ethical aspects, how these can be articulated (on the basis of social-science fiction about impacts?) and given a place. ELSA components in nanotech stimulation programmes (required or own initiative) are an interesting entrance point.

Actors

First, setting up a FORUM implies that the organiser associates himself (explicitly or implicitly) with an actor or cluster of actors interested in achieving some 'decideability'.

Second, Garud & Ahlstrom's (1997) analysis in terms of 'enactors' (those who want to develop something) and 'comparative selectors' (those who are offered new possibilities, sometimes for existing functionality). A FORUM can have different audiences (and thus, composition):

Mainly enactors, who can become more reflexive in general. In nanotechnology (as in any evolving field) there are two levels of enactment: on the lab floor, where actors are not interested in broader issues because of the limited world they live in; and heads of groups, institutes, centres, and other who move about in the wider world and experience the challenges to their enactment strategies. Enhancing reflexivity means different things for the two kinds of actors.

Mainly comparative selectors, whose preferences can be articulated and who can get support for making comparisons and selections. Models are to be found in pTA, iTA, …

Hybrid groups which then function as a 'bridging event' (Garud & Ahlstrom terminology). This can be addressed organisationally (e.g. by reversing roles over the duration of the workshop, as happened in a NOTA workshop on field trials of GMO) and in terms of substance (what does a bridging event do? as part of co-evolution of technology and society).

(Source: Arie Rip, presentation at the WP6 workshop, Utrecht, 12 December 2003)

Support for and collaboration with an expert-stakeholder network

This Forum initiative should collaborate with networks of analysts and with non-researcher stakeholders (policymakers, industrialists, NGOs, other).

As a first step we consider to collaborate with an existing network of science policy scholars and research council officials. One objective of this network is to understand the ways in which the ERA vision is already contributing to changes in science policy decision making, and its organisation, at a national level, and the barriers it is facing. The network looks at the ERA concept as a science policy mechanism from different approaches, countries and types of organisation. The aim is to continue the productive interaction between practitioners and academics on these subject matters. Academic contributions on the topic can focus for instance on:

- The meaning of the ERA as a science policy, from different theoretical perspectives.
- The concept of uncertainty in European Science policy.
- The ERA in relation to possible effects of Enlargement and the Accession Countries.
- Same pressures, different answers? National policy variations in funding policies as a response to the rise of a ERA.
- Intermediary structures and accommodation to the ERA.
- Competition vs. co-ordination in the ERA.

This would be an active reflexive place about the fora experiments made and discuss the ways forward. But it would also build a privileged channel for the circulation of new knowledge produced and for periodic discussion of the relevance of the research agenda.

6.6. Conclusions

The reader can readily see how different the three "structural" actions are from the previous thematic ones. We organised a different process emphasising internal reflection and debate in order to provide "operational" guidelines for future action. This is typical of this latter structural action when the group was urged not to reproduce the classical list of "dissemination" activities (a website, a conference, articles in newspapers etc.) but to propose new directions, building on previous work that had "piled on the shelves" with little effect other than our improved understanding of policy developments. This is a shared lesson for all these "infrastructural" dimensions: they require a truly European-level platform if we wish them to move beyond the realm of solely national definitions. The work done in the 1980s in evaluation demonstrated the feasibility and interest of such shared action at the EU level, but it also demonstrated the difficulty in maintaining it over time. The present situation in ST&I indicators (see developments below, section IV. 2.) is another example of the limitations of present organisational frameworks. The ways in which 'foresight' and 'anticipation' activities are addressed now with the dual setting of a service within the administration (supported by a research programme) and an agency (ITPS) supported by a providers network, should be looked at carefully as one possible avenue for embedding policy practice within the policy-making process.

This latter situation illustrates the following point: it would be a mistake to consider that simply funding a network of excellence will be enough to solve these enduring problems. One should not confuse its role in supporting work on long-term issues (that R&I policies face) with meeting the on-going needs of the R&I policy process. It can at best serve as a support for “demonstrators” which help in studying and defining the conditions for new, more lasting developments. This is especially true for ST&I indicators and for “spaces for interaction between policymakers and stakeholders”. Part IV. will elaborate further these issues, highlighting what could be the role of a European Platform in our field of science and innovation policy studies, and what specific facilities are required at EU level.

IV. CONCLUSIONS AND POLICY IMPLICATIONS

This fourth part of the final report addresses the policy implications of the work carried out. We see four types of policy implications. One was anticipated, that is the development of a **European platform** and its organisational aspects. One specific work package was devoted to this, and will be presented below in section IV.3.. One came emerged from the work carried out, that is the need for a better "characterisation" the field in Europe. We undertook a small survey (an effort which was not initially planned) which covered 50 groups and over 200 researchers specialising in the field. We shall start our analysis of policy implications with its results and their policy implications (section IV.1.). Before coming to the organisational issues and possible options at the EU level, and taking into account the results of the first call of the 6th FP (section IV.4.), we briefly review in **section IV.2.** the policy implications of the "scientific" results arrived at and set out in part III of this report. They represent for us a major result since they propose (perhaps for the first time) **a typology of the relevant activities for a network of excellence** (at least in social sciences).

1. Policy implications of the characterisation of the field

This first section is dedicated to the examination of the field of "science and innovation policy studies". We consider it to be a crucial element with clear policy implications.

Elements for the characterisation of the field

What follows is based upon a selection of units interested into establishing lasting relationships. It brings together some 50 groups from over 40 European institutions and 15 countries. We have only considered researchers and doctoral students focusing on the field per se (since many others work in more broadly defined groups). The intention is not to build an exhaustive picture (with numbers) but to identify the main characteristics of this population since with over 200 researchers and 150 doctoral students, analyses should be fairly robust.

The above simple figures give a first overview of the ***degree of fragmentation*** of the field: there are on average fewer than four persons involved in PRIME-related topics in each group. And the distribution is rather 'flat'. If we consider the 6 groups or established consortia that involve more than 10 researchers, they represent only 35% of the total personnel. There are two important aspects to this simple picture. One is to highlight the degree of 'fragmentation', the other is to look for the reasons, and these are quite clear: there is a need for broader and more even spatial distribution, since policymakers in each country (and indeed in many regions) require in-depth analyses of their own situation.

This raises another issue than simple concentration: how to build lasting and productive ‘virtual’ centres that will help research groups to attain the critical size needed for international recognition in the field[27].

A second important element of the characterisation of the field lies in its ***truly inter-disciplinary dimension***. This is visible both in the disciplinary background of researchers (Box 27) and in the areas of work (Box 28). When these elements are linked with the total number of researchers, one can understand very clearly how marginal this ‘specialisation’ is, whatever field is considered. This reinforces the importance of establishing a platform directly at the European level for the field to gain visibility.

Box 27. Participants’ disciplinary background

Over one third of the participants have been trained in economics, and another third in sociology, followed by political sciences (12%) and management (just under 10%). One fifth of participants are split between eight other disciplines, philosophy and geography being the two main ones, and there is some involvement.in history and law.

It is important to note that more than 15% of participants have a dual training in social and exact sciences (mostly physics and chemistry).

Box 28. The main thematic foci identified

On average, participants mentioned 1.5 themes related to PRIME. This represents over 40 different themes covered.

We have grouped these into six main categories:

- *policy*: work on science, science and technology, research, innovation and/or higher education policies: 45% of participants

- *economics* of science and innovation (including regional aspects and labour markets): 32% of participants

[27] There has been numerous debates about ‘optimal’ size and its two thresholds, this under which you cannot perform durably, this above which there is no longer any economies of scale (and argue some even of scope). The issue here is about the mimimum threshold, that is one where you can both address the very diverse questions you are locally faced with and at the same time concentrate enough resources on given topics and issues on which you produce ortiginal knowledge and are progressively recongised as a “specialist”. There was no clear agreement between the core group, but when developing the progress model (see below) our analysis was still that we faced over fragmentation, thus forbidding an effective use of the competences gathered in the field.

- *science, technology and innovation studies* (generally based on micro-approaches focusing on actors and networks, and covering a wide spectrum of disciplines): 25% of participants

- *management* of research, technology, innovation and/or knowledge: 15% of participants

- *ST&I in different sectors* (life sciences and especially biotechnology, ICT, services, environment, energy and food/agriculture): 13% of participants

- *specific research themes* related to ST&I including indicators (8%), IPR (5%), policy supporting tools (evaluation, foresight, TA) (10%), technology transfer, gender studies, risk studies: (a total of) 30% of participants

However small and fragmented, the field is an ***established*** one, if one considers the existence of core journals with high status (such as Research Policy) and the publication record of researchers in the sample. We have made an internal experiment based on templates (quite similar to those of the British RAE exercise). In a way, we have applied to ourselves the tools that some of us have devised. The procedure is explained in Box 29 It shows that over half the participants have an international standing ('high' and 'middle' level of visibility), while less than one in seven has published only reports, working documents or articles in non-refereed journals. This should be compared with the figure of 13% for post-doctoral fellows and 24% for researchers who consider that they have only so far achieved a national standing.

Box 29. Criteria for national/international visibility

A list of journals of international standing has been established. It contains 120 journals, most of which concern the different fields mentioned above, while only a few are fully dedicated to PRIME-related topics (like *Research Policy*). We also have included books where the researcher is the main author, co-author, editor or co-editor, and produced by established publishers in the field (e.g. Oxford University Press, Edward Edgar).

Four categories have been established: 'standard' visibility corresponds to the case when at least one recent publication corresponds to these criteria, 'middle' visibility when there are 2 or 3 such publications complemented by chapters in books (corresponding to the above mentioned definition), and 'high visibility' when there are 4 recent publications corresponding to the standards mentioned above.

Visibility	high	middle	standard	low	Total
%	22%	30%	34%	14%	100%

These results on their own are perhaps less significant. They need to be linked with yet another feature highlight as one of the key issues of the field, that is ***the need for renewal***. The field clearly faces an age problem. Nearly half of the researchers are more than 45 years old, and only 20% (including post-docs) are under 35 (see Box 30). This highlights the limited recruitment during the 1990s and points to a priority for the field: fostering research capabilities. The 150 doctoral students listed (within the sample) represent a significant step towards enlargement. However, in the last few years, we have witnessed an important "evaporation" phenomenon, which shows that there are important efforts are needed to make the field more attractive both to young researchers and to institutions.

Box 30. Age structure of the participants to the survey

Age of participants	≤35	36-45	46-55	over 55	Total
%	20%	34%	35%	11%	100%

A complementary critical aspect of the competencies assembled in the network concerns ***gender issues***. If we take the EU objective of having 40% of women in responsible positions, the field is currently significantly below this target in terms of overall participation, with only 27% women. The target is only met for PhD students with exactly 40% (coincidentally! – there is actually a wide variation across groups), while the figure is 36% for post-doctoral researchers. The situation is much worse for those with high visibility in the field, of whom only 17% are women. Consequently, there is need for a specific action to maintain women in research and to ensure that they take on research responsibilities that foster their international visibility. This seems, at this stage, more important than to establish a type of *numerus clausus* in committees.

Box 31. Participation of women in the survey

Participants' seniority	World / International recognition	Other int'l recognition	Others with EU visibility	Mainly National visibility	Post-docs	total	PhDs
% of women within each category	17%	22%	33%	29%	36%	27%	40%

One important lesson from work on collaborations (especially on EU projects) concerns the long learning process before partners are in a position to develop effective collaboration. This is why it is crucial to assess the ***collaborative dimensions*** of a field. This is not yet an established feature to characterise a field, and probably a topic where more research is needed. Here, we have taken as a proxy for the experience of inter-group and inter-country collaboration, participation in EC projects (single or multiple), and within it, experience of co-ordination. We then face a very atypical situation for social sciences, with just over 70% of individuals having participated in at least one EC project (see box 32). Out of these, there is a core of 40% who have considerable experience of collaboration and one in five who has co-ordinated at least one EC activity. We therefore have a field that is apparently ready for a further step in terms of integration.

Box 32. Involvement in previous and on-going EC programmes

Each participant listed the projects in which he/she had participated and the ones that he/she co-ordinated. These amounted to over 90 FP4 and FP5 research projects or thematic networks, over half of which were co-ordinated by participants to the survey. We have devised a measure of involvement over the last four years: 'multiple' (participation in 3 or more projects or networks) vs. 'significant' (participation in at least one), in conjunction with the nature of the role played (co-ordinator vs. participant).

Involvement in EC projects	multiple & co-ordinator	significant & co-ordinator	multiple	significant	none	Total
%	16%	6%	21%	29%	27%	100%

A final lesson from this survey deals with geographical coverage. One can witness the effects of EC activity within the EU 15 since, apart from Greece and Ireland, the survey has identified at least one established academic team working in the field in each country[28]. Some associated countries like Switzerland and Israel have also been very active. However, it has been very difficult for us to find "groups" in ***incoming countries*** with the exception of Hungary. We have identified various individuals but not groups (even loosely defined as one professor with assistants and PhD students). It will be a task over coming years to help promising individuals to develop lasting research groups.

Policy implications

This characterisation effort highlights three main results.

First, we face a small (scale is a crucial element here) interdisciplinary field. There is therefore a case, should the field be considered strategic, that a ***European "platform"*** would help in its recognition, since we know how difficult it is in traditional disciplinary surroundings to encourage the development of small specialisations, even more so\when they do not 'fit' the disciplinary culture. The options devised will be presented below.

[28] Should we have taken consultancy groups, then we would have had no difficulty in finding established capabilities in the latter two countries. But this was not the objective. We aimed at addressing the long term capability of undertaking research activities, and the capacity of anticipating through research on problems that may arise only in a few years. One cannot expect in our field private firms (that are mostly small consultancy groups) to undertake such investments.

Second, the field is faced with certain tensions: it can be considered in some respects as reasonably well established and, like most established disciplines, it faces a double problem of ageing and a strong gender bias, however attractive it remains for young people, male and female. The issue is therefore a dual question of attractiveness of research, both for these young trained people (to remain) and for institutions (to offer attractive positions). Attractiveness is, however, not an 'end of pipe' issue and should be tackled from the start by complementing at the EU level, local PhD training. ***Training*** should be a second major policy action along the lines developed in the specific group (see scientific report above).

Third, the second tension centres on the high fragmentation which is partly (but only partly) linked with the will of public authorities (including regional ones) to have support available in close 'proximity'. However, this is linked with a strong practice of research collaboration. There is therefore a dual challenge of remedying the over-fragmentation in given areas where co-location is feasible to attain critical mass, and of going beyond ad-hoc collaborations towards "virtual centres" in other cases, while still maintaining a healthy level of competition. How to achieve this, and at which level of domain delineation are, for us, ***key institutional questions*** that we face, and which encouraged us to establish a "progress model". The option we suggest is presented below.

2. Five lasting functions for a European platform

Building the "scientific roadmap" of the field

What has been described in three of the sections of Part III., entitled scientific results, deals with the research agenda of the field as we see it over the coming years. It is a type of scientific "roadmap" with its dual dimensions (as demonstrated in works on foresight).

First, it helps in building up a shared framework. In doing so, what is critical is the process and its ability to widely involve those concerned, here researchers in this field. And this is for us a major achievement: there were 11 of us initially promoting this idea of a network, and we have mobilised over 50 groups and more than 150 different researchers in the various events that have taken place over an 18-month period. There is certainly more to be done, but it has paved the way towards being more systematic in thinking about the research agenda. This had not been done on such a scale for at least a decade, and we consider it important for this to be deepened and periodically updated.

This is our first policy lesson: without a proactive effort, such efforts remain local, short-term and partial. Moreover, the temptation is to move too quickly to interactions with policy-makers. And such a tendency is not neutral in its effects, as the following example shows. A decade ago, a large international foresight exercise took place focusing on environmental research issues. This exercise developed an original way of questioning "experts" (more than 1000 all over the world responded). This choice was arrived at as a result of extensive qualitative work that demonstrated that policy-makers were very active in identifying and prioritising existing recognised problems, while for more long term issues, they were either completely focused on a particular issue (their "hobby") or simply sent back the interviewer to the "researchers". We also demonstrated that those researchers, when questioned on long-term issues, did not behave as "advocates of their speciality" or of "the problem they were working on", but as "citizens with particular skills, those of anticipating and back-tracking". This explains why we consider it critical to develop a space where such anticipation activities can take place for both identifying and framing issues that should build a longer-term research agenda.

From what has been done during the TN, we see two complementary directions for this activity. One is to use periodic meetings on major themes based upon a review of on-going research activities and publications. These can be considered as thematic reviews of the 'state of the art' and their regular updating. In the TN, we considered that the best way to undertake them was to establish open "working groups". This proved quite successful. however, this also showed that, when there were few scattered activities on-going or very diverging views on a given subject, it was important to go beyond the usual review of the 'state of the art' and to organise dedicated seminars with well prepared background and position papers that de facto provide the basis for an edited book or a journal special issue, thus helping to establish the issue or subject as an important research topic.

Establishing and updating the scientific roadmap of "science and innovation policy studies" is therefore a first critical responsibility of a European platform.

Fostering differentiated interactions with stakeholders

A second role of such a "scientific roadmap", besides serving as a catalyst for researchers and groups in defining their own research priorities, is to foster interactions with policy-makers. There is here a dual dimension in this interaction: on the one hand, policy-makers are those who select the research priorities, and define and organise the research efforts, and our field is similar to others in this respect: we have to be proactive in promoting what we consider to be the major long term issues, if we wish to have adequate resources for developing significant research programmes. On the other hand, policy-makers are the customers/users of our research results that they should absorb and internalise in their overall policies (and not just the policies dedicated to our field). In this latter function, they play the role of "companies" for many fields of science and engineering or "public procurement" in such fields as defence, health or the environment. Yet it is very difficult to get policy-makers to recognise this dual function. They often tend to consider that funding us for expertise or consultancy jobs is sufficient for developing good research (so that in many EU member countries there are no research funds dedicated to our field), or they believe that, because they fund research on the topic, this should meet the expertise and consultancy requirements they have.

We are thus faced with a specific issue whereby we must make it clear that we need to address both "facets", and probably organise work on each rather differently.

There is a need for ***on-going exchange on the "long term" research agenda of the field***, and to define a space for interaction that specifically focuses on this aspect (typical of this dimension is the willingness – see section III.2. - to seriously question the normative assumptions that govern EU research policy such as subsidiarity or multi-level governance: we have made this one of the three major themes that require significant long-term research efforts).

Similarly there are today open questions about the construction of research policies, not only in term of priorities, but also in term of research settings and practices (see the GMO or stem cells examples), and there is a need of experimenting on ways and means to achieve this (as has been done with consensus conferences in Denmark or with the Futur initiative in Germany). This is what has been debated in one of the work packages of this network with the proposal of a ***"forum" experiment*** (see section III.6.).

This second type of interaction should fulfil most of ***the needs for interaction with our users: policymakers and other stakeholders***. We see three complementary aspects of this. One lies in the need for "***professional training***" (mostly in the form of short courses that enable them to become acquainted with the latest knowledge in a specific aspect, such as evaluation or foresight).; A second lies with the need for periodic exchanges about the 'state of the art' on particular topical issues: the answer here might involve organising ***periodic events*** along the lines of the AAAS in the US. However, this is time-consuming and requires a lasting infrastructure that needs public or quasi-public funding[29]. This could also be dealt with by the development of a professional association bringing together research administrators and policy-makers. However, responsibility for

[29] One should not forget that in the US most of these intiatives are established by not for profit foundations that find their funding through tax deductions, at such a level that the money so gathered can be assimilated to indirect public funding, a situation that does not exist in the EU, all the more since there is no tax harmonisation!

this lies in the hands of stakeholders themselves, and we have to recognise that, while city engineers have developed such an association at the EU level, this has not been the case up to now in our field, though it has been moving in that direction. There is a third aspect dealing with consultancy and expertise needs: while it is clear that member state needs are addressed by the corresponding national teams (at least this is de facto the case in over 90% of instances), there are doubts about the role of a European Platform as to the ***expertise and consultancy needs of the EC***. Our view is that this should not be the role of such a platform (otherwise policy-makers would face a monopoly, or at best an oligopoly), but one could consider the platform as a facilitator, as long as it keeps competitive procedures alive.

Establishing a training European Area

A third continuing function relates to training. This has long been mentioned in most EU documents, and there is a specific programme on this within the FP. We shall come back to this point at the end of this section. We devoted a full work-package (see section III.4.) to training issues relevant for our field. We derive three major lessons from it:

The first lesson has just been mentioned; it deals with professional training with both professional postgraduate courses (like the one developed by the University of Lausanne for Swiss administrators and policy-makers) and professional short courses.

The second lesson deals with the critical importance of "master studies". In a small interdisciplinary field, one cannot expect to have many universities where there will be a large enough number of master students to organise a specific Masters programme. This is currently the case in the two well known British places (Sussex and Manchester). A number of other universities have considered it important to propose other possibilities (especially in countries where students do not pay large fees for their Masters studies). The work carried out in the network proposes to capitalise on the unique experience of ESST, a Belgian not-for-profit association bringing together a dozen European universities to organise a joint STS Masters programme. This could serve as a platform for developing other Masters programmes (and especially one on research and innovation policies). ESST is, however, faced with the significant cost of such solutions, for developing a shared curriculum, and for circulating lecturers and Master students. This is an issue that has yet to be addressed by EC policies (as was highlighted in the Liege conference on higher education, April 2004).

Doctoral studies is the third and critical component of the training function. Although there are shared dimensions with most other fields, the delineation of what should be a "good" PhD programme, how exchanges between PhD students should best be organised at the European level, and how should the circulation/mobility of PhD students be specifically organised, are clearly field–dependent, and they require specific organisational developments at the field level. This has clear financial costs. If we were to foster the circulation of half the students, we estimate that this would require approximately half a million Euro/year for our field.However, while our field had been quite successful in previous FP3 to 5 EC training programmes, there has been a systematic rejection of all proposals in the first calls of the FP6 Marie Curie Training Programme. Whatever the reasons for this, the consequences are clear. They raise questions about the coherence of EC policy for promoting a European platform. And they call for an articulated scheme covering all aspects of what the new instruments are supposed to address.

Developing the conditions for a European facility on Science, Technology and Innovation indicators

All policy-makers need figures. Yet they have progressively learnt that traditional statistics are not enough. OECD has played, and continues to play, a major role in fostering the development and use of ST&I indicators. The Frascati Manual is part of the landscape of all research administrators and policy-makers who daily cite its key indicators, such as the elusive (and probably largely counterproductive!) 3% target. However, OECD data contain strong biases linked to (i) the weak articulation between the recommendation about the construction of data and effective data-gathering (a recent PhD thesis demonstrates that adopting other data-gathering rules in Switzerland could nearly double public research expenditure!), and (ii) the recognition of countries as the sole relevant unit of aggregation (thus comparing Finland – which is roughly equivalent to Rhône-Alpes or Cataluna – to Spain or France, and comparing France – which is in many ways equivalent to California – to the US).

The work carried out in the specific work package of this network (see section III.5.) shows that, in order, to overcome these problems and to build truly European indicators that can be reliably compared to US ones, there is probably no other pathway than rethinking the process, finding an intermediate level between individual actors and nations, a meso level from which to then organise aggregation that will both foster comparability and produce meaningful indicators for policy making. This would also have the advantage of providing, as in the US, more flexibility about the ways to develop new indicators that truly address the issues at stake (and not spend time repeating the mantra that indicators are not adapted to that specific purpose, only to continue using them since they are the only ones available). To progress towards a European facility, the European platform should foster the emergence of a ***specific network of European***

indicator producers which would develop shared knowledge about their de facto practices and carry out investigations of other data gathering and treatment procedures on existing indicators, so as to prepare the conditions for a future European facility.

This is, however, not sufficient and there is an urgent EC policy issue to be addressed. Up to now, the choice made by the EC department of research (DG Research) has been to have, as in many countries, a service in charge of indicators. This has enabled the production of three successive "European Reports on Science & Technology Indicators". This is undoubtedly a major achievement which has paved the way for further developments. However, this service was rather unusual since it had no responsibility for primary data collection (which is traditionally the strength of the national services), and it operated mostly through contracts with limited internal capabilities. Recent reshuffles within DG Research illustrate that there is no lasting stability guaranteed for such a service at EU level (and this is not the sole evidence, since there was a similar outcome with the EC team on energy and environment models within the same DG). There are therefore two options left: either to hand over this responsibility to an existing EC "agency" or to enter into a long-term contract with an outside specialised organisation. Internal discussions within the PRIME teams, and especially with those involved in indicator production (who could be potential contractors), clearly favour the former solution - that is, to allocate responsibility for developing and managing the ***European facility of ST&I indicators***, and for staffing it accordingly, to IPTS. Whatever the policy choice, it is now urgent that this issue is sorted out quickly.

Focused direct intervention in the support of research activities

What about research support? Should a European platform directly support research activities or not? Or can it just remain at the infrastructural level? There have been numerous debates between researchers on this issue. There is agreement on the minimal requirements for a European platform to be attractive and to play a proactive role in the shaping of the European research area in our domain. We fear that, without more than simply "infrastructural conditions", there will be, at least at present and in the near future, little attraction in investing time in its deployment. There must be an incentive for investing in the establishment of a European Platform. At the same time, we believe that it would be a mistake to concentrate all European support within the platform. We therefore maintain that there should still be a "targeted research programme" at EC level dedicated to the main current recognised research issues in our field. Nevertheless, we feel that there are two areas on which the European Platform should target its research support and thus provide an incentive to invest in the development of the platform: (i) ***exploratory projects*** dedicated to test the interest and feasibility of new heterodox approaches to addressing long-term issues, and (ii) ***comparative and aggregative projects*** that require, on key issues identified, capabilities beyond those of existing groups and multiple country field work. Both address very different issues.

It has been one surprise to the principal author of this report and co-ordinator of the network to see how few new conceptual developments there have been in the last decade. Though Europe is clearly on the lead in our field (with many of the world recognised scientists and with the leading specialised journals), there has been little in the way of new conceptual frameworks, while several long-standing issues remain poorly addressed (not having been targeted by public programmes) and are only now being 'rediscovered' (e.g. collective goods or defence research). There is therefore a "research community" responsibility to devise suitable means to anticipate future issues and to support the initial research steps of "non conventional" or "heterodox" approaches[30]. The different work packages have identified a number of such issues (e.g. new methods for measuring the performance of research groups, new approaches to policy mixes, and rethinking the notion of intermediary structures).

One important result of the work packages has been the need for a limited number of extended comparative studies on topics that are judged critical and on which existing funding sources (mostly at national level) do not enable researchers to undertake such work. Good examples of this are the need to compare the numerous surveys of spin-off firms in order to establish a taxonomy at the European level that might help to adapt policy interventions to the situations faced rather than always shaping them against the mythical future large firm, which only a handful will ever succeed in becoming over the next decade. Or the need to help universities (whatever their diversity and very different institutional backgrounds in which they operate) to develop indicators for supporting their research strategies. Or the critical issue of competence building: how relevant is it to consider two periods, one of training through research (the PhD period) and one of research apprenticeship (the post-doc period). Should we not reverse the approach, considering the overall PhD and post-doc period as one, this being required in order to attain a stable position within higher education and public research, and then study it as the first period of the professional life of "researchers" with specific "on-the-job training" activities and multiple ways to profit from it, some before the PhD degree is obtained (where it is therefore important to know which competencies are most valued), and others (but may be no longer the majority) through employment within public sector

[30] This does not mean supporting individuals, but making it knwon that individuals being able to capture the interest of other teams (say at least two from two other countries) can find support for a first exploration or demonstration of the interest of the approach proposed.

research (that is universities, public research institutions and research positions within NGOs). These are three examples from a set of ten that have been identified by the working groups (see part III.) as requiring large-scale, multidisciplinary and comparative research projects. We face here a number of related issues: are the research projects large enough to build integrated projects? Do the topics identified coincide with the areas targeted by policymakers? Andwhat support, if any, should be given by the platform? The issue here is not to entirely fund the overall cost of the project; it is to fund those aspects that enable us to go beyond what can be done in individual groups at the national level. The question is, however, one of balance between the funds that teams find on their own (be they institutional or through national 'leverage'), and the funds provided for by the European Platform. The early experience of the PRIME network of excellence shows that the balance used (generally less than 20% of total funding) may not be adequate and indeed may even be counterproductive. This is an issue that will require in-depth analysis at the end of the first 18-month period, and which should be cross-checked with the experiences of other NoEs.

3. Organisational design for a European platform

This builds upon one work package (formerly WP8, now WP7) that was part of the original proposal and framed as dealing with "the institutional, administrative and logistical conditions enabling both a strategic and a scientific management of a future network of excellence". Box 33 summarises the activities developed by the thematic network and the main outputs produced.

Box 33. the activities developed under WP7

> The activities of WP7 were directly conducted by the core group, which was able to meet 6 times (not including the preparatory meeting), three times more than originally planned (Paris, September 17, 2002, Paris, October 30, 2002, Paris, December 17, 2002, Paris, January 16, 2003, Paris, February 27, 2003, Karlsruhe, April 28, 2003, Madrid, January 7, 2004. Electronic exchanges and telephone meetings have enabled further exchanges to take place after this last date.
>
> Members: P. Laredo (Armines/OST), L. Esterle (OST), A. Rip (U. Twente), S. Kuhlmann (ISI), B. Martin (SPRU), L. Georghiou (PREST), K. Bruland (Oslo U), L. Sanz (CSIC, replaced E. Munoz), A. Bonaccorsi (SSSUP), P. Sanchez (UAM) and J.A. Heraud (BETA). Alternate members (who participated in some core meetings): B. van der Meulen (U. Twente), J. Edler (ISI) and M. Nedeva (PREST).

Specific activities undertaken for WP7:

- elaboration of the organisational design of a potential NoE (see main results below and in the annexed documents)

- survey on the characteristics of the field (see section IV.1.)

- development of a 'progress model' for integration and of a monitoring approach (see section IV.3.)

One has to recall the circumstances of this labelling. The proposal was written at a time when the Commission was just starting experimental work on the definition and identification of "centres of excellence" and when the notion of a "network of excellence" did not have its present definition. It was then considered by the authors of this proposal as an articulation mechanism that would cover entire fields and would develop another type of "intermediary layer" (to use the terminology proposed by Rip and colleagues). Such an understanding led to two main considerations that provide an overall coherent framework for action.

1) We understood the selection of a NoE on a given theme as a de facto delegation of public funds by the EC to manage the theme (or part of it, see section IV.2:). This confronted us (and our colleagues) with a rather unique situation: to devise governance mechanisms for the self-management of a field. Researchers in the field would no longer be in the realm of the "invisible college", nor indeed of a "trans-epistemic arena". They would have to face issues of selection and evaluation which are far wider than those of journals, but still far less than those of given institutions employing and rewarding people. Similarly such a delegation could not be looked at like a traditional "funding programme" since this would be self-managed by the "community" itself. Furthermore, this required that we translate the notion of "community" into operational terms (who is part of it? - this being a critical element well known in relation to public debate and new forms of policy making). One output of the work package has been to devise a structure that could be lasting and not dependent on its initiators. This has been further translated into a "consortium agreement" that in many ways looks like the charter of an organisation ("statuts" in French). The latter is annexed to the report and has been used, fairly closely in the proposed format, by the PRIME Network of Excellence.

2) We considered that the notions of 'excellence' and of 'integration' remained unclear and required further analysis if only to devise operational mechanisms

to monitor them over time. The core group, together with the data group (see section III.5.) spent some time elaborating about the very narrow definition of excellence *de facto* used by the experiment undertaken by the EC on centres of excellence (2001-2003). This corresponded to work done by quite a few members of this thematic network on research collectives and government labs. We were then rather cautious about ways of differentiating "scientific excellence" from "research performance" which we consider as a more encompassing frame of analysis of this professional activity. Similarly there has been extensive work on collaborative practices in research, and numerous approaches to 'integration' with concepts such as "labs without walls" dating back from the 1960s. The issue there was not of undertaking another review of this wealth of literature, but, within the framework of on-going developments at the European level (including the selection of given networks of excellence and integrated projects), of how such aspects could be defined and their dynamics (not to say their progress) monitored. Both elements led us to suggest a "progress model" and a framework of analysis for monitoring progress.

3.1. Towards a NoE organisational design

We identified 2 key considerations that shape the organisational design:

i) Support (which is only a fraction of research costs, up to a maximum of 20,000 Euro per researcher), is based on overall 5 year objectives, while only the first 18 months are clearly set out. This means that the NoE must be in a position to oversee and assess the activities carried out in order to revise and update its objectives. This requires clear and strategic decision-making capabilities.

ii) This also means that the Network must develop strong operational management capabilities (keeping these costs at below 7% of total support – but not cost!). We have created the post of 'technical and administrative co-ordinator', due to the width of responsibilities delegated by the EC under its new financial rules.

This led us to an organisational design that resembles very closely a classical organisation with an overseeing body in charge of all strategic decisions (the governing board). Given its large size, it will nominate an Executive Committee in charge of implementation, supported by three advisory bodies: a Scientific Committee for scientific advice and evaluation, an Ethics and Standards Group for ethical and normative issues, and a Characterisation Group for monitoring the structural development of the Network (see below for the latter).

Governing Board

The Governing Board should be made up of representatives of all the participating institutions with 'full membership' status (see item on membership below). There should be one representative per institution but the voting rights of each should depend upon the scale of excellence and involvement of participating researchers in that institution as assessed by the Characterisation Group (see items on voting rights and the Characterisation Group). The Governing Board should decide upon the strategic orientation of the Network based upon reports of activities and proposals prepared by the Executive Committee (see below). In addition, the Board should decide on the adoption of new full members or the exclusion of existing ones, and on amendments to the Consortium Agreement (see item below). One of its key functions should be to nominate the members of the Executive Committee. Decisions by the Governing Board should be taken upon a majority of two thirds of the votes of those present. The Governing Board should meet periodically, the precise periodicity being linked with when decisions need to be taken (due to the need to keep the costs of organising meetings to a minimum).

Executive Committee

The Executive Committee should be in charge of preparing and implementing the objectives set. It should have full decision-making responsibilities for these tasks. In particular, it should be responsible for the different calls and selection procedures that will structure the implementation of the objectives. In order to insure credibility, the decisions of the Executive Committee should be supported by advisory bodies. We see three of them as being critical: a Scientific Committee, an Ethics and Standards Group, and (as explained below) a Characterisation Group. It will be supported in its operational management by a Management Team working under the Technical and Administrative Co-ordinator of the Network. The Executive Committee should be limited in size (our suggestion is to have a maximum of 12 members, of which two can be nominated by Committee members in order to ensure adequate coverage in terms of expertise, gender or other factors considered relevant). Decisions should be taken upon a majority of three-quarters of those present.

Scientific Committee

We see two main functions for a Scientific Committee. The first one is "strategic", that is to develop an overall assessment of the directions chosen, of the degree of success of the implementation structures developed, and of the originality and importance of the new knowledge created. What is required here is external advice about "where to go" and "what to do". This role mainly involves the periodic reviewing of the 18 month programmes of activities. The second function is "operational": there is a need to develop external evidence of scientific quality (originality of the topic, quality of the research design, feasibility of the work programme and so on) and we consider it important that the quality mechanism put in place is independent from the decision-making body. For these two functions, there is no need for a large committee; it should, on the contrary, remain a truly working body (we have therefore recommended a maximum of 8 members) knowing that it can turn to external experts when necessary.

Ethics and Standards Group

With growing collaboration and sharing of databases, issues to do with intellectual property, quality and other norms (for example, about authorship, about references to and involvement of specific database producers, and about the standards for qualitative research used by others) will become more important. There is consequently a need for a group to look in more detail at issues relating to ethics, "deontology", quality standards and other legal aspects. The idea is therefore to have a small dedicated group that can help both individual projects as well as the Executive Committee, and hence progressively build a set of practices truly adapted to the situation.

It should be noted that do not consider it relevant (as in US life sciences projects, for example, with the ELSA requirements) to enlarge it to include broader social aspects. Instead, we believe that interactions with stakeholders and society at large are so important that these require specific actions that a committee cannot address.

Operational Management and the key role of the "Technical and Administrative Co-ordinator"

There are four aspects included under operational management.

Scientific management includes the preparation and implementation of research actions (as distinct from individual research 'projects') and structural actions, the organisation of meetings and seminars (where these are not linked to a specific research action), the preparation of reports and minutes for the committees, and interaction with the EC

Priority 7 scientific management structure. We suggest that this is directly handled by the Executive Committee (that can delegate specific tasks to particular members).

Financial management concerns the allocation of funds, the verification of expenditure (both planned and incurred) by different partners, and responsibility for ensuring the quality of the auditing process (within actions). It involves producing annual financial reports and handling financial discussions with the Commission.

The legal aspects of the functioning of a NoE concern the establishment and development of the general rules of the NoE as well as all specific aspects linked to intellectual property or any other legal matter arising from the activity of the NoE.

Logistical issues concern the practical organisation of the general activities of the NoE. Besides the secretariat of meetings and reports, they include providing support for the virtual exchange network (the IT infrastructure) and the website that any NoE will have to develop and maintain.

We suggest that the latter three tasks, which require specific professional skills, are handled by a Technical and Administrative Co-ordinator (TAC). The first experience of PRIME NoE shows how important these aspects are in the operating performance of an NoE (especially when faced with the uncertainty surrounding new financial rules adopted by the EC). This has, for instance, led Armines, which acts as the PRIME NoE TAC, to develop a specific extranet to manage electronically the financial and contractual exchanges. This costly development was only possible because it is split between a set of new instruments that Armines now manages.

3.2. Dealing with the dynamics of a network: handling existing differences and evolving participation

Participation and the 'Progress Model' of the Network

Networks of Excellence clearly need to be evolving 'organisms', open to newcomers and active in structuring the field and in pushing to create new (and probably multi-institution) centres of excellence. Networks of Excellence have therefore to manage a tension between, on the one hand, strengthening groups that already possess an established reputation for excellence so that they can become world-leaders in the field, and, on the other, the requirement to spread excellence to others in Europe, which requires the provision of some form of 'stairway to excellence'.

We have attempted to translate these objectives and tensions into a 'progress model' with specific development stages so that: (i) one can establish a 'baseline' which shows the current level of excellence but also the fragmentation in the field (see the analysis in section IV.1.); and (ii) it provides criteria for judging the achievements of the NoE. Clearly, "If a network is similar in shape at the end as compared to the initial situation, it will have failed".

The model is conveniently visualised with the aid of a classical matrix: along one axis is the degree of recognition attained, and along the other the critical mass gathered. The objective is to move more of the NoE participants towards the upper right quadrant of this global 'map' – that is, a network made up of entities with a far higher proportion demonstrating "collective excellence".

This requires that the organisational design recognises the existence of the existing differences and develops ways to monitor their evolution. This is translated into the principles set forward for voting rights and into the establishment of a dedicated structure for mapping and monitoring: the Characterisation group. This also requires that a NoE should be able to deal with the diversity of the situation of groups and researchers involved in the field. We consider that this requires a differentiated participation that is not yet taken into account in EC regulations.

Voting rights and the Characterisation Group

Two principles have guided the approach we suggest: (i) there is a need to achieve a fair representation of both larger established centres of excellence and smaller groups, (ii) given that we are trying to ensure that NoEs will have a lasting existence, one should develop an open and flexible procedure, as opposed to a once-and-for-all *ex ante* definition of a "core group". In this approach, the nomination of the Executive Committee by the Governing Board becomes central. Voting rights are key to this process. These two principles have led us to depart from the usual nomination rules. We believe that neither an 'intergovernmental' approach' nor a traditional voting approach (based on head counts or on lists) is likely to provide a balanced representation. Instead, we consider that voting rights should be established taking into account the main features and objectives of the Network. Box 34 sets out one possibility for organising the allocation of voting rights.

Box 34. An option for the allocation of voting rights

We have identified two criteria (that are field dependent and cannot be established as standards applicable to all disciplines). They depend on four main criteria: (i) international recognition gained (the notion of 'excellence'), (ii) critical mass obtained (in one place or through lasting institutionalised collaborations; this is typically field dependent), (iii) investment in the training of new researchers, and (iv) involvement in the NoE activities. We had a debate about the inclusion of other criteria of research performance (e.g. relations with the economy, role in expertise or standard setting) but, as NoEs are focused on long term research, we decided not to include them. This remains open for further discussion. This led us to highlight two main principles: - Principle 1: It is logical that larger groups which can demonstrate "collective excellence" should each have a representative on the Executive Committee. The issue is then to define a relevant threshold. We do not believe it can be sets as a fixed number once for all, and this explains why we consider the role of the proposed Characterisation group to be critical. - Principle 2: In the light of the bottom-up approach to achieving lasting integration, one objective of NoEs is to lower the "entry cost" for excellence and to facilitate the attainment of critical mass. Consequently we anticipate that collective excellence will not always be associated with a single institution or location, with the result that multi-location groupings will need to be taken into consideration in determining the composition of the Committee. The approach suggested is to set similar size criteria for these multi-location virtual groups as for localised "demonstrated collective excellence". The idea is that such groupings are developed bottom-up by participants themselves and should be anticipated. One way to do this is to adopt a process whereby participants not achieving this threshold have the option to group themselves bottom-up before the vote and select one representative whom they can propose and vote for.

The option presented in Box 34 requires that a "mapping" of the situation is periodically carried out, hence the notion of an independent "characterisation group". We suggest that this should be a small group composed of recognised individuals knowledgeable about the dynamics of research activities and the tools and indicators best able to represent it. They should be fully independent from the Executive Committee. They should be responsible for mapping the Network and monitoring its evolution in terms of excellence and integration (and thus be in charge of providing one critical element required by the EC), and for using this to make proposals to the Executive Committee regarding the voting rights of members[31].

Need for differentiated Participation

This progress model underlines a key principle for participation. NoEs should not be based on individuals but research groups. However, the door should be left open for small groups that have not yet achieved the minimal standard set up by the Characterisation group (another aspect not yet mentioned, but critical when one speaks of Networks of Excellence) or for individuals who have international recognition but still work on their own. This is why, besides full membership, we consider that there is a need for another status, marking at least partial involvement. We therefore suggest creating an *associate membership status*. This provides one way to progressively enlarge NoEs while keeping their 'branding' role.

We have suggested that associate membership should go with de facto involvement in given projects or activities of the Network, and that the selection mechanism of projects and activities (since there should be a double review, of quality first by the Scientific Committee, then of relevance by the Executive Committee) should play the role of a selection mechanism for granting the status of associate member.

These arrangements seem particularly well suited for our field for accession countries (where we have difficulty in finding established groups), and for those other EU groups who are only marginally interested in science and innovation policy studies (for instance, dealing only with one specific aspect).

The first months of experience of the PRIME NoE shows, however, that the Commission, although pushing for flexibility and enlargement, has nevertheless devised such high legal and administrative barriers that the whole idea of progressive involvement (which is key to the notion of excellence) is endangered.

[31] This has been a complex part of the process of designing a consortium agreement. We had to find ways for dealing with any opposition to the proposals made by the Characterisation group. We believe that we have found a reasonably "elegant" solution to this problem (see Annex).

Networks of excellence as "attractors" at the world level

One ambition of Networks of Excellence is to play a role at the world level. If this is to happen, and if the approach proposed (see IV.2.) is adopted, the degree of attractiveness will first of all depend on the "research agenda" or the "scientific roadmap". Another factor will no doubt be in the enthusiasm to be involved in certain projects, even to suggest and initiate new projects that would be shared by "many" EU teams.

We have suggested to use the "associate membership" to render this involvement visible. However, it would be confusing to mix too many different situations under the notion of "associated member", so there is perhaps a need to invent another term.

Many of these teams will be from OECD countries, and therefore in a position to find their own funding sources. However, this will not always be the case. Moreover, the EU has devised a specific mechanism to foster the association of third countries to the Framework Programme. Under this mechanism, there are two possibilities: either the country pays an annual fee to the EC for its teams to participate fully in (and be directly supported by) EC programmes (this is the case for Israel and, from January 2004, for Switzerland), or the associated countries have to find their own means to support the teams involved in EC supported projects (as was the case for Switzerland until 2004). Some have developed specific mechanisms to do so (see box on Switzerland[32]). Others have not, so that the political agreement signed by the EU does not readily translate into an implementation scheme agreed upon by the EC (DG Research) and its counterparts. This is typically the case in Mexico.

Box 35. Participation of associated countries, the example of Switzerland in PRIME NoE

- 5 Swiss groups participated in the PRIME proposal representing 11 researchers.

- The Swiss Federal Office of Research considered that, since PRIME had been selected through a competitive process, no new competition was necessary to fund the Swiss groups.

- The amount of funding was calculated using the same ratio as the one used by the EC.

[32] in 2002 Switzerland devoted 15% of the federal funds allocated to research to the support of EC projects (Lepori, 2004).

- The total budget was allocated to only one group which acts as the Swiss group responsible for participation in PRIME.

- The allocation to the different groups is linked to the participation of researchers in the projects and activities selected by PRIME Executive Committee and decided in agreement between the co-ordinator of PRIME and the Swiss group responsible for participation.

- The overall allocation of funds is thus determined depending on effective involvement in projects and activities, which helps both in terms of the transparency of the funding allocation and also in the review of research activities supported.

4. Which perspectives for a European Platform in science and innovation policy studies?

Section IV.2. dealt with the results of the PRIME TN in discussing the roles of a European Platform. Section IV.3. addressed organisational issues, proposing a number of elements to be incorporated in the design of networks of excellence. Both were written with a more general framework in mind, while also attempting to address specific issues for the field (such as ST&I indicators).

In this last section, we focus again on the specific issues of our field, science and innovation policy studies, taking into account the evolving landscape. We have identified four aspects that will influence our notion of a European Platform in our field.

First, we have to take into account the choices made by the Commission, not to go for one Network of Excellence covering the field but for at least two networks, and probably three. This means that we need to develop a specific analysis of the relationships between our overall notion of a European Platform in the light of the co-existence of more than one Network of Excellence.

Second, we have to consider the overall perspectives for EU research policy. Should we go as far as to develop different scenarios of the future of EC research policy, such as the three put forward in Kuhlmann and Edler (2003)? Our answer is ‘no’, but we believe that on-going developments about the ERC and about the future of ERA-Nets might have strong implications for the future of the field at the European level.

This second issue links directly with a third, that is the assumption made by the Commission that NoEs, and more widely the anticipated European Platform, should be self-sustaining after the initial period of support (i.e. after 5 years).

Finally, we shall have to consider, as was mentioned in our first annual report, the effects (both positive and negative) of the high expectations raised when initiating the new tools as was manifest in the high response to the 2002 call for "expressions of interest". Do we risk being faced with the well known promise-requirement-disappointment cycle, well studied by specialists of technology assessment? What are the conditions to avoid such a "down-turn"?

Such are the "policy aspects" that this last section examines.

Shared functions between NoEs as a support toward the emergence of a European platform?

Section IV.1. has set out the characteristics of the field which is both small (in comparison with most specialities, even within social sciences), interdisciplinary and rather fragmented. Even when one takes into account that part of the community that is more focused on innovations dynamics (mostly made up of economists, complemented by some management scientists and geographers)[33], the picture remains much as was described by Frieder Meyer-Krahmer when he put forward the need for an "umbrella" network or platform covering the entire field (see related expression of interest, 2002). This is now borne out by the selection of at least one other network of excellence. When reading other proposals, we can see that the same 'transverse' functions remain: developing a long-term research agenda, the training activities, the issue of ST&I indicators and the relationships with stakeholders (who are, of course, the same). Will each NoE develop similar structures? Or should some effort be made so that the means are pooled, de facto building a "European Platform". Another issue is about the way forward: should it be left entirely to "bottom-up" initiatives, or should there be EC incentives from the top pushing toward it?

Longer-term support of NoEs: what responsibility does the EU have?

Network of Excellence are supposed to focus on long-term issues and generate world-class research. At the same time, they are selected on the basis of identified priorities. In a way, they fit closely with notions developed at the turn of the nineties, respectively "strategic research" (see work done at SPRU) and "basic technological research" (see work done at CSI), two notions that emphasised the need for new fundamental knowledge to be developed before any development could take place in given fields of

[33] The DIME proposal lists for instance 113 persons involved on the topics mentioned out of 380 members in the different participating groups (though there has been different calculations depending on groups, some only counting members participating to DIME while others mentioned their total membership).

interest. Work in science studies (by Latour and others) has shown that anticipating the future and aiming to solve currently "non-soluble" problems has always been a prime mover for researchers, even for those working in areas and topics classified as academic or fundamental. Does this mean that NoEs could represent one way to position a "European Research Council" that would not be another funding agency (on top of all the existing ones in different countries)[34], but the "agency of agencies". The answer is possibly 'yes', thereby providing a revised definition of subsidiarity (if our suggestions about the role of NoEs are taken into account)[35]. Does this mean that the NoE should be a tool only for the ERC while the FP and its priority fields should avoid addressing long-term research issues this way? Here, the answer is clearly 'no'; NoEs will probably represent a form of "boundary object" (to use a well known concept from the sociology of science) and require specific articulation (rather than simply a division of labour) between the existing FP managing structures and the future ERC management.

Can Networks of Excellence be self-sustaining?

There is an assumption made by the Commission that Networks of Excellence, once they have demonstrated their usefulness, should find their own resources and thus be self-supporting. This assumption rests, in turn, on two presuppositions which are never made completely explicit. The first is that NoEs will demonstrate their abilities so that the institutions involved will not only fund the national structures, personnel and equipment, but they will also be willing to invest in the shared infrastructures. This goes against 20 years of official EC thinking, whereby the EC has only sought to support activities that can demonstrate true EU 'added value'. How can NoEs be seen as successful if they do not demonstrate EU added value? And if they demonstrate this, why should regional or national authorities pay for it, especially at a time when the share of EC funding in the total R&D public expenditure is expected to double over the next five years, rising to 10%? EC policymakers have to be coherent in the way they articulate their different positions.

The other presupposition is that NoEs will turn out to be so attractive that firms will be ready to co-invest, not only in specific projects but also in supporting the overall infrastructure. One can strongly challenge this hypothesis, looking at the recent evolution of university-industry links (while these may be increasing, one can see from the overall

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[34] When looking at most position papers developed, we remain however in the traditional realm of the well known research council, focusing on the selection of individual research projects, groups and even researchers!
[35] There are many other possible alleys, from full delegation by research agencies to the ERC of given topics (the ERC would then act along similar terms as NSF) to "niche" positioning (as the one often mentioned: support the project of individual "promising researchers", including the possiblity of developing a full team over a given period of time, as in the famous Japanese ERATO programme).

pattern that certain types of relations tend to be given priority). Yet even if one partially accepts it, this does not solve the problem of NoEs where the public funders of research are also the customers of its results, thereby mixing both roles, as is the case of our field.

We would therefore argue that there is virtually no chance that Networks of Excellence will ever become totally self-sustainable; and if they do, this will surely be because they will have 'forgotten' some of the 'transverse' functions identified – the long-term research agenda, the training activities, the issue of ST&I indicators (or more widely the issue of shared facilities) and the relationships with stakeholders – to focus on only a short-term brokerage function for research projects.

There is therefore an issue of on-going support for NoEs. Our suggestion is to investigate how solutions that have been developed for the labelling and support of research centres or units (such as the UK selection of 'centres' or the French INSERM practice for funding selected research units) can be adapted to NoEs.

Do we risk encountering a disappointment phase in a "promise-requirement cycle"?

It is difficult for the authors to anticipate at broad level what will be the effects of an extremely competitive selection process for the first call for new instruments. However, in our field, the coverage of well established teams, thanks to the support for two or perhaps even three networks, will be quite extensive. Consequently, we do not see this problem as likely to be critical, as long as the selected networks can remain flexible and open (presently, in mid 2004, this is somewhat problematic - see section IV.3.2.).

This does not, however, mean that we shall not face strong disappointment. There is a level below which incentives no longer work: when you allocate an average of 5k Euro/researcher/year (as is the case for the PRIME NoE where there was a 50% cut from what was requested) while maintaining the need for the full infrastructure (thus doubling its relative cost), you automatically require the network to make drastic cuts. This may be because policy-makers anticipate that there are many "sleeping partners" within those that were listed. However, when this is not the case, there are only two ways to cope with such restrictions: to greatly reduce the spectrum of activities, or to greatly reduce the level of support given to the activities undertaken. Alternatively, one can attempt a combination of both. This was the choice made here. First, there has been a strong reduction in the number of topics involving "comparative and aggregative projects" (i.e. the expensive ones). Second, the network has chosen (in agreement with the Commission) to "frontload" (that is, to spend far more in the first years, anticipating a change in EC position and increased support if the network proved successful). But third, the network has decided to keep open the spectrum of planned activities so as to leave participants to decide bottom-up on the choices made: what should be pursued as planned, what should evolve and what should be postponed or abandoned.

After six months, two calls and more than 1 million Euro (20% of the whole budget for 5 years) allocated, we can observe three trends. The first trend is to delay the start of anticipated shared projects by adding a layer of further exchanges, reviews of the 'state of the art' and workshops (that is, entering progressively with lower investments, so as to be surer of the degree of interest before investing further, encouraging more risk averse strategies, the level of incentives not being sufficient to foster clear investment decisions). We witness, secondly, unequal involvement on the part of the various teams. Here, there seems to be a significant correlation between the level of involvement and the funding of permanent researchers: the involvement seems much more limited when teams need to cover part of the salaries of their researchers (while teams which, whatever their costing structures, do not have this problem, have been far more active). Thirdly, the selection of topics is not random along the spectrum that had been collectively established. There is clearly a far poorer take-up of items or issues that are seen as "risky" and that require long-term investments before having a chance of delivering visible results.

We take these elements as warning signals about the conditions for the effective operation of networks of excellence. And reduced involvement on the part of well established teams for the above mentioned reasons, if it was lasting and widespread over a set of networks, would be really damaging for an instrument which we consider particularly relevant for the various functions highlighted in section IV.2.

V. DISSEMINATION AND EXPLOITATION OF RESULTS

This report is not the first step towards dissemination. In a way, the whole thematic network has been focused on 'dissemination'. The audience we targeted from the start comprised our colleagues, with the aim of encouraging them toward a more collective approach in our field. The fact that, starting from just 10 initiating groups, we have mobilised persons from over 50 groups, and that most have come together in a proposal for a network of excellence that has won the first competition, is, in itself, an achievement. This was due in part to the specific approach, that of "workshops" and "seminars" where the majority of participants and of presentations came from the "core group" of the thematic network (that is, the set of official participants to the network). We had included this within our initial budget but with an overall target of adding another 30 or so experts. In fact, we have added over 100 persons and gathered some 70 presentations (see list in references).

The objective was to define the research agenda and, within it, the priorities relevant for a network of excellence on policies for research and innovation. Again the six work-packages and their reports (see section III and VI.) demonstrate the progress made on this. The first external visibility came with an article published in an international journal on the challenges facing our field (Larédo, SPP, 2003). However, we have not been very active in circulating them until recently because we decided to develop a website to make them widely accessible and funded a first preliminary project on this. We left matters at this stage when we learnt that there would be a Network of Excellence continuing the investment made, and handed to the NoE responsibility for developing fully the website and making all the material developed accessible to the Community[36]. This website is now fully operational and this should ensure wide dissemination of results.

As far as exploitation is concerned, it is difficult to separate the various effects. The research agenda has largely been taken over by the PRIME NoE, not least because of the bottom-up process for initiating projects which means that new projects not only take into account the directions which the NoE proposal established at the beginning of 2003, but also largely base their development on the further work carried out within working groups, seminars and workshops by the six work packages. We can thus claim that this represents a significant exploitation channel for the results arrived at by the thematic network.

[36] the website is www.prime-noe.org.

There is, however, still important work to be done in terms of interacting with policy-makers about key research priorities in our field, since quite a few of those issues that we consider critical have so far received little attention. The question is how to undertake it and in what format. We are firmly of the view that it should be taken over by the network of excellence which has made the updating of the research agenda an important element of its functioning.

VI REFERENCES AND BIBLIOGRAPHY

The following list does not contain the usual list of references. Our choice has been to emphasise the documents produced during the life of the network, knowing that one of its major roles was to produce reviews. They in turn contain the references to the key documents of the field including those cited here.

All the documents mentioned have been collected on a CD-ROM. Most are accessible through the following website: www.prime-noe.org. In particular, the CD-ROM includes all the annexes to this report.

WP1 new rationales for public intervention

Overall documents

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A. Bonaccorsi, Search regimes and public policies.

P. Laredo, Evolving rationales for public intervention in research and innovation.

L. Cruz Scope, Roles and coherence of S&T human resources policies.

P. Nightingale, Changing rationales for Science.

B. Poti, Changing rationales of public policy in RTD.

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J. Edler, Scope and nature of the patent surge, a view from Germany.

F. Lévèque and Y. Ménière, The functioning of IPR systems, overview and research questions.

T. Luukkonen et al., Issues in IPR, a position paper.

L. Paija, Innovation, collaboration and IPRs in small and medium-sized firms.

U. Schmoch, IPR and Public research organizations.

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L. Bach and M. Matt, Reviewing economic rationales for science and technology policy.

A. Bonaccorsi, Search regimes, a research programme.

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J-A. Héraud, Multi-level governance and decentralisation in a traditionally centralised country: the case of France.

K. Kotschatsky, Science-based regional development: scope of action for regional government (and case of Trento in Italy).

C. Lyall, Multi-level governance structure and foresight: the case of Scotland.

D. Pinelli, Spatial features of the knowledge economy: the role of ICT and cultural attitudes (quantitative tests in the case of Italy).

W. Polt, Regional innovation policy in Austrian regions (two case studies).

L. Sanz and L. Cruz, Science and innovation policies in a decentralised country: the case of Spain.

P. Shapira, Contribution from the US point of view.

WP3 Public sector research

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A. Bonaccorsi, Conclusions from the Madrid meeting: Anticipations about research projects in public sector research.

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M. J. Santesmases, Links for a European integration of PRS: knowledge and science policy making in an international context.

J. Enders, Higher education policies and research policies, areas of interest and research questions.

M. Nedeva, Public sector research and institutional dynamics.

C. Musselin, Unsolved paradoxes in the organisation of academic labour markets: four research themes.

A. Bonaccorsi, Research on research.

V. Mangematin, The career for academics: modes of recruitment, evaluation and incentives and pattern of mobility.

M. Benninghoff and J Perellon, Learning capacities in Public-funded Research System.

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B. Poti and E. Reale, Knowledge production and productivity at research collective level.

A. Webster, public goods and intellectual property in the ERA.

P. Laredo, The dynamics of research collectives and networks.

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B. Van der Meulen, The transformation of funding agencies.

A. Bonaccorsi and C. Daraio (SSSUP), New methods for the analysis of performance at the micro level.

I. Recotillet, PhD trajectories, results from French survey and future methodological directions.

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P. Moguerou, Labour markets for Ph.D., post-doc and young scientists, Lessons from a US-France comparison.

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V. Mangematin, Academic labour market in the University.

A. Ekeland, International mobility of high skilled labour, preliminary results from the ENMOB project.

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D. Braun and B. van der Meulen, Position paper for defining priorities of research, discussing a common theoretical framework and exploring stimulating research avenues for collaborative work.

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P. Mustar, Introduction to the session, part 1: Metrics and typologies to understand the university spin-off firms (Is there a European model of University spin-off firm?).

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M. Fontes, Roles of academic spin-offs in the transformation and use of public sector research knowledge.

J.J. De Groof, Academic spin-off processes and types of ventures in regions outside high tech clusters: the case of Belgium.

B. Clarysse, Research based spin-offs in Europe.

A. Lockett and M. Wright, University Technology Transfer: Research Overview.

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B. Poti, The relation between individual productivity, pattern of mobility across the career, scientific fertility, and the organisational factors at the level of labs and institutes.

P. Stephan, Individual benchmarking and collective research.

P. Laredo, Laboratories profiles within the Human genetics scientific community: what the key lessons.

C. Dariao, New techniques for assessing scientific productivity of research groups.

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