# EVALUATION OF THE SIXTH FRAMEWORK PROGRAMMES FOR RESEARCH AND TECHNOLOGICAL DEVELOPMENT 2002-2006

## Report of the Expert Group

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## THE EXPERT GROUP ON THE *EX-POST* EVALUATION OF THE SIXTH FRAMEWORK PROGRAMMES (2002-2006)

We, the undersigned, the Expert Group on the *ex-post* Evaluation of the Sixth Framework Programmes, are pleased to present our report to the European Commission


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# *Ex-post* Evaluation of the Sixth Framework Programmes

# Foreword

The European Community's Sixth Framework Programmes for research, technological development and demonstration (FP6) were established in 2002 and ran until 31 December 2006. They aimed to contribute to the creation of a European Research Area and to support innovation in Europe.

In 2008, the Commission appointed an Expert Group to undertake an evidence-based, *ex-post* evaluation of FP6, the group meeting six times between July 2008 and January 2009. This report is the result of our work. In addition to analysing and drawing conclusions from the past, we make recommendations and formulate a vision for new dimensions of European Research and Technological Development (RTD) policy.

One of the paradoxes of European RTD policy is that in successfully building connections between researchers in different European countries and developing infrastructures across national boundaries, it has to an extent fallen victim to the very disease it seeks to treat, i.e. a lack of global orientation. Some aspects of that policy now seem inwardly focused and defensive in the face of challenges posed by the globalisation of research and innovation. Hence, one of our main messages is that Europe should to a much greater extent open up and by intensifying its science and technology diplomacy seek academic as well as industrial cooperation and competition with the other parts of the world. We wrote this evaluation as the 2008 banking crisis began to trigger economic recession. Our analysis strongly supports the view that investments in research and innovation to build global competitiveness must be central to Europe's response and that the European Framework Programmes must be key components of this response. The understanding and capabilities provided by science and technology have consistently underpinned 'Game Changing' developments and they again represent a historic opportunity in these times of severe problems. Using investments in science and technology to help overcome the present crisis will also, it can be hoped, lead to greater understanding and acceptance of the contribution of RTD to Europe's economic, political and societal well being.

We in the Expert Group would like to express our deep gratitude to those who have helped to create this report. We are particularly grateful to the external experts (Professor Jakob Edler, Professor Philippe Laredo, Dr. Tarmo Lemola, Dr. Michael Stampfer, Professor Nick Vonortas) for supporting our work with their most valuable input, to members of the Commission services and others who gave up their time to meet us and especially to members of the European Commission DG -RTD unit 'Evaluation and monitoring of Programmes' (Dr. Peter Fisch, Dr. Neville Reeve and Dr. Gerburg Larsen) as well as to Dr. Susanne Holstein of the Evaluation Department of the Leibniz Association for their competent and discreet support.

Our special thanks go to our rapporteur, who – always under time pressure – made the impossible possible.

Berlin, Brussels, February 16, 2009
For the Expert Group
Prof. Dr. Dr. h. c. Ernst Th. Rietschel, Chair

# Executive Summary

## 1. Evaluating Framework Programme 6

This report presents the conclusions and recommendations of an Expert Group convened by the European Commission to provide an *ex-post* evaluation of the rationale, implementation and achievements of the EC and EURATOM Sixth Framework Programmes (FP6). Their combined budget of €19,235m, represents an impressive sum of money which accounts, however, for only about 4% of EU Member States' combined public R&D budgets.

The Expert Group finds that the achievements of FP6 have been substantial, while recognising that not all of its programme initiatives and tools have proven to be successful. It can find no evidence that plausible alternative approaches would have been more successful in the same timeframe, acknowledging the ambition, scale and importance of FP6.

Given the size, goals and the role of the FP6 on the European research scene, the Expert Group undertook a comprehensive review of FP6, and the conclusions and recommendations are aimed at distilling lessons learned from successes and failures of the FP6 in order to help shaping future FPs as key elements for achieving of the objectives of the European Research Area (ERA).

This evaluation was carried out while the 2008 financial crisis developed into a global economic recession. The analysis of the Expert Group strongly supports the view that investments in research and innovation are the best way to ensure Europe's competitiveness at a global scale.

This executive summary presents the Expert Group's evidence-based **conclusions** about FP6's performance and its **recommendations** about what needs to be changed in the future. It also offers the main elements of a broader **vision** for the future of the FP.

## 2. Conclusions

### 2.1. Achievements of FP6: a positive balance

FP6 was a powerful mechanism for catalysing RTD in Europe that could only be realised through action at the European level. It built upon the contributions of the Member States in order to become a key instrument to tackle sub-criticality in European RTD. The Expert Group believes that the activities under FP6, especially its core thematic priorities that constitute 65% of its total expenditures, have generated European Added Value (EAV), contributed generally towards increased industrial competitiveness, generated network externalities, and strengthened the knowledge infrastructure in Europe

FP6 included first-rate projects, involving top-quality researchers and well-managed consortia. Collectively, these have contributed to the improved mobility of researchers and to the internationalisation of research teams. This has helped Europe to amend its capacity to perform internationally competitive research at the frontiers of science and technology and in research areas of social and industrial importance.

While FP6 has strengthened the European Research Area, it was successful only to a limited extent in bringing the new knowledge all the way to the industrial sector.

Overall, FP6 achieved internationally respected scientific and operational standards for competitive, merit-based selection procedures, ensuring quality and offering a role model to those whose practices lag behind.

The Expert Group supports the view that bottom-up activities such as NEST need further analysis. Such activities could be instrumental in encouraging the exploration of new research avenues and to overcome established lock-ins.

The relationship between the Joint Research Center (JRC) and the FP deserves further investigation. The recent evaluation of the JRC called for significant continued development and improvement, including structural and strategic changes. Given the rich supply of equivalent and complementary capabilities available to the Commission at the Member State and global levels, the continuation of the JRC in its current form could be questioned. In fact, the non-competitive basis of JRC funding appears not to fit to the highly competitive environment of the FP unless it is given greater freedom to perform research.

FP6 took a considerable step forward towards coordination of EU and Member State RTD policies. Initiatives like the ERA-NETs and European Technology Platforms (ETPs) have helped stakeholders identify and explain their needs jointly, easing the process of developing mutually supportive policies at European and Member State levels.

The Expert Group noted with some concern that a downward trend in industrial FP participation continued under FP6. The poor quality of data available makes it impossible to state with some confidence whether the goal of allocating 15% of the FP resources to SME participation has been met. In any case, such a general goal is considered to be arbitrary and other ways to safeguard the adequate participation of SMEs in future FPs need to be developed.

Although some progress has been made towards an increased participation by female researchers in the FP, neither the level nor the rate of improvement are at this stage satisfactory.

### 2.2. Design of FP6: a mixed picture

While the overall achievements of FP6 were considerable, there is reason to believe that a more transparent consultation with stakeholder communities and a more explicit ‘programme logic’ would have produced a more robust overall FP design. Such an ameliorated, more transparent and probably also more detailed design would enable the FP to act more effectively as a ‘focusing device’, giving signals and incentives for the changes needed.

The role of the FP in the 'policy mix' at EU and Member State level is not yet well defined. Given its small size compared with Member State budgets, the FP needs to use its EAV in a more strategic way, defining an attractive and generally accepted European agenda rather than trying to implement such an RTD agenda by 'brute force'.

Many of the social and economic changes sought via the FP cannot be attained without greater consistency between research and innovation policy. Moreover, other policies such as transportation and energy would benefit from more coordination between FP research activities, regulatory and demand-side policies.

In the future, more attention needs to be given to the relationship between the FP and activities in the Member States. The FP cannot be treated as either a substitute or a coordinator for Member State R&D policies, nor as a remedy for local problems or cohesion issues. Instead, it may act as a 'coordinator' or 'lubricant' for multi-actor initiatives (like the ERA-NETs), alongside and in parallel with the traditional collaborative activities, which should not be weakened.

### 2.3 Implementation and management of FP6: room for improvement

The main novelties of FP6 in the thematic priorities – the new instruments IPs and NoEs – were not as successful as initially hoped in structuring the research community and institutions in the way envisaged. The smaller-scale efforts at policy coordination and establishing focusing devices, such as the ERA-NETs and ETPs, have been more, and in some cases very, successful.

The human resource actions of the FPs are almost universally judged to be a major success. By establishing working relations across Europe's knowledge infrastructure, these actions have been a major driver towards the ERA and also provided opportunities for European researchers to build long-term relationships with colleagues outside Europe, even if the take-up of such opportunities by Europeans could be improved.

The research infrastructure actions are seen as successful and of high value for Europe, as they are *a priori* much easier to implement than the complex arrangements needed to run a particular research infrastructure through an independent organization.

Complexity and lack of timeliness in administration remain stains on the reputation of the FP both within and without Europe. These flaws are a significant disincentive to participation in FP activities, and have for instance been cited as among the major factors contributing to the continuing decrease in industrial interest in the FP. In far too many ways, implementation acts against achieving the objectives that are being set for the FP. The complexities of the application and contractual procedures raise significant barriers to entry at the proposal stage, especially for first time applicants, be these research groups, firms, or organisations from new Member States.

The Expert Group has not seen evidence that the Commission, the Council and the Parliament sufficiently recognise the requirement for management processes which could cope with the complexity of a FP, with many goals, new instruments and approaches. More flexible application and contract procedures, based on a fuller, experienced-based understanding of the operations of high-performing research procedures are needed.

There has been considerable improvement in the way evaluation of the FP is organised in recent years. However, opportunities remain to improve these processes and an increased exchange of good practice with Member States could be of mutual benefit.

The public accountability of the FP must be increased – not through audit control, but through clear procedures and access to information at all stages and, where appropriate, through open access to the research results obtained through the FP funding.

## 3. Recommendations: a look to future FPs

The overarching objective for future FPs, and indeed for all aspects of European RTD policy, should be to increase the attractiveness of the European research ecology, making Europe the first choice for performing and capitalising on the fruits of research through knowledge transfer, commercialisation, social development and other routes. Procedures should be developed that are capable of providing substance to this idea. Based on these considerations the Expert Group recommends the following:

1 Prior to proposing plans for FP8, the Commission should analyse and more clearly document the current and future rationale of the FP at both aggregate and micro levels. The number of goals set for a FP should be commensurate with the Commission's and other actors' capacity to manage towards these goals. The Commission should document and make more transparent the consultation processes involved in designing a FP at both the aggregate and the Work Programme level

2 An FP, however, needs to be more than a reflection of what competing beneficiary or stakeholder communities want of it at the outset. It needs the flexibility to evolve and change. The FP should not develop into a substitute for the RTD policies of Member States or for other local problems, but should be better synchronised with national research efforts in order to strengthen and structure the ERA. It should also consciously avoid monopoly. At present, the Commission and the FP have a hand in almost all European RTD cooperations, risking a monotony of thinking and ideas and precluding the benefits of diversity in the European research system.

3 The 'Third country' terminology must be abandoned as it stands in the way for strategic thinking. It should be replaced by three strategies: one for EU FP

collaboration with the developing countries; one for collaboration with growth economies; and one for collaboration with industrialised countries outside the EU. The budget for cooperation with the major existing (such as US and Japan) and emerging economies (including India, China and Brazil) should be increased dramatically and strategies tailored to reinforce mobility with these countries and to engage them as partners in the mainstream of the FP, thereby strengthening both the quality and purpose of ERA. FP activities for collaborating with developing countries should concentrate on topics and technologies of relevance for development and where EU scientists are globally in the lead

4 A new bottom-up format (inspired by NEST in FP6) should be introduced to test research directions and original ways of achieving collaboration. The format's characteristics should be swift and risk-taking, 'scientific excellence' being the only criterion for selection

5 SME participation in the thematic priorities is important and should be encouraged. However, the utility of an overall 15% target should be re-examined in favour of mechanisms which are more in line with the relevant industrial dynamics

6 The Expert Group recommends continuing the ESFRI process, including its roadmap and foresight activities, recognising that FP activities that support research infrastructures which serve multiple fields have proven highly effective

7 Steps must be taken to substantially increase the participation of female researchers in FP projects, by means of much more pro-active approaches such as (re)introducing specific gender equality actions after quality criteria as a condition of funding in large instruments. Statistics must be systematically and continuously gathered, analysed and monitored and actions taken if progress towards equality is not being achieved

8 It is crucial for Europe's future scientific and technological vitality and competitiveness to ensure that research is seen by young people as an attractive career choice. Focusing the FP more strongly on addressing the major global needs and challenges could be one way of addressing this issue. Other elements would be to promote further the mobility of young European scientists and to allow more students and young researchers from scientifically emerging countries to study and work in Europe

9 Administration of the FP needs radical overhaul, not incremental tinkering. The Commission should engage external help to review its procedures – including its financial control procedures, with specific targets including reducing the 'headline' time-to-contract indicator by 50% and of moving from a cost basis in contracts to a price basis, so that cost no longer needs to be audited except perhaps for a small number of projects. In its support of scientific projects, the Commission should continue to change from a contract to a grant basis

10 The Commission should broaden its evaluation culture considerably, in order to measure and demonstrate the impacts of the FP. To date, evaluations of the FP have tended to focus on the planning and organisation of the most recent programme. There is a significant deficit in our understanding of the effects of the FP over time and on the wider context (including institutions; disciplines and technologies; industry; society at large; policy). While the programme-focused style of evaluation promoted by the Commission's internal regulations is of course important, it is hard to develop a good understanding of how the FP works and to improve it without also considering these other perspectives

During the interim evaluation of FP7, particular attention should be given to progress achieved in respect of simplification, the gender issue, and the issues of knowledge infrastructure and the inadequate level of industrial participation.

## 4. Vision

The Expert Group sees the spirit of Lisbon, Barcelona and the ERA as signaling a radical break away from the introvert character of Europe's past RTD policies and a desire to engage with a fast-changing world. Europe will build on its strengths to become a proactive partner in a global knowledge society, contributing actively to solve the global challenges.

Such a vision requires foresight and discussions of priorities that engage citizens as much as researchers and industrialists. It requires the promotion of risky research aiming at new knowledge, technologies and products. It requires the recognition that inventive and innovative sciences are nowadays strongly interlinked and mutually important. European collaboration and competition should represent the fundamental ingredients of Europe's path to global scientific and industrial excellence during the coming decades.

It is therefore time for a confident, scientifically capable, innovative European knowledge society to engage strongly with the world rather than defending itself from it or limiting itself to local concerns. This is not altruism but a necessity for survival: if Europe does not play the global game, it faces a future of decline. If Europe does not engage more effectively with the existing and emerging global economic superpowers, it will be left sitting at the side of the road.

There is enough experience now of the governance of research and innovation systems that we know the importance of combining top-down and bottom-up approaches. A future Europe, able to take on a confident, outward-facing role in the world will focus on two new lines of action: Grand Challenges and Great Ideas.

First, there will be a top-down process by the Commission to convert the problems, concerns and questions of citizens into a series of **Grand Challenges** and then act to meet them. Examples for such Grand Challenges could be social cohesion (including overcoming marginalisation and unemployment in the labour market), global security, education, climate change, environment, energy, global economy, health and aging population.

Second, Grand Challenges should be met by **Great Ideas** from bottom-up activities initiated by researchers, universities, research institutes, companies and others who

can offer interesting, high-quality research ideas. This implies something like the **European Research Council (ERC),** but one that is freed from the short-term constraints of being a budget line in FP7 and which builds also on research that is both cross-disciplinary and cross-institutional by virtue of being carried out by Pan-European teams of scientists.

The **ERC** must be supported by a strong political mandate to play a role in funding European frontier research. To do this, the ERC needs operational freedom and financial autonomy. In our vision, the current ERC policy towards individual grants should be supplemented by **NEST – like** competitions, strengthening the idea of cooperation as Centres of Excellence Programs do. ERC and NEST-like projects or programmes could be managed by an independently acting broad **Pan-European Agency** which functions on the basis of a strong Member State mandate and which is capable of handling increasing budgets in support of Frontier Research. The European Science Foundation (ESF) – in a suitably modified form – could take up such a role.

At the same time, an instrument could be created, which promotes excellence in the transfer of visionary scientific results into industrial applications (innovation). This instrument could ultimately reinforce European frontier innovation. For this instrument to be effective, the same requirements for excellence in addition to relevance must be applied to industry and SMEs, as to all other participants of the FPs.

Future FPs and other means to develop the ERA also must be funded adequately. **The budget required to achieve a well-designed and well-implemented FP that addresses the Expert Group's more far-reaching vision, given the heightened context of ERA, will be significantly more than the funding provided to FP7. The Expert Group supports such an increase, recognising that investment in science and technology may be the best response and a visionary step in the present times of economical crisis.**

The Expert Group therefore envisages a future for FP8 based upon the objective of "**European excellence through Global collaboration and competition".** This objective has to be coupled with an open collaborative attitude to the 'rest of the world' and an adequate financial support, a transparent but consistent evaluation culture and flexible, less onerous administrative and contractual procedures to address both the demand and the supply side of an EU RTD strategy. This will move the FP from being an incremental addition to national resources to something that is **Game Changing** in nature: perhaps two or three times its current size, valued for its contribution to new knowledge, enhancing the quality of life of Europe's citizens and solving global problems in partnership with the world. Participation in these endeavours will thus become a badge of honour for Europeans working in both academia and industry. The Expert Group looks forward to the day when the test of EAV becomes obsolete because each European project or programme, independent of its geographic origin will be considered beneficial for Europe and, therefore, fundable by Europe.

# 1 Introduction

Europe's recent decades of peace, prosperity and security have been enabled by its economic stability and that of neighbouring countries. Europe's economic growth and competitiveness and high social standards depend upon the capacity to generate and apply knowledge in many different fields. Europe currently produces about one third of the world's new scientific knowledge. The European Union (EU) is particularly strong in chemistry, astronomy, physics, biology, food research and the engineering sciences. In nanotechnology, for instance, the EU is one of the most active regions worldwide.

The Lisbon Council Meeting in 2000 ("Employment, Economic Reform and Social Cohesion towards a Europe of Innovation and Knowledge") took up the challenge of investing in research, innovation and competitiveness. It set the ambitious goal that the European Union should become the most competitive and dynamic knowledge–based economy in the world by the year 2010. Since research and innovation know no national borders, achieving the Lisbon goal would also require supranational cooperation and competition, including a borderless European Research Area (ERA) for academia and industry, just as the Community's wider economic objectives require common markets for goods and services.

The ERA idea received broad support at the highest political levels but achieving it required a strategy. The planning of FP6 provided the needed opportunity to translate the ERA vision into Research and Technological Development (RTD) policy. Hence, FP6 was intended to focus and integrate European research so as to 'structure' the ERA and strengthen its foundations. To achieve this, FP6 was allocated a budget of €19,235 billion[a] (amounting to annual spending of 3.9% of the EU Budget in 2001) and ran from 2002 to the end of 2006.

In May 2008, the Commission charged an Expert Group with undertaking an evidence-based evaluation of FP6. According to its mandate[b] the overall objective is to provide an evaluation of the rationale, implementation and achievements of FP6 in order to provide inputs to future Framework Programme (FPs) and policy design.

This is the report of the Expert Group.

In this introductory chapter, we place our evaluation within the longer history of FP evaluations and explain our evaluation methodology.

## 1.1 This evaluation

This is the first time there has been such a comprehensive evaluation of a single FP. The FP6 is also the first that is clearly intended to contribute to a wider set of policy initiatives, specifically the ERA and the Lisbon goal.

*Ex-post* evaluations of EU RTD programmes began in the early 1980s. A more systematic evaluation system developed from 1987 with the creation of a centralised Evaluation Unit. Five-year-assessments[1] and annual monitoring studies of the FPs

[a] Throughout this report, 'billion' (bn) means 'thousand million'

[b] Reproduced in full in Appendix B

using external panels of experts were introduced in the mid-1990s. Originally made up mainly of scientists and technologists, over time evaluation panels have become more heterogeneous, now including evaluation specialists and science policy experts. The current *ex-post* Evaluation of FP6 deals with the entirety of FP6 and will also provide some input to the interim evaluation of FP7 to be performed in 2010.

The amount of evaluative material available has increased across successive five-year assessments through to the current evaluation exercise, and the Expert Group has had at its disposal the following evidence base

- Twenty-eight evaluation and impact studies of various aspects of FP6, based largely on social scientific techniques
- Other studies of FP6, including a number of national FP6 impact studies and studies of 'Third country' participation in the Framework
- Panel-based evaluations of the Joint Research Centre[c] (JRC), and the IST theme of FP6[2] [3]; Expert Group reviews of ERA-NETs and Networks of Excellence together with the Marimon panel report on new instruments conducted early in the life of these new instruments in 2004
- Self-assessments of major thematic priorities, provided by their managers
- External reviews, such as that undertaken by the European Court of Auditors [4]
- Six background reports on key aspects of FP6, produced by independent experts and intended specifically to support the work of the Expert Group
- Interviews with key EU and FP officials as well as with chairs of expert panels that had reviewed the JRC, IST and certain new instruments
- Pre-existing published literature on earlier FPs, which help place the objectives, workings and outcomes of FP6 within a longer-term policy context
- Various contacts with national and institutional stakeholders at the national level

The Expert Group is composed of members[d] from a wide selection of research performing and funding institutions.

The work of the group has also drawn on the knowledge of its members, which includes technical expertise in several of the thematic priorities, wide coverage of different parts of the EU expertise in evaluation and science and technology policy, and expertise in the management and organisation of large-scale R&D activities.

The larger evidence base available to the Expert Group reflects a significant change in Commission practice, with a much increased commitment to doing and learning from evaluation. Partly in order to promote evaluation use and partly owing to the lack of personnel resources to drive a strong, central evaluation process, the Commission has decentralised management of RTD evaluation to the relevant programme managers in the four Directorates General involved in the management

[c] The JRC is a part of the European Commission and functions as a 'government laboratory' at the European level, largely providing data relevant to policy and regulation

[d] In line with the standard procedures, all members signed a declaration on the absence of potential conflicts of interest.

of the Framework Programmes. This leads to inconsistencies of timing and among the questions addressed by evaluation studies.

Despite the Commission's efforts at improvement, however, the Expert Group feels that at this time the evidence base is far from complete and still contains too much internal material. A similar need for better and more timely evidence was also identified by the last Five Year Assessment panel[5]. It would be particularly useful if future evaluations were provided with improved statistics on the principal investigators (gender, age, institution, country); industrial participation (type of industry, size and sector) and innovation resulting from FP funded activities (numbers of start-up firms, patents submitted and issued).

## 1.2 Evaluation issues

The Expert Group has aimed to address four broad sets of evaluation issues.

The first is the **rationale** of FP6. What are the policy objectives it addresses? Is it an appropriate way to tackle these objectives? Are its goals and the scope of its activities consistent with these objectives? The Expert Group tackle these questions within the historical context of FP6. In particular, the fact that overall policy goals shift through time means that the group is not only interested in how well FP6 addressed the policy context of 2002-2006 but also what it can learn for today's situation.

The second is **implementation**. This covers the way goals were set and the manner in which FP6 was designed as well as its structure, the amount and type of participation it attracted and the suitability of the instruments it employed to reach policy objectives. It also includes the way FP6 was administered, including progress in the Commission's efforts at simplification, processes used to assess proposals, the Commission's use of *ex-post* evaluation and the extent to which RTD results are disseminated.

The third is **achievements**. Here the Expert Group considers the results of research and their quality, the effects of FP6 on research and industrial competitiveness, its contribution to reaching wider policy goals such as the ERA and a number of other goals including gender and SME participation.

An evaluation that only looks backwards is of less use than one that also looks forward. The Expert Group therefore draws **conclusions** from the FP6 experience and – informed by these – sets out **recommendations** and a **vision** for the future.

There are many opinions about the value and effectiveness of the FP. The Expert Group has chosen, in line with good evaluation practice, to prioritise the use of evidence over opinion and to 'triangulate' among different sources of evidence wherever possible. But finally, however much the group strives to follow good social scientific practice in the use of evidence, evaluation involves judgements. The Expert Group has aimed as far as possible to distinguish between the evidence base and its own judgements and, where judgements are made, to justify them.

# 2 The Sixth Framework Programmes and their context

This chapter describes the rationale for the FP: why it is necessary to intervene in RTD; the idea of European Added Value, and the importance of the European Research Area. It discusses the context of the programme and its history before setting out its budget, structure and goals and ends by briefly mentioning some developments in EU RTD policy thinking that have taken place since FP6 was launched.

## 2.1 Policy Rationale

### 2.1.1 Why intervene in RTD?

To consider why a Framework Research Programme is necessary requires a contemporary perspective, based on what the scientific literature on research and innovation says. All governments fund research and seek to stimulate innovation, aiming to exploit knowledge to create more welfare through economic development and improvements in public services. This is justified in economic theory by the idea of **'market failure'**[6]: private companies cannot fully capture the economic benefits of research, some of which spill over to others in society. Hence entrepreneurs 'under-invest' in research and the state invests on behalf of society, which is rewarded through the creation of public goods and spillovers.

While the old 'linear model' of innovation – the idea that fundamental research somehow 'causes' innovation – remains influential, it was shown 30 years ago[7] to be incorrect. Research and innovation play roles in complex 'innovation systems'[8], where actors have bounded rationality, make imperfect decisions and depend to a significant degree upon interaction with other actors and the broader context. Current research and innovation policies therefore tackle not only market failures but also various kinds of **systems failures,** such as lock-ins to old and/or inappropriate trajectories and failures of information, networking and coordination. '**Focusing devices**', such as foresights and thematic cooperations that draw the joint attention of industry, universities and research institutes to interesting research fields and important industrial and social problems, can address such failures. Research and innovation policymakers are also concerned with the **balance** among different types of intervention, so the old debate about whether to fund 'basic' research or innovation has been abandoned as misconceived. Growing attention is paid to **governance** of research and innovation systems to ensure each component is able to play its part.

The FP to date has – like national funding – played a role in combating market failure. But its main contribution is to tackle systems failures at the European level and to provide focusing devices. Key issues in thinking about the FP then include: "What is the right policy mix?" and "How does one find and use focusing devices that concentrate European efforts on the important things?" The quality and effectiveness of FP **design** are therefore crucial to its ability to play its intended role.

### 2.1.2 European Added Value

The focus on improving the European innovation system has been embodied in the idea of European Added Value (EAV) since the early FPs. Up to and including FP5, almost anything that involved cross-border networking, mobility or infrastructure building within Europe counted.

From FP6 onwards, the idea of EAV has become more complex[9] to include 'variable geometry' interventions, where not all Member States need be involved. It has included establishing new organisations such as European Technology Platforms (ETPs) and, during FP7, the European Research Council (ERC) and the European Institute of Technology and Innovation (EIT) that have the potential to become permanent. One new aspect of EAV from FP6 onwards has therefore been a more generous interpretation of 'subsidiarity' that allows the Commission to intervene in things that make sense at a European level even if they could – at least in principle – be addressed by Member States or groups of Member States. While the ambition to 'structure' Member States' RTD policies and activities was present before FP6, the introduction of the Open Method of Coordination as well as interventions such as ETPs and ERA-NETs in FP6 made it clear that the Commission aimed not only to tackle things that (from an European perspective) could be seen as systems failures but also the policy mix at European and national levels.

### 2.1.3 The European Research Area: a new policy dynamic

This extension of the idea of EAV results from a change in the ambitions of EU research and innovation policy. The 2000 Communication on the ERA[10] argued that Europe lagged the USA and Japan in industrial competitiveness and the ability to make social and economic use of research. Complaining that there was no European policy on research, it proposed a unified research area, comparable with the idea of the EU as a common market for goods and services. "De-compartmentalisation and better integration of Europe's scientific and technological area is an indispensable condition for invigorating research in Europe."

This meant breaking down borders between the Member States in order to 'optimise at the European level' features such as policy coordination, overall investment in RTD, networking and the building of critical mass in RTD. Also targeted were increased human mobility and the bringing together of the scientific communities of the new Member States with those of the EU-15, the creation of more opportunities for female and young researchers and steps to make Europe a highly-attractive place to do research based on common ethical values. Two months later, the Lisbon Declaration[11] set Europe "a new strategic goal to become the most competitive and dynamic knowledge-based economy in the world, capable of sustained economic growth with more and better jobs and greater social cohesion". Research and innovation actions building on the idea of the ERA were to be pursued but broader policies were also involved that included improved policies for the Information Society, modernising the 'European social model' and macroeconomic policies. Not long afterwards, the Council set the Barcelona target of spending 3% of EU GDP on R&D.

One of the roots of the ERA idea is expressed in *Society, the Endless Frontier*[12] which in 1997 promoted the idea of a 'European innovation system' that would be federal in character and that would reduce Member States roles. This federalising aspect appears to have been one reason why policymakers were initially reluctant to be more specific about the meaning of 'ERA'. The so-called 'Open Method of Coordination' of Member States' RTD policies promoted by the Commission in the

past few years is an attempt to increase the amount of federal-level influence on their policies.

The 're-launch' of ERA in the 2007 Green Paper[13] defined the ERA concept as: "a European 'internal market' for research, where researchers, technology and knowledge freely circulate, effective European-level coordination of national and regional research activities occurs, programmes and policies and initiatives are implemented and funded at European level." The European scientific community, business and citizens should have an adequate flow of competent researchers, world-class research infrastructures funded at EU scale, excellent research institutions, effective knowledge sharing among research and industry and research-governments, well-coordinated research programmes and priorities including cooperation to coordinate research activities and a wide opening of the ERA to the world. The meaning of 'ERA' has therefore shifted and evolved over time. It is argued[14] that the concept of ERA has helped to replace the subsidiarity principle with the idea that the EU is the 'natural level' for major initiatives. "ERA is not a state but the … outcome of a long lasting process of Europeanisation".

## 2.2 Context

The Expect Group does not intend here to provide a lengthy analysis of changes in the industrial and research context in the period leading up to and during FP6. Nonetheless, the evaluation must take account of the fact of continuing changes in how, by whom, where and why RTD is undertaken

- The growth in business expenditure on R&D, in absolute terms in most economies and often also as a proportion of Gross Expenditure on R&D (GERD), underlines the changing balance of knowledge production in society towards production of knowledge in the context of application[15] with a corresponding need for appropriately-skilled people right across society, not just in the universities. An old-fashioned policy focus on the knowledge infrastructure as the source of all new knowledge does not deal with this new reality
- The apparent gradual withdrawal of many major companies from more fundamental research increases the importance of network links in industrial knowledge acquisition. Some aspects of what is now termed 'open innovation'[16]are related to this trend, but much RTD activity is networked without also being 'open'
- From the start of this decade there have been reforms to EU universities and to a lesser degree research institutes, so the roles of key institutions are in flux
- With continued globalisation of production, the 'Triad' (Europe, USA, Japan) has lost its quasi-monopoly of RTD. China, India and other large developing countries such as Brazil have become major actors with huge RTD investments
- The growing consensus on major social priorities such as climate change and altered perceptions of security since 9/11 imply a growing role for non-economic criteria in setting aims for state-funded RTD

The accession of ten New Member States during FP6 also meant that the FP had in 2004 to absorb many new participants from systems still undergoing reorganisation towards EU standards, with RTD generally having been under-funded for many

years, comparatively weak infrastructures and institutional structures that had tended to keep research, higher education and industry apart.

## 2.3 History

Europe has a long tradition of research cooperation. CERN was set up in 1954 and COST, one of the longest-running European cooperations among scientists and researchers in 1971. RTD has been central to the European communities since the early days of the iron and steel community. The FPs date from the mid-1980s: the First in 1984 to 1987 emphasised IT and nuclear energy. Over time, the scope has widened[e] and the repertoire of instruments has increased from pre-competitive collaborative research to encompass mobility, networking, research infrastructure, self-organised joint actions aiming to coordinate national RTD funding policies, development funding for non-EU countries and research to support the Commission's policy needs.

Up to and including FP4 (1994 to 1998), the collaboration benefits of networking, cohesion and scale were largely seen as sufficient justification for the FPs. FP5 (1998 to 2002) shifted the focus towards socio-economic benefits but this was largely abandoned because it proved too hard to assess projects and evaluate FP5 in socio-economic terms. The focus of FP6 on the ERA led to increased concern with research and the Knowledge Infrastructure of universities and research institutes. The Commission was also under pressure to limit administrative costs to the 6% prescribed in the FP6 legislation. FP6 therefore included new, larger instruments. The original industrial strand received less focus, especially outside Information and Communication Technology (ICT). Later during FP6 the Commission launched European Technology Platforms (ETPs) and ERA-NETs, encouraging groupings to self-organise and develop cross-border arrangements that would drive RTD and innovation policies for their sectors or technologies. By and large, these collect together strong established interests. The thrust of the ETPs is continued in FP7's JTIs (Joint Technology Initiatives) and increased interest in joint programming, including Article 169 consortium arrangements.

Thus, while the nature of the FPs has evolved, there has never been a clear strategy to ensure that its relatively small contribution to Europe's state-funded research would assist in structuring the whole investment, which is still primarily shaped by national institutions and investments. Yet, with FP6, achieving such a structuring effect became an explicit objective.

## 2.4 Structure and goals of FP6

The legal basis of FP6 is set out in Article 163 of the European Community Treaty[17], which says that Community research is about industrial competitiveness and the provision of research to support policy.

> §1. The Community shall have the objective of strengthening the scientific and technological bases of Community industry and encouraging it to become more competitive at international level, while promoting all the research activities deemed necessary by virtue of other chapters of this Treaty.

[e] The Appendix B shows a schematic view of the changes and links between thematic areas from FP3 to FP7

> §2. For this purpose the Community shall, throughout the Community, encourage undertakings, including small and medium-sized undertakings, research centres and universities in their research and technological development activities of high quality; it shall support their efforts to cooperate with one another, aiming, notably, at enabling undertakings to exploit the internal market potential to the full, in particular through the opening-up of national public contracts, the definition of common standards and the removal of legal and fiscal obstacles to that cooperation.

These goals are to be pursued via RTD and demonstration programmes, promoting cooperation among companies, research centres and universities and with 'Third countries'[f] i.e. those which are neither members of the EU nor associated with the FP) and international organisations, disseminating the results of research and promoting researcher mobility (Article 164). The Community and Member States are to coordinate their research and technological development activities (Article 165). Article 166 says these goals shall be pursued via a [18]multi-annual FP, which is to comprise more specific programmes and which should be adapted or supplemented as the situation changes. The FP is therefore a multi-purpose construction with the freedom to evolve.

The specific legal basis of FP6 is in five separate pieces of Council legislation[19] comprising two distinct programmes, one under the European Community Treaty and the other under the EURATOM treaty.

**Table 1** assembles the budgets[g] from these decisions (as revised in 2004 to take into account the enlargement of the EU at that time) into a single table, in order to make the overall structure of FP6 visible. The combined budget of €19.235 bn, or a little under four billion Euro per year – was equivalent to about 4% of EU Member States' combined government funded RTD budgets. (Coincidentally, FP6 also made up about 4% of the EU's overall budget).

The biggest part of FP6 was the 'priority thematic areas', which represented a strong continuity with the work of past FPs. (5.4Appendix B shows how this thematic continuity is achieved at the level of the specific programmes.) The new instruments (NoEs and IPs) were deployed here.

The 'Specific activities covering a wider field of research' (7.3% of the budget) were a blend of the new and the old. The 'Policy support and anticipating scientific and technological needs' line mixed up rather targeted policy-relevant research with the New and Emerging fields in Science and Technology (NEST) programme, which relied on researchers to propose projects that could set new directions, in order to serve as a leading edge not only for research but also for intelligence about interesting research directions. Special activities for SMEs, which had been incorporated in the FPs since FP2, also continued under this heading. The 'special measures in support of international cooperation' also continued previous activities in support of the EU's relationship with developing countries.

The block 'Structuring the European Research Area' accounted for almost 15% of the budget and also built on previous FPs. The innovation line contains networking

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[f] This Expert Group argues that "Third countries" could be subdivided into three subdivisions: developing countries, growth economies and industrialised countries.

[g] An additional €50m was voted in 2004 to fund the second line of the EURATOM Framework

and information measures, many linking the academic and industrial communities. The main mobility measures fell under the Human Resources heading. The major effort in research infrastructures was new to FP6, however, while the Science and Society line scaled up activities already present in FP5.

The block 'Strengthening the foundations of the European Research Area' which accounted for just under 2% of the budget was new in FP6, aiming specifically to 'structure' the combined European RTD effort, coordinating national activities, doing policy studies and benchmarking to encourage coordination and the development of a European research and innovation policy.

**Table 1 Structure of FP6 and its Budget (€m)**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Sixth Framework Programme for RTD and Demonstration Activities (EUR million)** | **17,883** | | | | | **93.0%** |
| *1. Focusing and integrating Community research* | | *14,682* | | | | *76.3%* |
| 1.1. Thematic priorities | | | 12,438 | | | 64.7% |
| Priority 1 Life sciences, genomics and biotechnology for health | | | | 2,514 | | 13.1% |
| • Advanced genomics and its applications for health | | | | | 1,209 | 6.3% |
| • Combating major diseases | | | | | 1,305 | 6.8% |
| Priority 2 Information society technologies | | | | 3,984 | | 20.7% |
| Priority 3 Nanotechnologies and nanosciences, knowledge-based multifunctional materials, new production processes and devices | | | | 1,429 | | 7.4% |
| Priority 4 Aeronautics and space | | | | 1,182 | | 6.1% |
| Priority 5 Food quality and safety | | | | 753 | | 3.9% |
| Priority 6 Sustainable development, global change and ecosystems | | | | 2,329 | | 12.1% |
| • Sustainable energy systems | | | | | 890 | 4.6% |
| • Sustainable surface transport | | | | | 670 | 3.5% |
| • Global change and ecosystems | | | | | 769 | 4.0% |
| Priority 7 Citizens and governance in a knowledge-based society | | | | 247 | | 1.3% |
| 1.2. Specific activities covering a wider field of research | | | 1,409 | | | 7.3% |
| Policy support and anticipating scientific and technological needs | | | | 590 | | 3.1% |
| Horizontal research activities involving SMEs | | | | 473 | | 2.5% |
| Specific measures in support of international cooperation. (4) | | | | 346 | | 1.8% |
| 1.3. Non-nuclear activities of the Joint Research Centre | | | 835 | | | 4.3% |
| *2. Structuring the European Research Area* | | *2,854* | | | | *14.8%* |
| Research and innovation | | | | 319 | | 1.7% |
| Human resources | | | | 1,732 | | 9.0% |
| Research infrastructures | | | | 715 | | 3.7% |
| Science and society | | | | 88 | | 0.5% |
| *3. Strengthening the foundations of the European Research Area* | | *347* | | | | *1.8%* |
| Support for the coordination of activities | | | | 292 | | 1.5% |
| Support for the coherent development of policies | | | | 55 | | 0.3% |
| | | | | | | |
| **EURATOM Framework Programme (EUR million)** | **1,352** | | | | | **7.0%** |
| *1. Priority thematic areas of research* | | *978* | | | | *5.1%* |
| 1.1. Controlled thermonuclear fusion | | | 824 | | | 4.3% |
| 1.2. Management of radioactive waste | | | 99 | | | 0.5% |
| 1.3. Radiation protection | | | 55 | | | 0.3% |
| *2. Other activities in the field of nuclear technologies and safety* | | *55* | | | | *0.3%* |
| *3. Nuclear activities of the Joint Research Centre (JRC)* | | *319* | | | | *1.7%* |
| | | | | | | |
| **Grand Total** | **19,235** | | | | | **100.0%** |

**Source**: European Commission

The EURATOM FP made up 7% of the total budget. Three fifths of the EURATOM budget was spent on the long-term aim of making fusion into a viable source of electric power. The balance went on nuclear safety, waste storage and radiological protection and to the JRC to enable safeguards and legacy work to be undertaken.

**Table 2** Overview of FP6 Goals attempts to summarise the rather complex set of goals defined at various levels of the programme. The overall goal of the FPs is laid down in the Treaty. The lower level goals associated with individual budget lines are subordinate to this overall goal but are so general that there is little potential for conflict among them. None of FP6's goals at this level can be described as 'SMART' (Specific, Measurable, Attainable, Realistic and Timely), – normally seen as desirable characteristics of goals in planning. There are at least five overlapping clusters of goals associated with the budget lines

- Increase of the inventive and innovative capacity as well as competitiveness in the EU
- Support of the development of the ERA, thereby involving industry as well as the knowledge infrastructure
- EU policy support, including identifying new and emerging areas of RTD
- Development of nuclear fusion
- Promoting nuclear safety

The preambles to the Council decision on the RTD programme introduced a number of additional goals, namely to

- Increase the participation of female researchers in the programme to better exploit the talent potential
- Promote sustainable development
- Promote researcher mobility and training
- Promote innovation
- Meet the needs of SMEs and encourage their participation
- Promote cooperation with 'Third countries', especially Candidate Countries
- Respect fundamental ethical principles

In addition, the JRC should actively pursue activities in innovation and technology transfer and, in relation to EURATOM, it should pay special attention to training Candidate Country people in safety and ways to prevent illicit trafficking in nuclear materials.

Table 2 Overview of FP6 Goals

| Activities | Goals |
|---|---|
| **Sixth Framework Programme for RTD and Demonstration Activities (EUR million)** | Strengthen the scientific and technological bases of Community industry and encouraging it to become more competitive,<br>while promoting all the research activities deemed necessary by other Chapters of this Treaty (Treaty, Article 163) |
| 1. Focusing and integrating Community research | |
| Thematic priorities | Support development of ERA |
| Specific activities covering a wider field of research | |
| Policy support and anticipating scientific and technological needs | Provide information to support EU policy<br>Research new and emerging areas of science and technology in order to explore potential and develop leading European positions |
| Horizontal research activities involving SMEs | Support the competitiveness and internationalisation of SMEs via trans-national collective and cooperative RTD projects |
| Specific measures in support of international cooperation | Open up the ERA to the rest of the world by helping EU researchers and businesses aces knowledge outside Europe, support EU participation in global RTD initiatives and support EU foreign and development policies. |
| Non-nuclear activities of the Joint Research Centre | Provide customer-driven scientific and technical support for the conception, development, implementation and monitoring of European Union policies. |
| 2. Structuring the European Research Area | Remedy weaknesses in European research and innovation |
| Research and innovation | Make a tangible improvement in Europe's innovation performance … by stimulating a better integration between research and innovation, and by working towards a more coherent and innovation-friendly policy and regulatory environment across the European Union |
| Human resources | Promote researcher mobility with a view to the successful creation of ERA and its integration in the global RTD communities |
| Research infrastructures | Develop high quality common research infrastructures at a European scale based on the needs expressed by the research community |
| Science and society | Increase society's acceptance of and engagement with science; rectify gender imbalances in research |
| 3. Strengthening the foundations of the European Research Area | Structure the ERA by coordinating Member State activities and policies |
| **EURATOM Framework Programme** | Contribute to the creation of the European Research Area (ERA) in the field of nuclear energy by improving integration and co-ordination of nuclear research in Europe. |
| 1. Priority thematic areas of research | |
| 1.1. Controlled thermonuclear fusion | Make progress towards demonstrating the scientific and technological feasibility of fusion energy and assess its sustainability |
| 1.2. Management of radioactive waste | Determine practical ways to reduce radioactivity, contain and safely store radioactive waste |
| 1.3. Radiation protection | Resolve uncertainties and set standards for the wider safe use of radioactive materials |
| 2. Other activities in the field of nuclear technologies and safety | Explore new concepts, train and ensure the safety of nuclear installations |
| 3. Nuclear activities of the Joint Research Centre (JRC) | Support Community policies and specific Treaty obligations entrusted to the EC nuclear energy |

**Sources**: Council Decisions

FP6 therefore was given a number of rather high-level programmatic goals onto which additional desiderata were hung. There was a large jump from the high-level goals to detailed work programmes, with little consideration of the adequacy of these programmes for reaching the goals, either in terms of their technical strategies or in terms of the size of the budget available. There was a general lack of explanation of

desired outcomes and how these were to be achieved or of how these would be complemented by other EU and Member State actions. Some steps were taken towards addressing this issue in FP7.

The European Court of Auditors[20] has pointed out that the lack of specificity of FP objectives tends to complicate monitoring and evaluation. However, the Expert Group believes that the situation also creates useful challenges which might lead to better evaluation. For instance the need to take into account evolving research goals requires more flexibility in the design of evaluation work. This in turn could support a more differentiated approach to the timing of evaluations, between exercises looking at intermediate results and other work to assess long-term effects. All of this could be achieved if relevant statistics for monitoring progress were more readily achievable.

## 2.5 Subsequent European policy developments

FP7 strengthened the link between research and the broader policies within the EU. It also responded to the concerns expressed by the scientific communities in Europe for a European Research Council (ERC) to fund researcher-initiated research.

By the time FP7 was launched, it was clear that the Union had made insufficient progress to reach the ambitious policy goals set in Lisbon and Barcelona. The Aho group emphasised the demand side of the economy and advised[21] on the need for a more innovation-friendly market in Europe and that a coordinated effort was needed in regulation, standards, public procurement, intellectual property and fostering a culture that celebrates innovation as well as more (and more effective) RTD. This innovation-friendly market should focus on large-scale strategic areas such as eHealth, pharmaceuticals, energy, environment etc. It depended upon increased mobility of people, money, organisation and knowledge, and such mobility should be pursued in EU policy. These ideas were underscored in the new Green Paper in 2007[22] to 'relaunch' ERA.

A recent expert panel report[23] looking at the rationale for ERA proposes moving beyond the more traditional view of EAV related to subsidiarity and focusing the ERA on Europe's response to a series of Grand Challenges that depend upon research and actions to promote innovation and that have relevance at the European level, effectively extending the direction set by the Aho group. It also reinforced the need for a dynamic 'research-friendly ecology', institutional (university) autonomy, functioning European research markets and a major increase in resources allocated to RTD at the EU level.

# 3 Implementation of FP6

This chapter describes how FP6 was implemented. It starts with the design process then looks at participation, thereby focusing on the overall shape of the programme, gender, country participation, industry and participants outside Europe. It discusses the design, rationale and implementation of the new FP6 instruments before addressing assessment and evaluation, the extent of simplification of procedures and whether more progress is needed in this respect. Finally, it discusses dissemination of knowledge from the FP.

## 3.1 How FP6 was designed

The design of a FP is a complex exercise in consensus building and consultation involving people from Member and Associated States and occasionally from 'Third countries'. There are both formal and informal aspects involved in this undocumented process, and while a great deal of consultation is clearly involved, the logic of the final choice of topics and the balance among budget lines remains opaque. Some established stakeholders can have influence on both thematic priorities and the content of specific work packages. At times, the results of this process can appear arbitrary. Some industrial research managers have indicated the need for more open trend analysis and technology road mapping exercises before selecting the topics for the upcoming programmes and calls. The ETPs could play a significant and more prominent role here.

The outcome of the consultation process is a draft FP, representing the work of many parts of the Commission. Hence in FP6 the structuring elements were largely disconnected from the thematic priorities. The decentralised nature of the design process means that strong coordination would be needed to ensure the overall coherence of FP design and experience suggests this is not achieved. The draft FP is agreed with the Member States and the European Parliament via the so-called Co-decision procedure (Art. 251 of the Community treaty) and becomes the subject of EU consultations with Directorates-General within the Commission, the Parliament and the Council of Ministers. In practice, the draft tends to emerge little changed from these formal consultations, so the real design choices are made at the earlier stage. The EURATOM consultations involve a much smaller number of stakeholders, whose identity is well known, and proceeds in a clearer fashion.

At the start of FP6, the Commission called for Expressions of Interest in IPs and NoEs. Over 11,700 Expressions of Interest arrived in Brussels, of which only 14% came from industry. Results of this large-scale consultation exercise – which from the Call text appeared to be a precondition for participating in FP6 at all – were presented to at least some programme committees but appear not otherwise to have been used.

While consultation is a key requirement for successful programming, the group is concerned about the lack of transparency of the consultation processes involved. It is a simple fact that the Commission requires high quality information on what are the real needs for research, and this should not be obscured or crowded-out by lobbying from the Member States or a lack of harmonization between the Directorates General in charge of the FP.

Steps should be taken to ensure that these processes are documented, and that stakeholders know how to provide the information needed. There is reason to believe that the design process is improving. Under current rules, the design of FP8 will have to be subject to an *ex-ante* impact assessment. This is an important step towards greater transparency.

## 3.2 Participation

### 3.2.1 Overall participation

FP6 made in total 213 Calls for Proposals, attracted 56,000 proposals involving 390,000 potential participations and awarded some 10,000 contracts to 74,000 participants. **Table 3** indicates that the new instruments led FP6 to have fewer, bigger projects than FP5. On average, the number of participants per contract doubled between FP5 and FP6. The Human resource and mobility actions (HRM) involve large numbers of small grants, which is why they are taken out of the equation in two of the columns. There were over 23,000 Marie Curie applications, of which some 4,500 succeeded.

**Table 3 Overview of FP5 and FP6 participation**

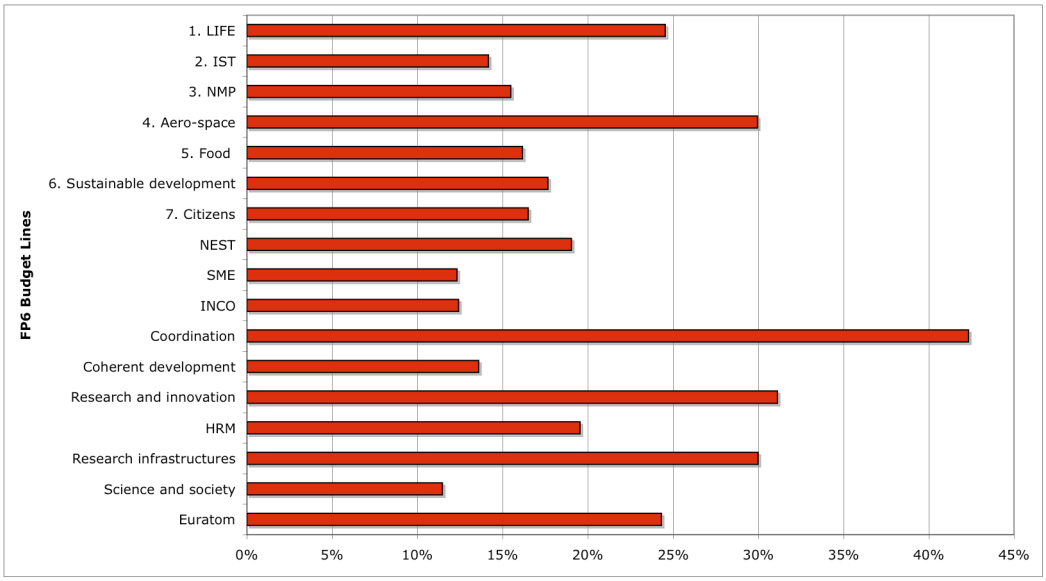
| | FP6 | FP6 excluding HRM actions | FP5 | FP5 excluding HRM actions |
|---|---|---|---|---|
| Total No of contracts | 10,058 | 5,485 | 16,553 | 12,391 |
| Total No of participants | 74,400 | 65,960 | 84,267 | 75,046 |
| Average No of participants per contract | 7.4 | 12.0 | 5.1 | 6.1 |
| Total EC financial contribution €m | 16,669 | 14,952 | 13,065 | 11,808 |
| Average EC financial contribution €m | 1.66 | 2.73 | 0.79 | 0.95 |
| Average EC contribution/participant €m | 0.22 | 0.23 | 0.16 | 0.16 |

**Source**: DG-Research, *FP6 Final Review: Subscription, Implementation, Participation*, Brussels: European Commission (EC), July 2008. Excludes EURATOM fusion, which is contracted via contracts of association with national fusion associations

Compared to FP5, success rates fell in FP6: fewer than one in five proposals was accepted in FP6 (18% success rate) and only some 19% of applicants were successful in FP6 compared to 26% and 24% in FP5. **Figure 1** shows success rates in the various thematic areas of FP6.

The most heavily over-subscribed major budget lines of FP6 were the SME measures, the International Cooperation area (INCO), IST, Support for the Coherent Development of Policies and Science and Society (Figure 1). Most of the areas with high success rates are ones where stakeholders are limited in number and already organised in networks, as in the aerospace industry, regional innovation support structures and research infrastructures. Comparing the major RTD instruments, the STREPs with only a 16% success rate were the most heavily over-subscribed.

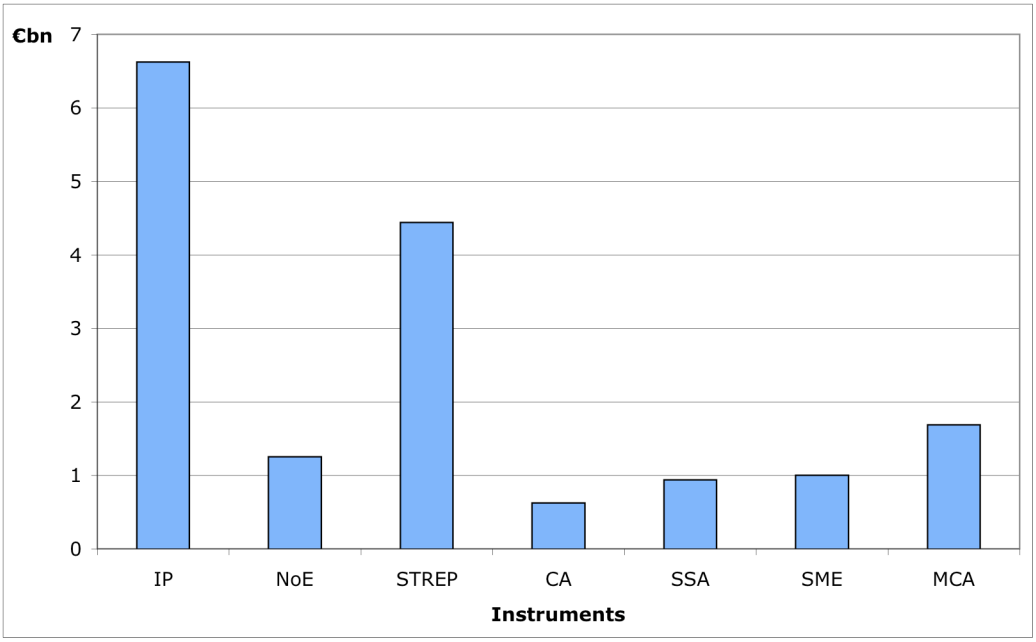
**Figure 1 Proportion of proposals obtaining funding (success rates) in FP6**




**Source**: DG-Research, FP6 Final Review: Subscription, Implementation, Participation, Brussels: European Commission, July 2008

The Commission financial contribution by instruments is shown in **Figure 2**. In the RTD framework (excluding EURATOM), the new IP and NoE instruments accounted for nearly half (47.5%) the Commission financial contribution while specific targeted research projects (STREP) accounted for a further 26.9%[24].

**Figure 2 Commission's Financial Contribution by Instrument in FP6**




**Source**: Nicholas Vonortas, *FP6 Participation*, Washington DC: George Washington University, 2008

IP = Integrated Project. NoE = Network of Excellence. STREP = Specific Targeted Research Project. CA = Coordination Action. SSA = Specific Support Actions. MCA = Marie Curie Action

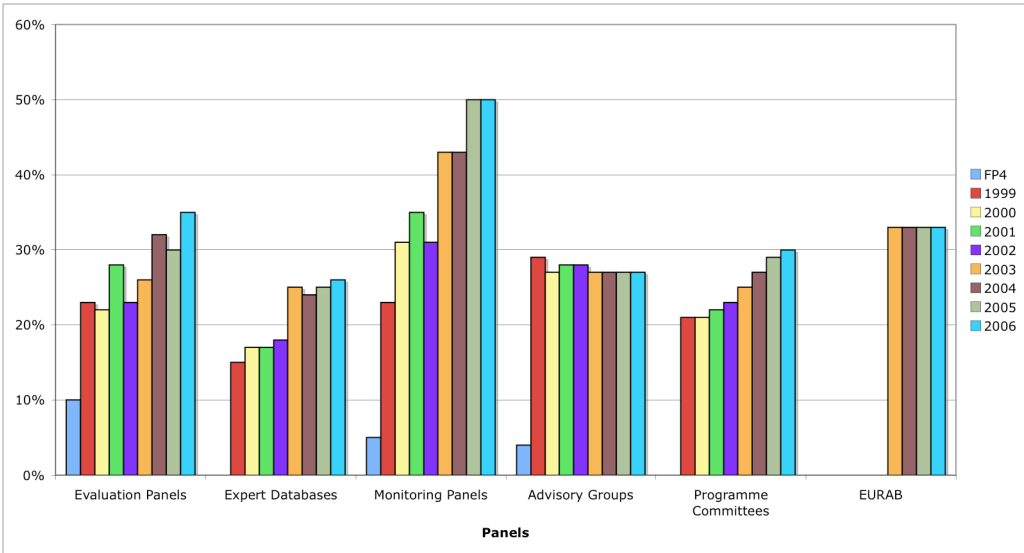
### 3.2.2 Gender

The percentage of female coordinators in FP projects (16-17% in 2006) was distinctly lower than the overall percentage of female researchers recorded in Europe in 2003 (29%)[25]. The success rate for women and men as coordinators is equal but women are more likely to coordinate smaller instruments like Coordination Actions and Special Support Actions than larger ones. Women coordinated only 10% of IPs and 8% of NoEs.

The Commission undertakes a gender survey of all FP projects and in FP6 it requested IPs and NoEs to produce specific gender action plans[26], which could be funded as separate work packages. However, these incentives did not result in any significant progress towards a more balanced gender participation in FP activities.

In 1999, the Commission set a target[27] of 40% female participation in Marie Curie actions and panels, which it subsequently expanded to include all groups, panels, committees and projects involved in the FPs[28]. The statistics suggest steady improvement since 1999 with women now accounting for some 26% of panel participations[29]. This is partly a controllable achievement: it is possible to decide to appoint more women, though the Commission cannot alone take these decisions since it appoints only some of the panels listed (i.e. evaluation and monitoring panels, advisory groups and EURAB). **Figure 3** suggests that the target is not taken sufficiently seriously by all actors involved.

**Figure 3 Proportion of female researchers in FP committees, FP4-2006**



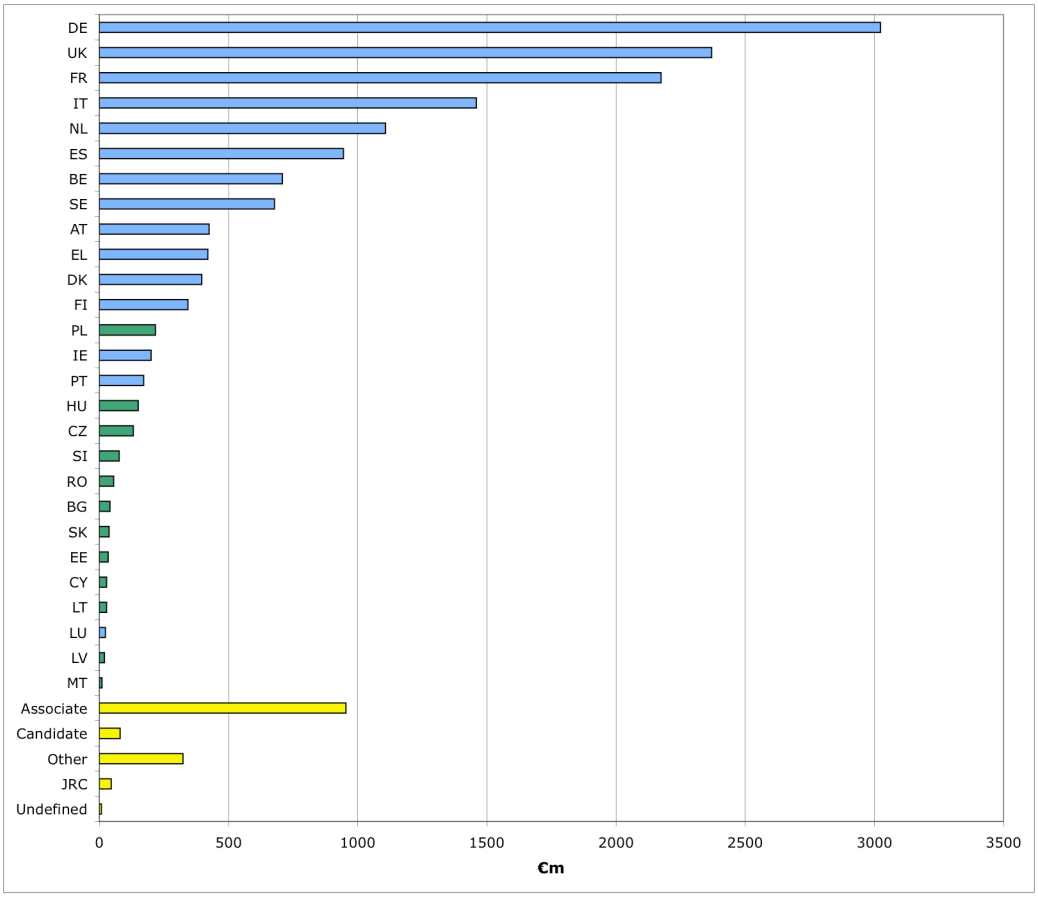

**Source**: DG-Research, Directorate L, Gender Equality Report – Framework Programme 6, Brussels: EC, October 2008. The composition of the expert databases and programme committees are outside the Commission's control

While there is some weak evidence that female participation in FP projects has risen[30], there is no mechanism in place in the FP to cause this, so it probably results from the growing proportion of women in younger cohorts of researchers and the natural effects of their ageing. However, there still appears to be a 'glass ceiling' of informal rules and practices that limits women's freedom to rise to the top in their research careers. The similarity of female and male success rates suggests there are no discriminatory mechanisms at work in the FP – and that it is under-representation of women at the senior level in participating institutions that causes their under-representation in the FP.

### 3.2.3 Country participation in FP6

The degree of financial participation by the EU-27 and other countries in FP6 varies significantly (**Figure 4**). Member States accounted for 91% of participation, Associated States for 6% and the current Candidate Countries for 0.5%, others received 2%. FP6 was the first FP in which the ten new Member States entering the EU in May 2004 participated with full membership rights. Romania and Bulgaria became full members only in 2007, i.e. after FP6, but all are included in the statistics below.

**Figure 4 Community contribution in FP6 by country**

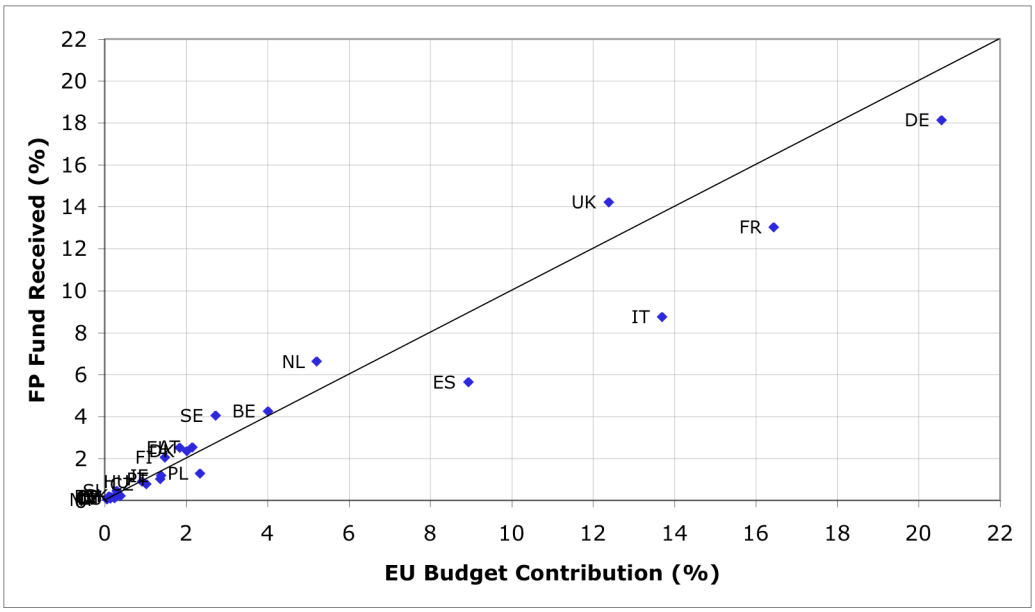



**Source**: DG-Research, FP6 Final Review: Subscription, Implementation, Participation, Brussels: European Commission, July 2008. New Member States shown in green

It has been a key principle of the FPs from the start that they exist to serve the European interest and that the principle of 'juste retour' does not apply. 'Juste retour' is the idea that the share of the financial returns a Member State obtains from the Community budget (in the form of grants) should be the same as its share of the overall contribution. In Figure 5a and 5b this principle is illustrated as the 1:1 relationship between input and output. This 1:1 relation is central to some types of non-EU research and technology cooperation such as the European Space Agency

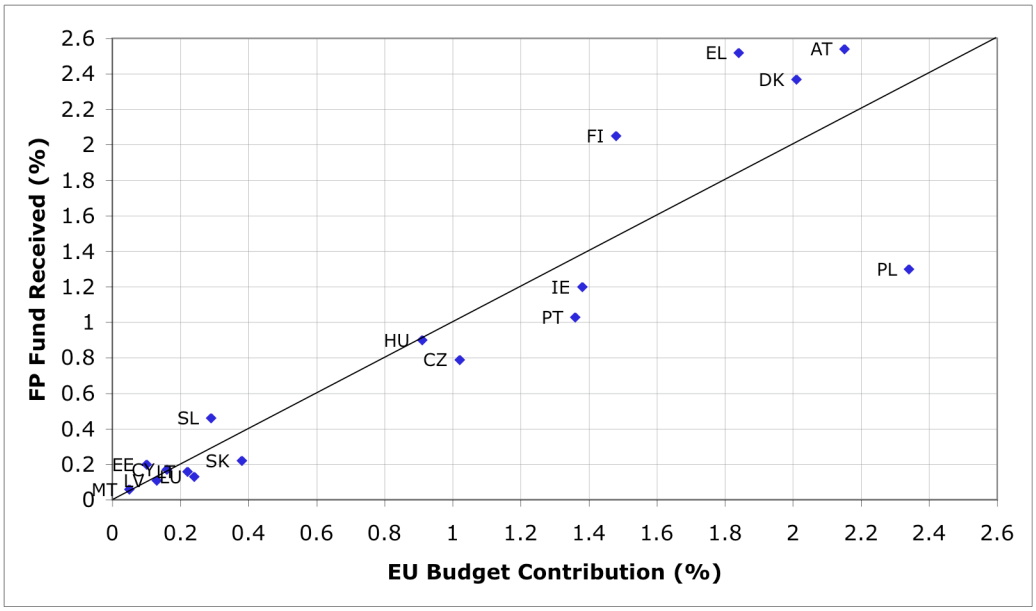
**Figure 5a and 5b** clearly show that the 'juste retour' principle did not prevail in FP6, as some countries deviated quite considerably from the 1:1 line.

**Figure 5a** **Shares of EU GDP (2005) and Retour in FP6 (larger Member States)**




**Source**: DG-Research, FP6 Final Review: Subscription, Implementation, Participation, Brussels: European Commission, July 2008

**Figure 5b** **Shares of EU GDP (2005) and Retour in FP6 (smaller and medium Member States)**

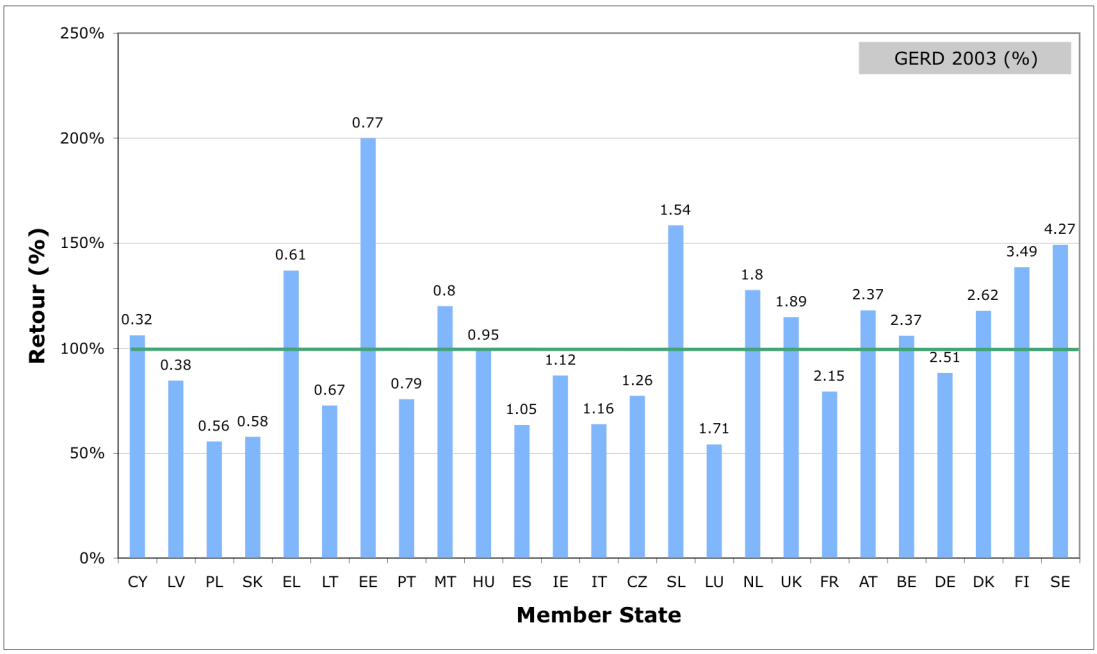



**Source**: DG-Research, FP6 Final Review: Subscription, Implementation, Participation, Brussels: European Commission, July 2008

These data should be subject to thorough analysis and reflection at a national level, as they provide a direct indicator of how efficient and persistent research communities are and could help when deciding how much time and effort should be invested in building international research networks.

Such an analysis needs to take into account certain more general trends. First, it takes time for new members to build up their participation, with the effect that at the outset they are often net contributors to the FP budget. The experience of Swedish and Austrian participation after they joined the Union showed this clearly. Second, small, research-intensive countries tend to get more back than they put in. Given that the majority of the FP budget goes to universities and research institutes, we would expect places like the Nordic countries with higher than average spending on those institutions to do especially well – as they do. Third, and perhaps rather surprisingly, there is only a weakly positive correlation between the percentage of GDP a country spends on research and development (GERD), and that country's financial success with the FP **(Figure 6)**. It appears that some countries under-exploit the opportunities provided by the FP, the key to exploiting these opportunities being greater investment in time and money.

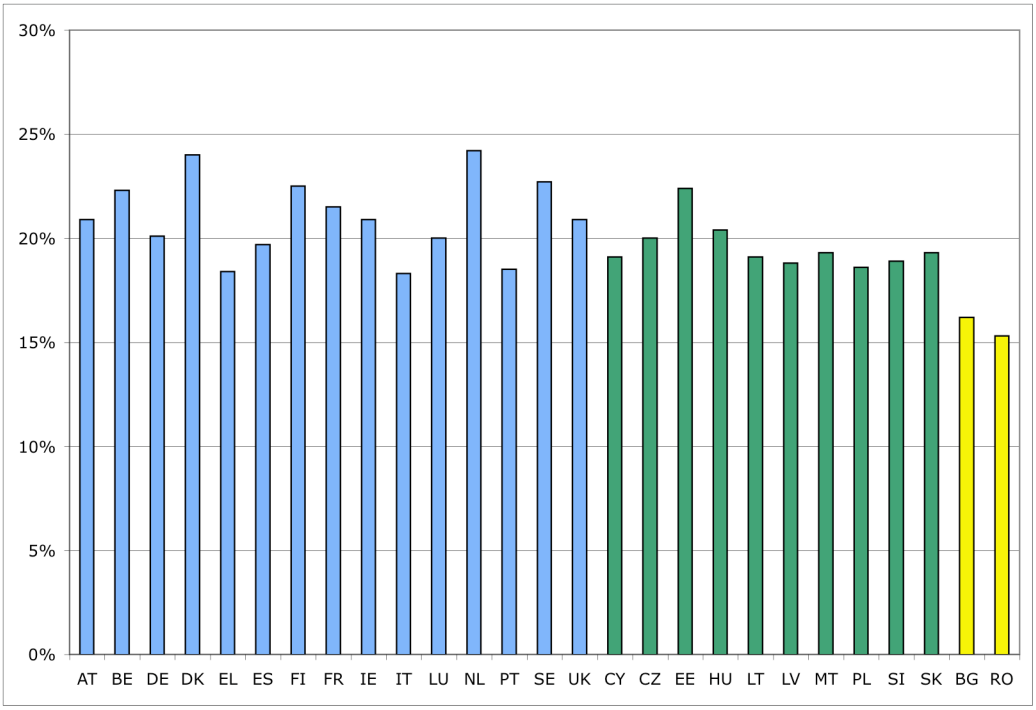
**Figure 6 Retour in FP (ratio of %FP participation to % contribution to EU GDP) vs. increasing Member State GERD level**




**Source**: DG-Research, FP6 Final Review: Subscription, Implementation, Participation, Brussels: European Commission, July 2008

**Figure 7** shows that success rates for proposals from EU-15 Member States (18% on average) were comparable with those of proposals that included participants from the (10+2) new Member States (16% on average)[31] across all priority areas and instruments.

**Figure 7 FP6 Success Rates for proposals by Country**

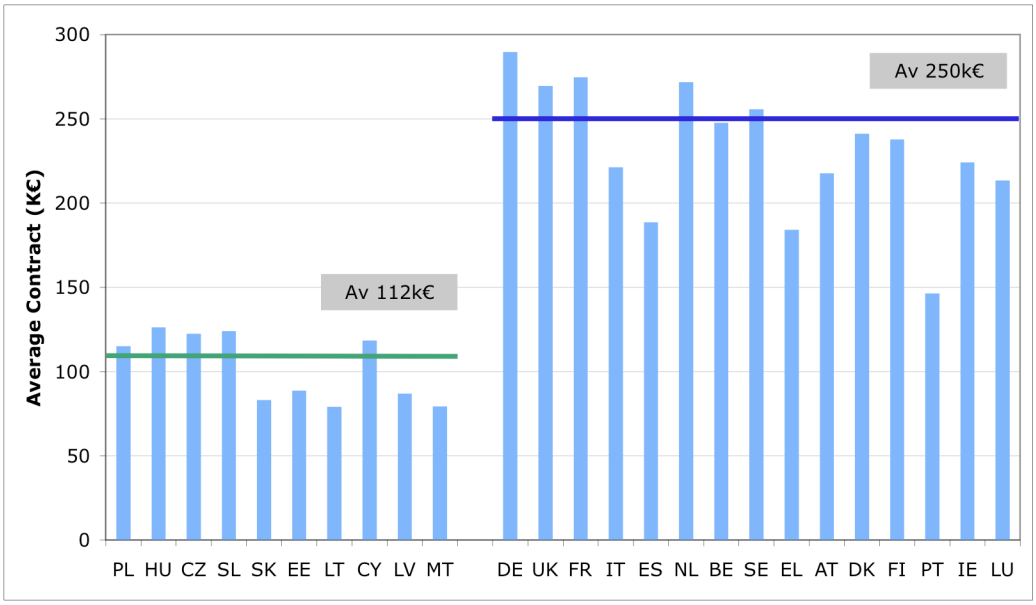



**Source**: DG-Research, FP6 Final Review: Subscription, Implementation, Participation, Brussels: European Commission, July 2008. EU-15 shown in blue. 2005 new Member States in green. Subsequent entrants in yellow.

Finally, in terms of Community participation per project partner, the participants from the new Member States received on average €112k, which is less than half of the €250k received per participation from the EU-15 (**Figure 8**). This difference is partly driven by wage differentials that should close over time and partly by the new Member States' participants' lesser FP experience that limits the importance of their role in many projects. Notably, they obtained few of the coordinator positions in FP6. FP networks operate much like any others: they evolve slowly and new members have to demonstrate capability and build trust before getting major roles.

The new Member States will assimilate further into the FPs over time, as others did before them. Ireland and Greece show that the FP can make a major contribution to developing RTD capacity and quality. Increasing FP participation requires also increased effort at the national level. Some of the latest 12 entrants need similarly to build capacity and will do well to build links to Structural Funds in order to fund this.

**Figure 8 Average participation contract NMS vs. EU-15**




**Source**: EC DG RTD statistical paper

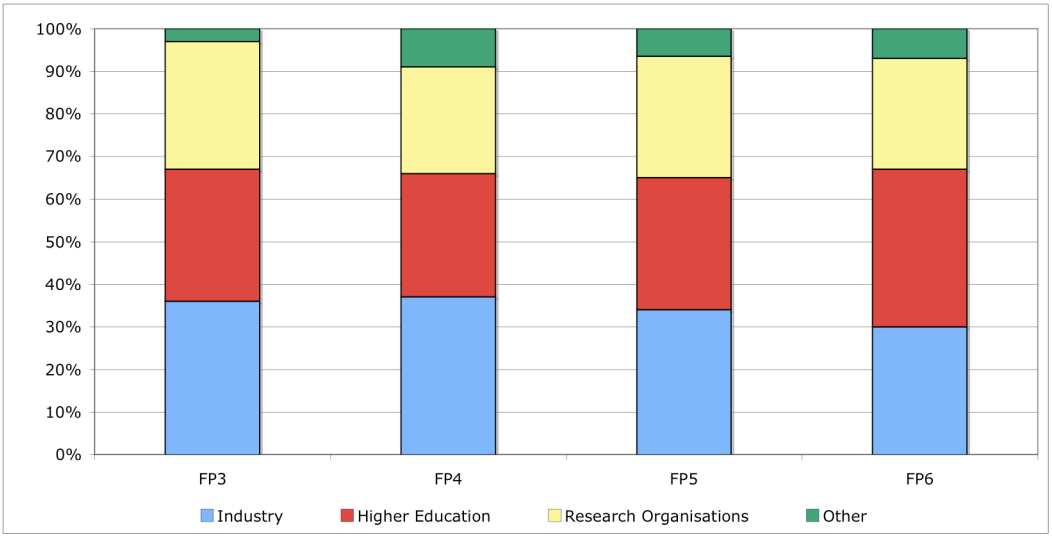
### 3.2.4. Industry

FP6 continued the trend of declining industrial participation in the FP (**Figure 9**).[h] The downward trend has continued steadily from FP4 to FP5 and to FP6. This is a very worrying indication that FP activities may not live up to the overall goal of stimulating the competitiveness of Europe. The major recipients of funding from the FP are researchers outside the business sector – who may of course have good industrial links - but the declining direct industrial participation suggests a problem, even if some parts of industry such as aerospace and automotive are clearly very well organised to participate directly in the FP.

Pharmaceuticals provide a useful illustration of where industrial participation under FP6 actually went down, in this case in spite of the selection of topics being designed to favour relevant research for the pharmaceutical industry. There are strong indications that the pharmaceutical, chemical and biotech industries in Europe have found that the FP is too time consuming and too slow for them to be able to participate. Other serious disincentives for industrial participation in FP6 included the contract conditions regarding IPR (requiring access to both background and side ground knowledge), combined with the large size of the IP projects (with the stipulation that competitors joined the same IPs).

[h] The quality of EC data about participants has improved over time, but there are still problems and different results are obtained depending on how much the data are 'cleaned'. The EC's Final Report on FP6 claims that the Business Enterprise Sector had 31% of participations and 26% of the funding in FP6. The meaningfulness of this statistic is undermined by the growing organisation of research institutes as limited companies, despite their real role as public institutions

**Figure 9 Shares of Participation by Organisation Type in FP3 to FP6**

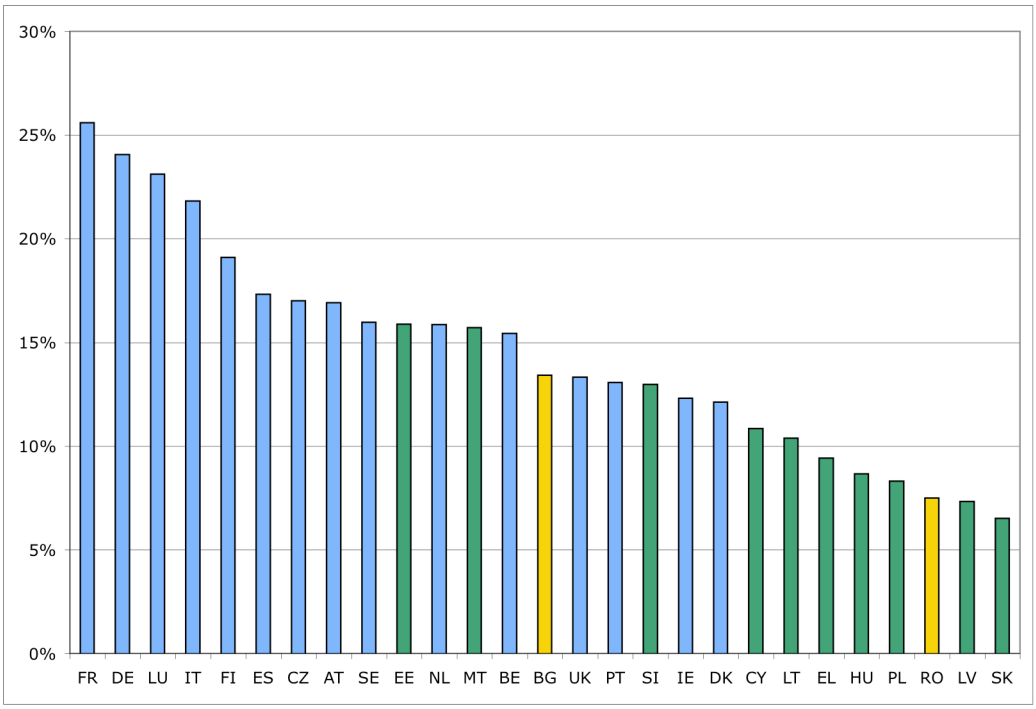



**Source:** Report of the Five Year Assessment Panel Chaired by Erkki Ormala, 1999 – 2003, Brussels: DG Research, 2004

The highest industrial participation is in IST, NMP, Aerospace and Sustainable Development. This reflects an important industrial focus in IST, a continuation to a degree of the industrially focused BRITE/EURAM activities in NMP and the concentration and research-intensity of the European aerospace industry. Industry participation is surprisingly low in the life-sciences-based thematic priorities: health and food.

**Figure 10** shows the degree to which industry in the Member States has benefited from FP6 funding. Industry's share of Community funding varies from the 6.5% of the funding received by Slovakian industry to 25.6% in France. On average, industry in the EU-15 received 17% of Community funding, compared with 11% in the new Member States. However, there are considerable overlaps between the ranges of shares obtained by industry in the two groups of countries, e.g. Bulgaria and Denmark.

**Figure 10 Proportions of Community contribution going to industry by country**




**Source**: Vonortas EU-15 shown in blue. 2005 new Member States in green.red. Subsequent entrants in yellow

### 3.2.5. Participation of Small and Medium Enterprises (SMEs)

It is unfortunate that the available FP6 data do not provide a clear and unambiguous record of SME participation. An analysis carried out specifically for this exercise[32] identified 6.1% of the FP6 budget as going to SMEs, based on the Commission's data, which contain large numbers of records where the size of participating firms is not clear. The Commission itself instead estimates that over all thematic areas 16% of industrial participations came from SMEs and that 11% of funding went to SMEs in FP6, compared with 17% and 12% in FP5. This would place the FP close to its target of allocating 15% of the RTD Framework budget to SMEs. It is surprising that the Commission has not been able effectively to monitor progress against such a simple indicator as company size. In principle, the Unique Registration Facility in FP7, that lets all applicants register their details once and re-use them if they make multiple proposals, should address this problem.

The requirement for significant SME participation in the FP routinely emerges as an addition to the mission of the FP during the process of negotiating its funding, rather than being something that is core to its mission. In principle, there are two distinct types of SME participation. The first category comprises companies with significant technological capabilities involved largely in the thematic priorities, often in partnerships with larger firms but essentially able to participate as intellectual equals who benefit from being part of the wider knowledge system. This category needs no special treatment beyond the requirements for simple procedures since such firms are

fully capable of standing on their own feet and playing a useful role in the FP, even if overall participation statistics suggest this role is normally rather short-lived[33].
The second category of lower-capability SMEs need to enhance their technological capabilities in an international context. However, we suspect this category in practice rarely participates in the FP. With only a 12% success rate in the SME-specific measures, the companies that win the competition are already technologically rather capable.

### 3.2.6 Opening up the Framework Programmes to the world

The five 'Associated Countries'[i] contribute to the FP budget as if they were EU members and participate on the same terms as Member States; they have become strongly integrated into the FPs and the European RTD communities. They account for about 6% of the FP budget.

So-called 'Third countries' provide 5.7% of all participations[34]. They receive in total about €375m (2.3%) of the budget in the RTD Framework without making any budget contributions. Two thirds of this budget (some €250m) goes to their participation in the thematic priorities. The difference of about €125 m comes from the INCO (international cooperation) budget, which is aimed at doing research to support development in financially weaker countries and not at routine FP participation. Thus, of INCO's FP6 budget of total €345m, only €125m (36%) ended up outside Europe, the balance going to EU participants. Of course, wages are lower in developing countries than in Europe and partners from developed countries in principle get no money from INCO, but it is nonetheless striking that two thirds of the money (€220 m) intended to support development in practice remains in Europe. Non-EU partners coordinate very few projects and tend to play a subsidiary role.

**Table 4** shows more details about the Commission contributions to FP6 participants outside the European community. Some 7% of these contributions went to developed countries, of which by far the largest part to the US. During the course of FP6, €2.5m per year, however, represents a very narrow link to the strongest scientific nation on earth. Arguably cooperation with the developed economies can build on co-funding from their side. The Russian Federation and China are the major beneficiaries. Given its size, India gets surprisingly little. Again, the tenuousness of the FP link to the major developing world economies is striking.

This should be seen as a warning signal: the EU is failing fully to exploit the potential offered by the FP's collaborative research activities as the means to connect with the most world's most dynamic and fastest growing research nations.

[i] Switzerland, Israel, Iceland, Liechtenstein and Norway

**Table 4 FP6 funding of 'Third Countries' in Euro**

| | | | |
|---|---|---|---|
| RU - Russian Federation | 49,843,528 | CA - Canada | 2,621,349 |
| CN - China | 35,192,191 | SG - Singapore | 2,225,707 |
| YU - Serbia and Montenegro | 14,887,074 | JP - Japan | 1,005,287 |
| ZA - South Africa | 14,435,614 | NZ - New Zealand | 901,626 |
| BR - Brazil | 14,397,318 | KR - Korea (Republic of) | 477,975 |
| US - United States | 12,526,867 | TW - Taiwan | 123,700 |
| IN - India | 11,877,892 | Other developing countries | 147,111,046 |
| MA - Morocco | 11,479,920 | Other developed economies | 532,184 |
| AU - Australia | 3,774,741 | Total | 323,414,019 |

**Source**: Calculated from DG-Research, FP6 Final Review: Subscription, Implementation, Participation, Brussels: European Commission, July 2008. Categorisation of countries as 'developed' or 'developing' follows that used by the Commission

### 3.2.7 Human resources and mobility

In FP6 the human resources and mobility (HRM) schemes (well regarded by the Expert Group) involved 8,440 participants, receiving an average of just over €20k each. Close to 20% of proposals in this area were successful. Only some 6% of participants were in industry. Since no other data for HRM in FP6 are available, a rough overview on its predecessors in this area is given.

In FP4-5, the main instrument – Marie Curie Fellowships – funded roughly equal numbers of PhD and post-doctoral fellows[35]. The fellowships have high prestige, offering candidates the opportunity to go abroad and learn new research skills. Mobility within the scheme is somewhat uneven, with the UK, Denmark, the Netherlands and Norway attracting a disproportionate number of fellows while Southern and parts of Eastern Europe experience net outflows. Most commonly, fellows return home after a period, bringing new skills and networks with them. The scheme is academically focused, with only 18% of beneficiaries having some kind of industrial link during their fellowships – a proportion that appears low in the context of the FP's overall objectives.

### 3.2.8. Conclusions on participation

The larger instruments in FP6 appear to have continued the downward trend in FP success rates described in Section 3.2.1. An overall success rate of some 18% of proposals involves a significant waste of resources and needs to be increased or mitigated via a two-step application process (see Section 3.4).

It is useful that the Commission now collects data about women's participation in the FPs, so that one can tell whether progress is being made. However, it seems to be doing little beyond exhortation to increase female participation. The Commission should study the 'glass ceiling' problem more closely and take coordinated action on women's research careers and opportunities with the Member States. It should use examples from the FPs to showcase women's achievements. The abolition of Gender Action Plans in FP7 is an example of unfortunate simplification. The Commission should make female participation a 'tie-breaker' criterion when considering proposals of equal merit in future. Gender equality should be strictly enforced in EU expert and advisory groups, panels and committees.

It is positive that all Member States and associated countries participate in the FP, as do a substantial number of other countries outside the EU. It takes time for new entrants to join established networks of FP participants. New Member States may need to invest in additional RTD capacity in order to increase their participation, for example using structural funds.

While there is little variation among the success rates of different Member States, some countries apparently manage to mobilise their research communities better than others. It is clear that in order to increase their returns from the FP the Member States should provide incentives and support for writing large numbers of high quality proposals.

The continuing slow decline in industrial participation in the FP is a cause for concern. Integrating producers, not only in industry but also in services and the public sector, into advanced knowledge production is vital in order to avoid perpetuating the 'European Paradox' expressed in the 1995 Green Paper on Innovation[36], which claimed that, while the EU was very good at knowledge production in the universities and research institutes, it was extremely poor at connecting that knowledge with value creation. Regardless of the true cause-and-effect linkages, increasing the supply of advanced knowledge without developing the networks with other organisations and feedback loops that are involved in innovation and wealth creation will make no contribution whatever to realising the Lisbon goal. The Commission therefore needs to ensure that the FPs and other policy measures are rebalanced so as to ensure the development of the European Research and Innovation System as a whole. This would involve tailoring the FP instruments better to match the needs of industrial participants, for example in relation to intellectual property right (IPR) conditions and the timeliness of procedures.

Overall, although the Expert Group recognises that support for SMEs is a worthy and necessary ambition, it is not convinced that overlaying this political concern on the FP results in the best use of resources, unless a thorough understanding of the sector dynamics supports this. The group urges the Commission to analyse the role of SMEs in the FP at a deeper level and to consider whether the FP or another mechanism is really the best way to support this group of firms in a way that is consistent with the principle of subsidiarity. (For example, the structural funds could be used more actively for the purpose of building up research and other capacities of SMEs.)

Global[j] participation in FP6 has increased compared with FP5. But the use made of this FP to engage with 'Third Countries' does not come across as strategically focused, despite the overlay of bilateral research agreements between the EU and various countries. The term 'Third countries' is in itself an obstacle to strategic thinking and strategic actions. Specific strategies and instruments must be made for each of the three categories of Third countries, e.g. attraction of talent should be thought through with most focus on growth.

[j] In this context, the group points out that the Commission's practice of describing non-European activities as 'international' is misleading. Europe is a Union, not a nation, and to describe non-European activities as 'international' is therefore incorrect

The human resource and mobility activities of the FP are well respected and involve large numbers of people in building international networks and experience. There remains scope to improve the somewhat patchy coverage of the schemes across countries (including 'Third Countries') and to achieve greater industrial involvement.

### 3.3 The design and rationale of the FP6 instruments

At the start, FP6 introduced three new instruments – Integrated Projects (IPs); Networks of Excellence (NoEs); and Article 169 arrangements. During the course of the programme, two new instruments involving a low level of Commission funding – ERA-NETs and European Technology Platforms (ETPs) – were added to the instruments portfolio. Other instruments were continued from FP5. Why their names were changed between FP5 and FP6 is unclear. These other instrument were

- The Integrated Infrastructure Initiatives (I3), which have been seen as very successful
- Specific Targeted Research Projects (STREPs) a continuation of the FP's traditional RTD collaborations ('shared cost actions'), doing objectives-driven research, involving limited numbers of partners, normally mono-disciplinary and focused on single issues within a thematic priority which had been very popular and worth continuing in future FPs
- Coordination Actions (CA – formerly concerted actions and thematic networks), designed to network together other research activities, normally in order to improve integration and coordination of EU research, without in themselves funding research
- Specific Support Actions (SSA – formerly called accompanying measures), which promote the work of the FP (for example, by road mapping or stimulating new partnerships and laying the ground for future joint projects)
- Specific actions to promote research infrastructures
- Human mobility schemes, notably the extremely popular Marie Curie post-doctoral grants, which were carried over from FP5 to FP6

The NoEs and IPs were intended to have a structuring effect by de-fragmenting the European research infrastructure. ERA-NETs and ETPs were intended to prompt self-organisation among stakeholders leading to cross-border funding cooperations with variable geometry inside the EU. On average

- An IP project involved 25 participants and received Commission funding of €9.5m over four years
- An NoE involved 30 participants with an Commission contribution of €7.5 over four years
- A STREP involved 9 participants and received €2 million in Commission contribution for three years

The Innovation Impact study found that IPs and NoEs tended to be used for slightly more exploratory projects than the traditional instruments[37].

### 3.3.1 Integrated Projects

Integrated projects (IPs)[38] were intended to assemble all major players in a specific area and to establish a 'critical mass' of activity big enough to affect Europe's competitiveness or to address major social needs. They were to include longer term or more risky RTD than previous shared cost actions, comprise multidisciplinary programmes with a number of modules, normally cost in the tens of millions of Euro and last three to five years. Part of each IP's budget was to pay for a consortium management, delegating administration and thereby reducing the Commission's in-house costs.

IPs tended to be led by people from industry or research institutes, who were equipped to take on the managerial task involved. Germany (25%), France (16%), Netherlands (11%) and the UK (16%) had the greatest proportions of IP coordinators: in total, 68% of Member State coordinators compared with their 57% of the funding. The EU-15 were more strongly represented than the new Member States in IPs: 24% of their participations were in IPs, compared with a little over 13% among the New Member States.

Interviews and surveys suggest that people from universities preferred STREPs to IPs both because they are small enough to be manageable from a university base and because their proliferation means there is a better chance of launching a STREP on a topic of interest to the researcher. Some branches of industry resisted participating in IPs because their larger size implied an obligation to cooperate with competitors beyond the logic provided by the business sector. This was especially difficult in areas such as life sciences, where specific intellectual property is key to competition but may take many years to reach application. The combination of larger projects (sometimes including industrial competitors in the same IP) and with compulsory contractual conditions for sharing not only the projects' own foreground results but also giving access to side ground and (when necessary) background results as well, was a very strong disincentive for industrial participation.

One use of IPs has been to reflect industrial consensus. This is clear from the Aerospace thematic priority, which is dominated by IPs and where the research agenda was to a high degree set by the European industry, using its European technology platform for aeronautics (ACARE) as a focus. This had had the effect of focusing, or at least including, FP effort on the interests of strong, existing EU industry. Such large instruments may be vital if in future the EU opts to focus some of its RTD effort on 'Grand Challenges' at continental level. However, in areas like biotechnology, clean technology and parts of ICT, where – especially in the USA – new, small firms drive growth, a different approach is needed.

Interim results from an ongoing study[39] of the original new instruments – IPs and NoEs – show that participants do believe IPs help build critical mass but also that the Call obliged them to use IPs. IPs did not reduce the administrative burden – over 50% of respondents thought it increased. IPs increased the size, diversity and international nature of the networks in which people operated. However, almost 50% experienced major unexpected positive benefits– suggesting that the protests of the research community against the IPs in the early days must also be tempered in the light of their subsequent experience.

### 3.3.2 Networks of Excellence

Networks of Excellence (NoEs) were "designed primarily to overcome the fragmentation of European research" and "to strengthen scientific and technological excellence on a particular research topic by integrating at European level the critical mass of resources and expertise needed to provide European leadership and to be a world force in that topic."[40] Commission guidance was that a NoE should durably integrate the research capabilities of at least six partners, involve education, training – typically at the doctoral level – and disseminate knowledge. Curiously, NoE coordinators are concentrated in France (26%) and Italy (22%), giving them 48% of all the NoE coordinatorships compared with their 24% combined share of NoE funding received by the Member States. Only two NoEs were coordinated by a research team from a new Member State[41].

The concept of NoEs changed a number of times. At one point, they were expected to be major funding instruments with tens of millions of Euros and few partners. Later publicity pointed increasingly to the need for NoE applications to have many participants. In the end, the NoEs became large and academic. Industry obtained only 7.6% of the participations and a mere 4% of the funding. Some of the NoEs approach the pure focus on networking seen in COST and ESF programmes. Only a minority of NoEs implemented joint programmes of activities that have provided a basis for more durable integration[42]; overall, the NoEs failed to address the problem they were designed to tackle, i.e. sustainably to structure the ERA.

A new survey of NoE participants[43] shows that most participated because NoEs were prescribed in a Call. They expected and got bigger networks and were exposed to more new partners and new interdisciplinary influences than would have been the case in STREPs. However, the NoEs were also more peripheral to their activities and they tended to be used as tools for preparing lasting relationships and proposals for research rather than to do research.

While the NoEs were initially conceived as a tool for improving critical mass within ERA, this outcome was hindered by the Commission's apparent desire to sign up as many participants as possible, reinforcing rather than decreasing fragmentation. In the period since 2000, many Member States have begun investing in competence centres and other kinds of centres of excellence to reduce national fragmentation.

While there were very few calls for NoEs in FP7, it was suggested in the review of Networks of Excellence[44] that they should in selected cases be continued in the form of **Joint Research Initiatives** (JRIs). These Initiatives would need long term funding in order to use networking as a way to restructure the research community and should not be limited to small numbers of participants. A related issue also deserving of further attention is the possibility for funding selected centres of excellence.

### 3.3.3 Article 169

Article 169 of the Treaty says that the Community can contribute to RTD programmes set up jointly by several Member States, without all the members of the Union having to be involved. Such initiatives should fit within the FP's thematic priorities and be co-funded by Member States. They should involve enough Member States to have a structuring effect and a critical mass.

Article 169 arrangements were found to administratively very complex to establish and only one was set up during FP6: the European and Developing Countries Clinical Trials Partnership (EDCTP), established in 2003 by 15 European countries to create a sustainable research partnership between European and African countries. The objective was to reduce the burden of AIDS, TB and malaria on the EU and global economies via clinical trials and capacity building in Africa. Implementation of the Article 169 appeared, however, to be challenging. The scope of EDTCP was very ambitious and it faced many difficulties. An external review[45] made several recommendations to improve EDCTP policies, governance and operations and urged the Commission further to develop Article 169 instruments.

Under FP7 two more arrangements have been approved (Ambient Assisted Living – AAL – and EUROSTARS) in addition to the upcoming programme METROLOGY.

### 3.3.4 European Technology Platforms

The European Technology Platforms (ETPs) were not true FP6 instruments but originate with the Communication 'Industrial Policy in an Enlarged Europe'[46], and then became a key policy complement to FP6. Their main policy objectives were to

- Support the development and deployment of those key technologies in Europe that are vital to address major economic and social challenges
- Define a European vision and a strategic agenda for the development and deployment of these technologies
- Support the objective of increasing European private research investment by bringing research closer to industry and improving markets for innovative products[47]

ETPs were to be self-organising groups of stakeholders, normally (but not always) led by industry in order to agree common strategic research agendas. In many cases, the Commission has funded early coordination costs but industry has generally carried the greatest load for funding the secretariats and other common activities involved. The Commission is otherwise not involved except as an observer if desired. In many cases, 'mirror groups' of potential national funders accompany ETPs.

The intervention logic can be interpreted in several ways. One is to give greater transparency to the foresight and other types of technology-road-mapping processes underpinning substantial industrial objectives that draw upon public funding, by increasing the number of public and private sector stakeholders taking part while keeping the most knowledgeable actors at the centre of the process. A second is to flag the legitimacy of industrial leadership in designing public-private RTD

initiatives: indeed, groupings akin to ETPs (e.g. NanoCem) have now been formed without any Commission involvement. A third is as a structuring tool, to help align union, Member State and industrial research policies.

As of December 2007, there were 34 ETPs. Their activities involve: developing Strategic Technology Plans for their own areas; identifying mechanisms to obtain the needed public and private investment; identifying relevant skill and education needs; and communicating the need for action at a European level. In many cases, industry participates in the hope of influencing the agenda of the FP. Some 45% of ETP stakeholders are industrial while 40% are from the knowledge infrastructure[48]. Generally, industrial members lead the creation of a strategic vision while the knowledge infrastructure is more involved in translating this into a Strategic Research Agenda (SRA). Concerns have been voiced about the ineffectiveness of SME participation and the comparative absence of end users and non-governmental organisations from the ETPs, which therefore tend to represent the more powerful industrial and research interests.

Those stakeholders involved judge that the ETPs have been effective in coordinating ideas about RTD directions but so far less so at raising new money or coordinating research policy at regional, national and EU level. They have had little effect in triggering more joint RTD. There has so far been little or no impact on skills. While it is still rather early to see effects of the rather slow policy coordination processes the ETPs are expected to trigger, there was apparently in some cases an effect on the agenda of FP7.

### 3.3.5 ERA-NETs

The ERA-NETs were launched in 2002 under the budget heading 'Structuring the European Research Area' to let national research and innovation funders jointly explore common needs and launch common calls for proposals. FP money could top up this joint research funding. The intervention logic uses self-organised national funders to structure parts of their activity into common programmes that involve those Member States that want to be involved and not all the members of the European Union. The FP covered additional costs associated with trans-national coordination. These 'variable geometry' constructions were expected to work in four steps

1 Systematic exchange of information and good practices on existing programmes and activities
2 Identification and analysis of common strategic issues
3 Planning and development of joint trans-national activities
4 Implementation, including joint calls and programmes

There were two types of ERA-NET: Specific Support Actions (SSAs) to establish new networks and Coordination Actions (CAs) to support the activities of the ERA-NETs themselves. Overall, 26 SSAs and 71 CAs were funded, involving over 1000 participants from 38 countries (25 EU Member States; 8 Candidate and Associated States; and 5 'Third Countries').

A 2006 review[49] found that many of the ERA-NETs were making good progress toward issuing joint calls and emphasised that they add value to the European RTD funding portfolio. A more narrow review of Nordic ERA-NET experience suggested that many agencies had rushed into ERA-NET participation without a strategy and found themselves over-stretched as a result[50]. Although many if not most EU agencies learned how to do cross-border calls with partners, this learning was repeated in each ERA-NET. Only a minority of ERA-NET participants engaged in the eventual calls for proposals. However, ERA-NETs enabled cooperative priority setting by sharing strategic intelligence. They encouraged the synchronisation of national research programmes. Small countries like Norway found that ERA-Nets enabled them to fill gaps in the national research portfolio and increased the exposure of national research performers to competition.

The introduction of ERA-NETs has to a degree added further complexity to the funding system, although overall it is recognised a great deal has been achieved. In some cases joint calls have involved large amounts of money and in a handful of areas the common programming which has resulted has been in areas of national significance, producing quite large calls, e.g. €35m and €15m in the Plant Genomics network. So far however, very few cases of 'real common pot' funding (where funders create a truly common funding pool rather than funding participants only from their own country) have emerged, such as for example the German Research Foundation (DFG)-coordinated ERA-Chemistry and the Norface-social sciences.

Another inherent problem with the ERA-NETS is the fact that they are mainly initiated and driven by civil servants from the Member States. It seems that smaller countries simply do not have a sufficient number of civil servants to take care of all the ERA-NETs of relevance. The limits to Member State participation may thus be defined by the limited number of civil servants rather than the amount of relevant research taking place.

National EU policy and ERA strategies have been strengthened or written in many countries and the principles and benefits of joint funding are increasingly recognised by Member States. ERA-NETs should continue in order to encourage greater use of true common pots, detaching funding from the national level, and developing common strategic issues.

### 3.3.6 Conclusions on instruments

The original new instruments were deployed insufficiently clearly[51]. The evidence so far shows that the real structuring effect of the IPs or NoEs has been limited and mostly related to the increasing size of project networks – which is an arithmetic consequence of funding bigger consortia – and allocating more of the project administration to the coordinator. FP7 has already made the required change to abolish the distinction between IPs and STREPs so that network sizes can match needs. The NoEs were implemented in a way which inherently limited their capacity to reduce fragmentation, notably since privately owned organisations were largely not present. Achieving the intention of the NoEs to alter the structure of research capacity in Europe requires different treatment.

During FP6, Article 169 produced only one action, which became well known for the time and effort involved in its creation. More experience is needed to assess the full potential of Article 169. The Commission should review its implementation with a view to radical simplification so that it is of more practical use.

ETPs are clearly useful and can act as 'focusing devices' in areas of RTD needs. However, they, like the IPs, can tend to favour participation by the established and the powerful players, and may be less suitable in sectors where SMEs, small Member States and unpopular ideas play primary roles. They must therefore be complemented by other measures that tackle small and unstructured industries and technologies as well as ensuring that the voice of the smaller states is not lost.

Many have enthusiastically embraced the ERA-NETs, which have enabled RTD funders to appreciate the value of cooperating and coordinating research activities and to change their practices. Further incentives are needed for 'single common pot' funding.

### 3.4 Assessment[k]

FP projects must be of high quality and relevance. Hence, the proposal assessment process needs to have high quality. It should be independent, transparent and fair and be supported by good quality feedback to applicants. Assessment improved considerably between FP5 and FP6 through the wider use of remote assessment, a larger pool of assessors, hearings with proposers and the codification of ethical review. Despite this the Expert Group expressed some concern over the mechanism for the choice of experts and the inadequate role of expert panels in the decision process.

The Group sees opportunities for further improvement, including

- Using a two-step application system with a 30-50% success rate at the second step for the larger FP instruments in order to reduce the burden of the initial application and to restrict the real competition to those who have greater chances to succeed. However, the system must allow proper pre-evaluation of the first stage proposals and should avoid prolongation of the evaluation process
- Greater use of Member State organisations' expertise and databases in identifying and quality-assuring peers
- Establishing a Scientific Council to advise the Commission on matters such as peer reviewer selection, ensuring competence and capability within the pool of peer reviewers to cover all aspects, the research quality, the relevance of the methods and partners and the potential impact of research done
- Maintaining peer panels over a period of years before refreshing them so that they build shared experience and understanding of the domain that increases the quality of their assessments

[k] To increase clarity, the panel follows the English terminology in distinguishing *ex-ante* **assessment** of proposals from **evaluation**, which is the mid-term or *ex-post* processes of judging the relevance, efficiency, outputs, outcomes and impacts of programmes and projects as an input to management and policymaking

- Installing an overarching committee of panel chairs, which should deliver the final ranking list for project funding
- More nuanced use of assessment criteria to distinguish between bottom-up researcher-driven areas, where normal funding practice would be to focus on scientific quality, and more top-down use-oriented areas where quality is a *sine qua non* but where other criteria like impact, implementation and policy conformity must also be applied
- Making the Evaluation Summary Reports that provide feedback to applicants more explicit
- Transferring responsibility for project review of scientific quality from Commission officials to scientific peers
- Ensuring that proposal application forms incorporate indicators which can be made available to evaluators and used in subsequent project reviews

### 3.5 Evaluation

Evaluation constantly struggles with the need to provide timely support to management and policymaking. Often the effects of one programme are observable only some time after it is necessary to commit the budget for its successor. Nonetheless, FP evaluation practice has been to review only a recent period – as a result of which the longer-term effects of the FP are consistently overlooked and poorly understood. The Commission has done well to investigate networking aspects of the FP in recent studies. This needs to be complemented by other innovative ways to understand how the FP works, especially its effects on participating institutions and industries. Future FP evaluations should

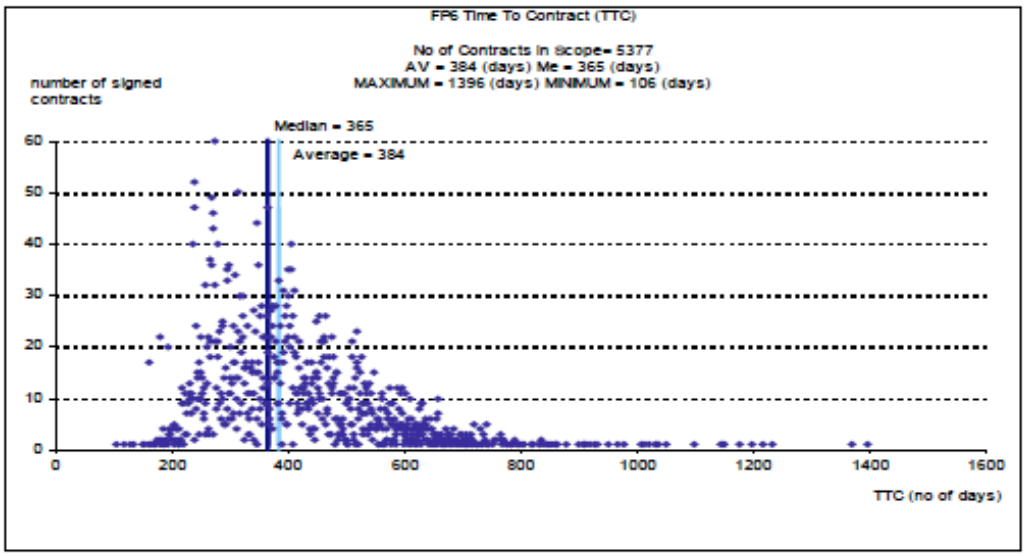
- Define a budget for evaluation in line with the recommendation of the Court of Auditors[52] and undertake evaluation activities at a commensurate level
- Review the Financial Regulation and its implementing rules to ensure that the provisions do not hinder, and are compatible with, the need to access and use the best possible worldwide expertise in evaluation
- Benefit from further exchanges of good evaluation practice with Member States, building on the Commission's network of national RTD evaluation specialists
- Be undertaken by panels not wholly of the Commission's choosing. The Commission should appoint the chairperson, and then cooperate with her to select the panel, taking care to ensure gender equity and an adequate representation of different types of stakeholders
- Have more focused terms of reference, prioritising those matters that are of policy importance
- Ensure that FP evaluation studies include a set of common core evaluation questions, which should in each case be tackled using the methods most appropriate in the specific activity and supplemented by other evaluation questions specific to the context. This, and the need for a common timetable, argues for a more strongly coordinated approach to FP evaluation within the Commission
- Ensure that the timetable for evaluating an entire FP is realistically long enough (about 12 months) for the responsible Expert Group to decide the needs for supporting analysis and to meet these needs in a timely way

## 3.6 Simplification and administration

The FPs have for many years been criticised for the protracted and bureaucratic nature of their procedures[53]. Combined with the low success rates described earlier, this is a powerful disincentive to apply. Hence, country impact assessments suggest participants come to the Framework only when they have objectives that cannot be met elsewhere[54]. Some of the difficulties are caused by the lack of a harmonised administrative approach among the four Directorates General involved in FP6; others by assumptions enshrined in the financial regulations.

**Figure 11** shows the time taken between receipt of proposal and issuing contracts, showing a mean of 365 days and that 75% of contracts were signed within 454 days. This is not quite international worst practice among RTD funders but comes very close to it. A large part of the delay results from protracted contract negotiations. A more useful indicator for many participants would be the time between application and notification of the funding decision. However, these data are not readily available. A longer time to contract is tolerable if the decision is known, because participants can start to plan earlier. **Figure 11** conceals the large variation in administrative performance that exists among Directorates General, which suggests that it is possible for the lagging Directorates General to speed up.

**Figure 11 Time to contract for a sample of 5377 FP6 projects**




**Source**: DG-Research, FP6 Final Review: Subscription, Implementation, Participation, Brussels: European Commission, July 2008

The difficulties are not just in the early stages of submission and approval and the Commission has made repeated efforts at administrative simplification. FP5 saw substantial standardisation of procedures and communications. In response to criticisms in the Marimón report[55], the Commission produced an action plan for improvement that included defining processes and deadlines for reaching contract signature in each instrument, identification of areas where processes can be speeded up, monitoring delays and unmet targets, additional efforts to streamline administrative procedures, clarifications to the Guide for Proposers to the FP and production of a *vade mecum* to inform participants in contract negotiations.

However, the Expert Group lacks data to show whether these measures have had any effect.

The delegation of management to coordinators in IPs and the novel use of audit certificates provided by Member State auditors as substitutes for the activity of the Commission's own financial services are in principle, positive steps. But the use of non-standard auditing criteria and failures to impose auditing requirements that are proportionate continue to leave participants exasperated. One can only imagine the feelings of a Chinese participant who, having received a grant for the lofty sum of €3,000 found he had to spend €1,000 on an audit certificate from a local accountant[56]. In principle, this problem has been rectified in FP7, where only large contributions require audit certificates.

The picture emerging is that FP6 has continued to entail a cumbersome level of administration. This burden is especially large for new participants – whether they are SMEs, young researchers, people from the new Member States or from 'Third Countries' – so it tends to lock-in those who understand the written and unwritten rules, who benefit from in-house RTD administration and have the cash to withstand payment delays, while locking out those who do not. Simplification is not merely a matter of convenience but a fundamental requirement for making the FP (and therefore the ERA which relies on an effective FP) more dynamic and relevant.

The Commission's moves towards simplification have so far been timid and incremental. But one should take care not to single out only the Commission for criticism. Others, including the Council and European Parliament, must recognise there is a collective responsibility towards the issue including the need to find solutions.

Much of the FPs' complexity results from the Commission's underlying assumptions (within the Commission or imposed on the Commission) and cannot be removed by trying to implement these assumptions in simpler ways. The Commission should radically change the basis of its thinking, for example by agreeing a 'price' for the execution of a contract, which will usually require comparing tenders for the same or very similar work and should then remove the need for a fussy bureaucracy to try to audit 'cost', and must therefore gain the support of those stakeholders who can authorise such reforms. Reforms need to go beyond the rhetorical. For example, the Commission has an (unreasonable) norm that it allows itself 60 days from the date of approval of a payment to execute the payment. There is an exception for SMEs, which should be paid within 45 days – yet the Commission did not reliably know which payees are SMEs. **Radical simplification** must be given the highest political priority if the FPs are to realise their true potential. The large variation in administration performance, with one of the three DGs being much faster than the others, provides ample evidence of the opportunities for simplification, and the spreading of best practise, guided by principles such as the following

- Rules should be as simple as possible, reflecting participants' working practices, and not impose additional norms
- Research-focused projects should be funded via grants
- Large-scale infrastructure projects should be regulated via results-oriented contracts

- The FP should be more closely coordinated with Member States' funding programmes and the capabilities of European industry

FP-level peer review should also be binding upon Member States' RTD funders, since current practices by some national research funders involve duplicating the reviewing effort when considering proposals. The panel recommends that

- Programme implementation should be devolved to a fully-empowered agency or agencies, leaving the Commission free to focus on policy
- Consortia should be granted greater operational autonomy and the burden of auditing reduced to a level that is proportionate with the risks
- Staff rotation should not disrupt the efficient handling of the funding process[57]
- Unitary IT tools should be adopted across the Directorates General implementing the FPs
- Time to contract should radically be reduced, with a target of halving the time required. Time to payment should correspondingly be reduced
- Audit procedures must be transparent and commensurate.

### 3.7 Knowledge dissemination

While a great deal of the knowledge produced in the FP finds its way into scientific journals, interviews and programme managers' self-assessments suggest that, as in many national RTD programmes, opportunities to link knowledge from the FP to use are often missed. Better information on patents, prototypes, services and so forth resulting from the FP would be useful, though care must be taken to protect intellectual property rights. While a few of the largest projects include specific dissemination activities, more systematic communication about results and knowledge take-up opportunities is needed, in order to put more of the FP's results to socially beneficial use.

Dissemination is especially problematic in 'bottom up' areas or in themes that are academically defined, which have no necessary link to knowledge users. In programmes where stakeholders have had some say in goal definition and often play a role in implementation, this is less of a problem. For example, the automotive industry provides very explicit recommendations for the FPs, notably via its EUCAR RTD organisation, and this connects to the take-up of results in innovation[58]. More generally, concentrated high technology industries seem to get considerable benefits from the FPs[59]. In both cases, however, dissemination is one potential source of socially desirable spillovers by making the public goods produced in the FP more widely available.

It is also important to celebrate and demonstrate the value achieved as a result of individual FP projects. In earlier times, the Descartes Award for good research in the FP attempted to do this. The Commission should consider new measures to achieve this and place greater emphasis on the dissemination of the knowledge generated in the FP, in order to increase spin-offs.

# 4 Achievements of FP6

The FP is a common European effort in RTD, which is small relative to the total spending of the Member States and which must therefore be used strategically. It presents a significant evaluation challenge because of the diversity of its goals and the unevenness of the available evidence across countries, sectors and themes. The larger portion of available evidence focuses on instruments and policy-related issues rather than the results obtained. The gap is greatest in accounting for the impacts of RTD within the thematic priorities. Country-level evaluations tend to be done among the more research-intensive nations, so that there is a systematic lack of evaluation-based intelligence about the countries new to the Union and those which may get the least out of the FPs relative to their financial contributions.

For future monitoring and evaluations it would be very beneficial to have more data and more evidence gathered about the achievements. This could include statistical data on the number of articles in top-level journals, the number of patents produced by projects, the career promoting effect of FP participation, the formation of start-up firms etc. It is important that the evidence base consists of independently verifiable data which is not subject to possible reporting bias on the part of those seeking to promote their own activities.

This Chapter assesses the programme's achievements in terms of: RTD quality, originality and innovative potential; strategic and policy relevance in methodology and in partnership; and potential for impact based on the knowledge generated. The assessment is conducted at the programme or instrument, not the project, level.

## 4.1 RTD achievements

### 4.1.1 RTD Quality

It is a major technical challenge to assess whether a programme as large and complex as FP6 has a high level of the appropriate kind of quality in each of its component parts. Nonetheless, several lines of evidence converge on a finding that average quality was high. There is little evidence to suggest extensive support for work of low quality.

Of the twenty-four Commission research managers who provided self-evaluations to the Expert Group, eight said independent reviews had confirmed that nearly all the research in their respective portfolio was of international standard while another seven said at least two thirds of the research was of international scientific standards. One indicated that the proportion of such work was between one and two thirds and another five that no independent evidence of quality was available. Based on their own judgement, the research managers believed in six (25%) cases that their area had significantly moved forward the research frontier while ten (42%) said they had moved the frontier forward in most areas and eight (33%) in some areas.

A Framework-wide bibliometric test[60] of whether excellent researchers contributed to FP6 projects shows that the 'lead scientists' have better publication and citation

performance[1] than their peers. Even if the study shows only the presence of highly-cited lead scientists, and not how important their roles were in their projects, like an earlier Swedish study[61] it does debunk the idea that the FPs are purely for the B-Team. Clearly, A-Team members participate.

In many countries the ability to acquire significant FP funding is regarded as a quality indicator for the scientists, research groups and the organisations involved. Some research councils have instituted instruments to support EU applications. Further, some universities, such as the University of Copenhagen have installed a matching funding instrument as EU grants are seen to be a quality stamp for the researchers involved.

In sum, the available evidence suggests that FP assessment procedures, the high level of competition for FP awards, and the widespread use of FP participation as a 'seal of quality' at national level has combined to attract the participation of some of the best researchers in Europe, contributing in turn to ensuring that the work performed will be of high quality.

### 4.1.2 Research Results

#### 4.1.2.1 Thematic priorities

Little systematic external evaluation evidence is available at the level of the seven FP6 thematic priorities. IST has been evaluated and sustainable development partly so, while the others are in the process of evaluation. The examples given in this chapter are thus mainly meant to illustrate the wide range of results obtained through the different thematic programmes.

*1 – Life sciences, genomics and biotechnology for health*

The most important achievement in the priority of life sciences, genomics and biotechnology for health research was the development of methods in high throughput genomics. FP6 made large investments in this area in support of raising the global competitiveness of European research. Health research projects have contributed to increased understanding of the possibilities of stem cells and various genomes and how they might be used to address widespread diseases such as diabetes, cancer and heart disease. The thematic priority has made possible a cross-national attack on some rare diseases such as Burkitt's lymphoma, Huntington's disease, Tourette's syndrome and others, which are uneconomic to tackle on a national level, building stronger international research positions in some of these areas. The programme has also addressed new and emerging diseases such as SARS.

[1] The number of times a scientific publication is cited is a standard bibliometric proxy for scientific quality

*The EUROHEAR Integrated Project brought together geneticists and physiologists in 25 teams from 12 countries in an interdisciplinary exploration of how genes and genetic defects control the development of the inner ear. Among the diseases they explored was presbycusis, which is the hearing loss most people experience, as they get older. EUROHEAR identified the roles of several genes and their mutations on different forms of deafness and achieved results that may become bases for cell and gene therapy. The recent discovery of stem cells in the inner ear suggests other future treatments. EUROHEAR produced these important results in what, for the field, is a very short period of time and contributed to positioning European researchers among the world leaders.*

*2 – Information Society Technologies*

The *ex-post* evaluation of the IST priority[62] was based on a substantial body of external evidence, as well as interviews with key participants and managers. It finds the research has generally been well managed and has reached its technical goals. FP6 has had a structuring effect by building sustainable RTD cooperation networks. IST has attracted high (20%) participation by SMEs in general – but not by high-growth SMEs, suggesting it is unable to move quickly enough to support them. IST is a rapidly-moving global industry. The evaluation underlines the need for EU IST RTD to engage in global networks, hence further efforts are needed to involve other countries and reflect the competitive nature of these networks. It argues that the IST programme has reinforced EU world leadership in some areas, such as mobile communications and GRID computing. IPs, NoEs and Technology Platforms have been important in building more robust alliances and networks. JTIs provide a way to extend this, provided the inefficiencies that tend to be associated with EU bureaucracy can be overcome, for example by auditing JTIs at the national not the EU level. The evaluation also calls for more 'joined up' policies in the form of venture capital investment, regional innovation strategies, public-private partnerships and public procurement are called for.

*The NanoCMOS Integrated Project, coordinated by Europe's largest chip producer, underpinned Europe's ability to stay in the global race to produce smaller and smaller microelectronic circuits by developing ways to reduce the width of features on chips from the 65-90nm common in electronics today to the 45nm needed for the generation of products likely to be introduced during 2009. (A nanometre – nm – is one millionth of a millimetre.) The number of transistors it has been possible to pack onto a chip has doubled roughly every 2 years since the mid-1960s. It is increasingly difficult and expensive to keep reducing feature sizes fast enough to do this – but falling behind in the race makes you almost instantly uncompetitive. NanoCMOS laid the foundations for the FP7 Pullnano project, intended to develop the 32nm and 22nm technologies needed to achieve the next two doublings.*

*3 – Nanotechnologies, materials, new production processes and products (NMP)*

Projects in this area are more aimed at improving the knowledge base and capacity for innovation than scientific research, though they nonetheless made a contribution to strengthening capacity in institutes and universities. About 80% of the projects are said to have positive economic impacts in the geographic regions of their participants. The projects which were mostly additional in nature, tended to reach their technical objectives but, as is normal with innovation projects, were less likely

to reach their exploitation goals. Nonetheless, 70% of firms claimed to have experienced some increase in sales as a result of their projects[63].

*The KMM Network of Excellence involved 34 partners from 10 European countries in a mixture of research, PhD training and dissemination. It brought together and published the state of the art in parts of advanced materials science involving compounds and composites of metals with metals and ceramics with properties that addressed known problems identified by industrial partners in the network. It produced 15 PhDs and transferred commercially useful knowledge to the industrial partners. Led by a Polish team, it integrated several research groups from new member states into wider European research networks. It established a non-profit company – the KMM Virtual Institute – in order to extend its activities beyond the FP6 funding period, which has already won FP7 and national projects.*

*4 – Aerospace*

Aeronautics projects identified ways to improve aircraft, aero-engine and other sub-system performance as well as exploring production and repair techniques unique to the aerospace industries. Industry was heavily involved, reflecting the importance of the FP to the EU cluster around EADS, which is the only serious international competitor to the American aircraft manufacturer Boeing. In the space sector, three quarters of the resources have gone to environmental monitoring by satellite (GMES) and the balance to satellite communications, producing a stream of environmental monitoring applications and improved technologies for broadband communications.

*The FANTASIA project aimed to produce higher quality, more precise metal aerospace components with reduced wastage, enabling improvements in aircraft performance and emissions. While traditional metal manufacturing involved cutting components out of blocks of metal, FANTASIA uses 'additive' techniques to build up the parts manufactured. The two main techniques used are laser metal deposition to build up the components and direct laser forming to shape them. The project begins with modelling and software and runs right through to fabricating and testing pilot components. Major European aircraft engine manufacturers, their supplier and people from research institutes and universities are involved in developing techniques that are eventually likely to spill over from aerospace into wider industrial applications.*

*5 – Food quality and safety*

Projects in this area produced advanced knowledge about how to improve quality and safety of food. In many cases, the networked institutions involved, established common databases and methods so that the multinational system for ensuring safe food is coherent – often outside as well as inside the EU. A result of the strong focus on safety, however, was limited industrial participation. While industry was clearly engaged in, and will be affected by, the safety work, firms tend to be more interested in exploring knowledge that will in future enable them to introduce new and improved product and process technologies. FP6 did not provide much opportunity for this type of exploratory research, focusing on finding bases for new improved processes, products and solutions.

*The somewhat defensive orientation of this priority under FP6 is exemplified by a STREP called HEATOX. In early 2002, Swedish scientists discovered that the potentially cancer-causing chemical acrylamide was present in some cooked foods. The EC incorporated this issue into the FP6 work programme and HEATOX began work on acrylamide and other potentially dangerous chemicals created through heat-treating food in November 2003. It developed methods to detect and measure these chemicals in food, explored their different potentially toxic effects using both models and genomics and synthesised the results into risk assessments for various kinds of cooked foods. In addition to scientific publications, the results have been used in a Commission Recommendation (2007/331/EC) on acrylamide monitoring and the European Food and Drink Federation's (CIIA) Acrylamide Toolbox, used in the industry. The HEATOX STREP is an example of where what may look as introvert and defensive research was used to actively stimulate formation of constructive new solutions.*

*6 – Sustainable development*

This priority consists of three parts: sustainable energy; surface transport; and sustainable change and ecosystems.

Sustainable energy projects were a mix of scientific and technological research, for example trying to understand how $CO_2$ behaves during sequestration. Therefore, producing guidelines for sequestration and exploring technological and regulatory options for connecting many small electricity generators to transmission grids that were originally designed to distribute power from a small number of large power stations. Quite a lot of the work involves engineering and technology rather than science, so the results appear in a mixture of scientific literature, reports, guidelines and regulations. An impact study of innovation and results transfer[64], at both FP and national level, points to gaps in technology development for technologies that can interface new and existing technologies, underlining the need for system approaches to technological change – especially in areas such as energy, which involve complex technological and social systems. The message is reinforced by a study of the long-term impact of the FPs in Sweden, which made clear that inconsistencies between research and innovation energy policies were significant obstacles to achieving impact[65].

Surface transport projects were chiefly orientated towards improving the environmental performance of engines and vehicles through increased efficiency, lighter weight, better interaction with the infrastructure and improved safety. Engaging key companies was especially important in order to connect research with improved performance of vehicles.

Sustainable change and ecosystems projects aimed largely to inform policy. An *ex-post* impact assessment[66] of the Global Change and Ecosystems sub-priority found, based on both peer review and bibliometric indicators, that the work was of high scientific quality and also produced a large number of results concerned with improving scientific understanding and supporting policy. Some projects have indeed contributed to the latest assessment report on the understanding on climate change from the Intergovernmental panel on Climate Change and others to the EU Water Directive. The policy relevance and impact of the projects has varied. Some projects were very influential. The sub-priority strengthened existing networks, built new ones and attracted strong non-European participants. Large projects were valuable in enabling complex global issues to be tackled by large international

teams, but were not needed in all areas. The level of support for environment issues was however, slightly decreased compared to FP5 as shown in the "EU research for Environment 2007-2013" (2008).

*Recent concerns about the effects on food prices of using foodstuffs to make biofuels underline the importance of developing 'second generation' biofuels based on feedstock such as crop residue and waste materials, which does not so directly compete with nutrition. The RENEW project has developed and demonstrated ways to gasify wood, straw and other vegetation and to use this synthesis gas to produce a range of liquid fuels usable in existing engines. Its objective is to enable industrial scale production of second generation biofuels at a cost of about 70 cents per litre, compared with €1 to €1.2 for other technologies. RENEW involves Europe's major car manufacturers and fuels producers, so if the technology is successfully developed the route to implementation is quite direct.*

*7 – Citizens and governance in a knowledge based society*

This theme continues a strand of work in the social sciences and humanities that has been present since FP4. The social sciences and humanities research in this area provides information and support for policy development across a wide range of topics such as participation, tax reform, crime statistics harmonisation, counter-terrorism, immigration and economic growth. There is a large number of instances of projects affecting policy, but at this stage there is no systematic evidence about the overall impact of the priority.

*The European Social Survey has so far run four times at two-yearly intervals, providing a methodologically rigorous picture of shifts over time in Europe's social, political and moral climate in relation to its changing population pattern and institutions. The Survey team also works on methodological issues associated with making international comparisons and is developing a set of indicators to monitor the quality of life in various European countries. Member state academic funding bodies and the Framework Programme fund it jointly, providing a solid basis for policymaking and research.*

#### 4.1.2.2 Fusion and fission energy (EURATOM)

The EURATOM work is mostly long term in nature, so outside the area of training few impacts are yet visible from FP6. Much of the fission work has focused on the areas of materials and their failure mechanisms, providing the knowledge needed when older reactors will need to be relicensed in coming years. Fusion work has focused on further work at the Joint European Torus, which has slowly been increasing the scale and duration of fusion experiments, and on preparations for the new ITER fusion research facility in France.

Cooperation on fission nuclear energy was historically one of the cornerstones of the European Community. However, Member State objections have restricted EU RTD efforts in this area to safety and waste disposal issues. This work has not been independently evaluated in recent years. However, it appears to have made an important contribution to the good safety record of the EU nuclear industry. The Commission has developed a significant programme on actinide partitioning and transmutation to run alongside that on geological disposal of radioactive waste. The

EU work should help ensure that different states adopt convergent policies on radioactive waste. Despite continuing debates, fission nuclear energy is enjoying a resurgence as a result of concerns over global warming and the limits to fossil fuel supplies. If increased use of fission is unavoidable, Europe would be best placed to tackle its challenges based on knowledge and strong capabilities (not least in safety). If certain Member States' objections cannot be overcome, there is a case for launching an Article 169 activity or a similar action based on variable geometry.

The main nuclear effort in the FPs is now directed towards fusion. The Joint European Torus (JET) and the associated mix of Community and MS-funded research is seen in the scientific community as a great success, producing interesting new knowledge and developing a well-functioning research community. An evaluation of the fusion work[67] says that the FP6 objective of 'preparing for the next step' was achieved. A clear outcome of FP6 is the way EURATOM has cemented its leading role in the worldwide fusion research programme. Based on the solid foundation of the EU's JET project, the decision was taken during FP6 to build ITER in Europe, the next major fusion facility jointly by the EU (acting through EURATOM) with China, India, Japan, Russia, South Korea and the USA.

#### 4.1.2.3 Examples of achievements outside the thematic priorities

- Research in support of the Common Fisheries Policy has increased knowledge about the interdependence of species within marine ecosystems and improved the scientific basis for the fisheries policy
- NEST conducted exploratory research in subjects such a hydrogen-producing bacteria and the catalytic conversion of $CO_2$ and water into hydrocarbons as well as contributing to the emergence of 'synthetic biology' as a field and bringing new communities into the FP. It is said to have influenced the emergence of new fields inside and outside the FP
- International Cooperation (INCO) projects were generally applied research aiming at answering needs at a local level through the transfer of knowledge and tools, or the development/adaptation of methodologies. They built capacities and knowledge in developing countries about health and poverty reduction
- Research infrastructures comprised a mix of projects aimed at planning or implementing new infrastructures, resulting in new facilities including new or improved test facilities, supercomputing networks and virtual data depositories. In cooperation with the independent ESFRI organisation, the FP has underpinned the creation of a coherent road map for future European investments in research infrastructure
- Human resource projects, especially Marie Curie actions, involve individually small grants designed to enhance the mobility of scientists across countries and are widely seen, both by participants and others as a major contribution of the FP to networking the ERA. While there are gaps in implementation – for example, only one Marie Curie fellow went to China during FP6 – the scheme is unique in the scale and coverage of the mobility it supports
- The Science and Society projects supported a wide range of studies and participatory events in areas including gender, ethics, young people and scientific participation. In the governance and ethics fields, S&S actions have led the European Commission to adopt a Code of Conduct for Responsible nanosciences and nanotechnologies Research

- Research and innovation activities under the budget line "Structuring the ERA" have focused on policy convergence and the Open Method of Coordination. A number of useful cross-border activities were launched that could not have been conducted at the MS level. Evaluation evidence suggests there have been achievements so far in networking and coordination, sharing best practices, and exchange of research tools and methods[68].

### 4.1.3 Conclusions on achievements and quality

Clearly, FP6's large investment in RTD produced high-quality research and results of scientific, industrial, social and policy interest. In practice, this type of impact-focused evaluation cannot say much about whether the priorities and programmes chosen were the most appropriate. One can, for example, raise questions about the balance between human health research and work on plants and microbes or between food safety and innovation in food. Getting the balance right depends upon having a good and sufficiently transparent programme design process. Nonetheless, despite the weaknesses of programme design, which mean it is hard to test the appropriateness of the themes and the distribution of effort chosen, it is clear that FP6 reflects a significant consensus in the RTD community about what is important and that it has tackled this agenda at significant scale and quality.

In the future, it will be necessary to focus a greater part of the FP evaluation effort on understanding the impacts of the mainstream of the FP work on research and society more broadly. Longitudinal studies will be needed to achieve this end.

## 4.2 Effects on beneficiaries

### 4.2.1 Industrial competitiveness

There has been little evaluation of the effects of the FP on firm or economy-level competitiveness. UK work on total factor productivity[69] found significant improvements as a result of FP participation, most notably in Greece. A recent Swedish study[70] that looked at the effects of participation on four branches of industry from FP3 to the present found big differences. In life sciences, there was almost no participation by large companies, so the FP was the territory of the knowledge infrastructure and SMEs and its main effect was to increase the pool of research and technology that might one day be acquired by the major companies. Established energy suppliers and equipment manufacturers made little contribution to the development of alternative and sustainable technologies, which was left largely to the knowledge infrastructure and SMEs. The FPs' effects on the energy industry were limited by a failure to inter-connect RTD, innovation and energy policy. In ICT, however, FP participation in European and global standardisation had been a key factor in building the Swedish telecommunications industry's position in mobile telephony, while in vehicles the FP had, together with complementary national programmes, been instrumental in supporting the Swedish industry's technical specialisations, especially in safety and combustion.

The wider picture from both EU and national evaluations of the effects of FP participation on companies has been consistent for many years and seems immune to changes in FP strategy or instruments. Larger and more capable companies understand how to use the FP to network, establish technological and business

partnerships, and develop knowledge that informs later work. They also use the FP to influence standards and explore markets. FP participation is rarely used directly in product and process development. Networking intensity has increased in FP6. Increased additionality is reported. Smaller firms are more interested in shorter-term outputs with greater direct relevance to product and process development. Their projects are also more likely to be additional, while larger companies have more alternatives for funding specific pieces of research.

The Innovation Impact study[71] has made use of the Community Innovation Survey to complement survey and interview-based participation data in FP5-6 to explore links between the FPs and industrial innovation. It found that, compared with the average for their sector, industrial participants tended to be more RTD-intensive, better networked, more orientated to international markets and to patent more. Knowledge goals were more important than other kinds – but the questions used were inconsistent with those used in past surveys, which tend to find that networking as well as knowledge is important[72]. Compared with projects that the companies funded internally, FP projects tended to involve less commercial risk, and have longer term RTD horizons, more interest in the non- core technologies of participants, a focus on exploration (rather than exploitation), a lower degree of flexibility and higher administrative burdens. There was no meaningful difference between FP5 and FP6 projects in this respect, despite the introduction of the new instruments. In general, companies in competitive high technology sectors were more likely than those in lower technology, oligo- or monopolistic markets to have strategies to commercialise results of FP research. However, the growing share of FP participation by the Knowledge Infrastructure meant that the proportion of effort that could lead directly to industrial innovation had declined.

Norwegian industry's experience of FP6 is that it does not address the areas relevant to Norwegian large firms, which tend to be in technology-based but not RTD-intensive branches, notably process industries[73]. This is an important reminder that focusing on 'the high tech' branches tends also to mean ignoring the opportunities in many large and more traditional industries – not only in Norway but throughout the EU. Revisiting these industries may be especially important not only in terms of the FP's industrial competitiveness goals but also in order to tackle global challenges associated with environment, energy and resources. UK industry views the costs and benefits of participating in the FP as finely balanced. The benefits are important, and primarily accrue to those who participate; but there is an urgent need for increased transparency in the programme and simplification of its administration[74].

Since the start of FP6, the balance of global economic competitiveness has changed. US science and technology policy has aimed to improve the capacity to obtain economic value from new knowledge via projects and institutional arrangements directed at collaboration between public and private RTD, strongly and proactively supported by public funding, based on integrated 'commercial-purpose research'. In the same period, Europe has also confirmed and supported its excellence in generating new knowledge. Nonetheless, within economically strategic areas such as biotechnology and health, there have been only limited improvements in Europe's ability to build profitable business on new knowledge. Today, the great majority of new drug discoveries under development are in the USA (estimated to be around 18 out of 20, i.e. 90%) while around two decades ago it was just the reverse (only

around 10-20 % of new molecules under development were in the USA). If this pattern continues and extends to other key sectors, Europe's competitiveness will decline over time. So far it is primarily the USA that has benefited from building business on other's discoveries and by importing their talent. Europe is now further challenged by the growth economies, with their growing capacity to cultivate and reap flourishing industries based on global scientific knowledge.

Soundings taken by the Expert Group among research managers in major European companies suggest that repeated users of the FP have learned how to integrate the Framework into their project portfolio, along with other national and international programmes. Those that are in a position to make comparisons say it is simpler to establish research networks in North America than in Europe via the FP approach. They also note that the FP places too much emphasis on research for its own sake without sufficient focus on how to get the results implemented, consistent with the realities of global competition and in a timely fashion (especially in sectors such as IT).

### 4.2.2 SMEs

Evaluation studies of the SME measures in FP6 are still ongoing at the time of this report. Existing evidence confirms that SME participation in FP measures has a distinct character. Company goals are more closely tied to product and process development. A series of evaluations stretching back to BRITE/EURAM in FP4 have provided estimates of the financial benefits of participation for such small companies[75]. Such quantification has not been attempted for the larger firms where the links between FP projects and economic impacts are more complex and indirect. A Norwegian study emphasises the greater enthusiasm of successful SMEs for participating in FP6 because of the urgency of the problems addressed, while large companies see the FP as one component of wider RTD portfolios[76].

Studies show that SME projects tend to reach their scientific and technological objectives but only a minority reach their commercial goals – though those that do provided numerous examples of job creation[77]. Both technological skill and exploitation capability are needed for success, so successful projects tended to have good business and dissemination plans and to have SMART goals. Small firms' market understanding and skills are often poorer than their grasp of technology so many pitfalls are commercial in nature. It is therefore vital that proposal assessment tackle the commercial as well as the technical plausibility of projects.

German SME participants in the thematic priorities and in EUREKA had high technological capabilities while those in SME-specific schemes had lower absorptive capacity[78]. The firms saw clear added value in participating in European programmes, which was connected with a need to internationalise their RTD as well as market relationships. However, they tended primarily to pursue knowledge goals, selecting EUREKA for close to market issues and the thematic priorities for longer-term questions.

A study of SME measures[79] in FP4-6 showed that their 'internationalisation objectives' set them apart from SME support at national level. However, the low proposal success rates meant that only unusually technically competent companies

received FP awards. Hence, measures aimed primarily at companies with modest technological capabilities in fact recruited high-capability firms.

The administrative burden of making a proposal to the FP is an especially big disincentive for SMEs. Key barriers to SME participation in the IST thematic priority, for example, were the nature of the consortia; financial issues; instrument related issues; and contract negotiations, as well as SMEs' limited knowledge of the detail of the FPs[80]. Nonetheless, the weight of evidence from existing studies suggests that participation in the FP does bring important benefits to SMEs.

While SMEs are crucial to maintaining and building a competitive, knowledge-intensive EU economy, the logic of the political priority given to SME participation *per se* in the FP is not readily apparent or clearly documented. Many of the factors that determine the birth of such firms, their ability to grow and their sustainability, such as access to early stage capital, extend beyond the scope of the FP programme and DG Research. In the Expert Group's view, a formula-driven set-aside of FP budget for SMEs, independent of context, is neither the best mechanism to nurture them nor the most productive use of FP funds. The Commission should reconsider the existing requirement to spend 15% of the FP budget on SMEs and investigate alternative approaches for supporting the technological and business requirements of the technology-based SME sector.

### 4.2.3 The Knowledge Infrastructure

FP6 participation has been dominated by the knowledge infrastructure of universities (37%) and research institutes (31%). Despite their intended central role in ERA, relatively little is known about the effects of FP participation on these institutions' strategies. The effects of FP6 and its predecessors on the universities[81] appear to have come primarily from the addition of a significant additional external funder with special characteristics. The Swedish longitudinal study found the FP has little impact on university strategies, because these strategies are largely constructed bottom-up. Where universities have thematic priorities, these are more likely to be determined by the economic structure of regions or states than of the EU as a whole. The fact that EU funding is available is sporadically crucial to the survival of individual research groups whose interests for a time do not match those of national funders, but the main effect is to help research groups to grow in those areas that correspond to the thematic priorities of the FP. These priorities are consensually derived so they are generic and often match national priorities. FP supplements rather than redirects the bottom-up changes in the thematic emphasis of university research.

The value of FP6 funding for universities and research institutions is nonetheless great. FP money provides access to large amounts of partner research and continues to increase researchers' international networks, 'leveraging' national investments in the FP and in the national research that enables researchers to participate in the FP. Hence, universities generally regard FP research as a quality label giving high status, encourage their researchers to apply and – where, as in some cases, participation has caused economic losses within the university – tend to be willing to cross-subsidise FP work from other sources.

Even less information is available about the strategic effects of the FP on research institutes. Many of these organisations are more demand-led in their activities than the universities and therefore more likely to be influenced by external funding opportunities in the short run. Social network analysis of the FPs shows that major Research and Technology Organisations (RTO), notably Fraunhofer Institutes and TNO, the Dutch organisation for applied research, also play significant roles as key nodes, interlinking very large numbers of other participants.[82] It is superficially surprising how little the RTOs are internationalising in response to the globalisation of their industrial customers. The reason is that their incentives are fundamentally national and are likely to remain so unless Member States start to fund them jointly or other incentives appear which encourage internationalisation.

The Expert Group concludes that the ambition of structuring the Knowledge Infrastructure as a key element of ERA has barely begun to be realised. Although 'structuring' is certainly happening via increased networking and key RTOs are probably achieving a changed role through their network positioning[83] there is as yet no evidence of the physical concentration of research capacities in Europe sought in the ERA discussion. More radically redistributive instruments will be needed in order to make progress.

### 4.2.4 Conclusions about beneficiaries

While the evidence is spottier than we would like, it is clear that FP6 had a positive influence on both industrial competitiveness and competitivity, namely the ability of companies to compete. Nonetheless, the FP appears more effective in situations where strong and established actors can articulate needs and opportunities to the Commission, influencing the design of the FP, than where technologies are new and there is little consensus about technology or road maps. Furthermore, the interpretation of what is 'high technology' may be too limited in view of the needs and opportunities in more traditional sectors, which are key to the economy and normally depend upon good technology even if they do not fulfil the OECD's rather restricted definition of 'high technology' as involving a high proportion of R&D in total costs.

Big companies can include the FP within their portfolio of different types of projects and reach out for other kinds of funding for other purposes. Individually, SMEs cannot take this long-term, portfolio approach – for them the project tends to be more central to their success and they therefore focus on shorter-term results applicable in products and processes. The FP might well be better adapted to their technology needs, but they have many other deficits such as commercial information, capital and skills, which cannot be addressed within the confines of the FP. It seems reasonable to ask whether they could not better be served by other means.

Companies and the knowledge infrastructure all benefit from increased knowledge and networking. However, the universities and institutes' incentives are little affected by the FP, despite the fact that they may be substantial beneficiaries. This is because they make strategy bottom up. Efforts to promote further university and institute autonomy would allow them to become international actors – especially if

the FP began to include incentives to trans-nationality. Such a parallel approach of both institutional reform and the creation of internationalisation incentives is needed in order to realise the vision of building critical masses within the ERA.

## 4.3 Wider policy achievements

### 4.3.1 Structuring the ERA

The FPs clearly establish network relationships among RTD performers but there is little evidence that FP6 or its new instruments have had permanent effects upon the structure of European RTD capabilities. There has been more success in encouraging states to coordinate RTD funding activities and progress made in respect of research infrastructures has have important structuring effects.

In order to explore further the structuring issue, the Commission has undertaken a range of studies on the formation of research networks. For instance, the Information Society Technologies (IST) projects have been shown to involve networks that are more international in character than those national programmes[84]. As a whole, IST projects involve strong network 'hubs' (for example, the Fraunhofer Institutes) connected to large numbers of participants. The average number of links 'or degrees of separation' between participants decreased at the start of FP6[85] as a consequence of funding fewer, bigger projects with more partners in each. However, the informational content of flows along the network links - whether the change in network topography has changed inter-participant cooperation, learning and research effectiveness - has not been determined. There is scattered interview evidence suggesting that simply using bigger instruments does not necessarily increase the amount of collaboration among those who belong to the same network.

There is a strong overlap between FP networks and ICT business networks[86] but while small-firm FP-IST participants tended to be more technologically active than others, only 5.4% of those European SMEs holding highly-cited patents participated in the FP. This tends to confirm the view coming from many sources that the FP is not a good vehicle for underpinning rapid innovation involving SMEs and a short time to market. While FP-IST networks are well linked to the knowledge infrastructure in Europe's regions, they are poorly linked to the enterprises that constitute the main regional deployment actors for the new ICT technologies, suggesting a need to use alternative means, such as the Structural Funds, to strengthen innovation in the regions[87].

Much more progress on ERA has been made in the area of coordinating funding. As a result of instruments such as the ERA-NETs, the views of policymakers and implementers appear to have changed considerably. The ETPs are successfully acting as trans-national 'focusing devices' that are likely to lead to changes in funding patters. The Open Method of Coordination, including exercises such as policy mix peer reviews, has helped Member States devote more effort to the Barcelona goal, even as it has become increasingly evident that this goal will not be achieved in the given time-frame.

The research infrastructures effort relates to one of the most obvious sources of EAV, and one, which has been pursued over many years by cooperative organisations such as EMBL, CERN and ESA. These organisations have historically

been difficult to establish, as each has required an international agreement or a treaty and the creation of a budget mechanism. The EU and the FP provide *a priori* a much simpler and easier way to do this. As a result, it has essentially internalised this cooperative infrastructure activity. These structures have obvious value, as they provide benefits in the forms of shared scale, network reinforcement and in many cases training. The fact that the new, shared infrastructures are attached to the EU also means that new Member States can quickly and easily use them, rather than have to negotiate their way one by one into the older style of multilateral research cooperations. An ongoing evaluation[88] points out that these shared infrastructures have significant benefits for the research community but have little direct social or industrial impact. This is nonetheless a clear example where the structuring effect of FP investments contributes to critical mass and interconnectedness within the ERA.

### 4.3.2 FP6 and the enlargement of the EU

Ten new Member States have been associated to the FP since FP6 and another two since FP7. Their ability to obtain FP funding has varied[89]. Well-established research groups and companies in the new Member States have easily been able to connect fairly easily to the FPs while others have struggled to become participants. Overall, to date, the new Member States have been net contributors to the FP budget. National Contact Point (NCP) systems have been built up in all the countries and special capacity building Calls were put in place for Bulgaria, Romania and Turkey from 2004. New Member State participants tended to have a 'follower' role in FP6 projects (they had few network initiators or coordinators in FP6 but more in FP7). While it can be expected that this situation will improve as capacity builds, this will take time at least in some of the countries concerned.

New Member States with weakly-articulated RTD strategies have so far not been able to exert much influence over the development of the FP. Some have more or less adopted the FP6 priorities as a basis for their own research policy, but the changing FP agenda implies this is not a viable strategy in the longer term. Several countries (especially Poland, Lithuania and Romania) have been inspired by the FP to take a more networked approach to funding, moving from single-beneficiary to multi-beneficiary projects. In these early stages, the FP is very influential in that it provides a much-expanded set of funding opportunities. Over time, as national funding sources increase, the role of FP funds may diminish – as it has done in Ireland, since the large increase in national funding after 2000.

The higher education boom in the new Member States means that new generations of researchers will begin to come on stream, and it is already clear that the Marie Curie scheme is making a substantial contribution to capacity development. The growing number of small entrepreneurial firms also bodes well for better participation as do increased national RTD budgets and growing foreign direct investment. However, the FP alone is not sufficient to trigger rapid and much-needed capacity growth, which must therefore also be funded from sources such as the European Structural Funds. This in turn demands 'joined up' policy development, both at new Member State and at EU level.

### 4.3.3 Relations with countries beyond the EU and the Associated Countries

The FPs have contained international development components since 1983, which were merged in 1994 to form the International Cooperation Programme (INCO). Like previous FPs, FP6 continued to include an activity for cooperation with 'Third countries' not associated to the FPs. In addition it opened the main thematic priorities to participation by these countries on a cost-shared basis and allowed them to participate in the Marie Curie human mobility programme. As elsewhere, evaluation evidence is uneven, an example of which being that the Russian Federation has become one of the biggest global partners of the FP yet to date no evaluation of this participation has been carried out.

An evaluation of INCO in 2005[90] pointed out the fragmented and apparently unfocused nature of the programme. Its main impacts are strengthening relations and building scientific partnerships between the EU and 'Third Countries'. INCO had very few resources compared with the size of its global remit, lacked scientific coherence and was poorly differentiated from the rest of the FP. A coordination function was needed to make Third Countries' access to the thematic priorities more systematic.

A panel evaluation[91] of the EU-China S&T agreement in 2004 found that it was highly regarded on both sides. It helped 'open' the FP up to Chinese participation but needed to be complemented by mobility measures, better communication and a specific instrument for cooperation with China. The 2008 evaluation[92] of the agreement found increased interest in co-funding on the Chinese side and argued for strengthening and coordinating the work of the EU and key Member delegations to China. A key issue was that mobility schemes from China to Europe were popular but that few Europeans used the schemes to visit China. There were over 300 Chinese participations in FP6 but many were small scale, the FP was poorly understood and difficult to access from the Chinese side and the FP indeed provided no more than a framework: a strategy and a common platform with key Member States and a much larger commitment of resources were needed in order to make an impact, especially in the light of large US and Japanese efforts[93]. The USA, and indeed some EU Member States have been working with China since the late 1970s. The EU's spend of about €5m per year in FP6 is paltry in comparison with these other efforts and the size of the scientific and industrial opportunity. In the absence of a strategy coordinated with the Member States, the FP will do little to strengthen the interface between China and the ERA.

An evaluation[94] of the S&T agreement with India also indicated that the main effect had been to open up the FP to Indian participation. Cooperation was largely generated bottom-up and was almost entirely limited to institutions in the Indian knowledge infrastructure. Only 35 Indian researchers had benefited from EU mobility schemes and the agreement appears to have had little impact.

Overall, the 'programme logic' for global cooperation in the FP has been poorly articulated. The S&T Agreements are instruments that could be used to define country-specific strategies but proceed slowly, partly because they often assume co-funding on the side of the partner countries.

The FP6 'Third country' portfolio was limited and without a clear strategy in its nature. Reformulation and strategic thinking are of utmost importance. An additional focus is needed on the African continent, for example on technologies for preparing it for a more sustainable future (renewable energy, more robust agriculture crops, better use of raw materials for food, feed and non-food purposes). Here European researchers are global leaders who have much to contribute. More strategically-focused collaboration is also needed with the growth economies, to fund EU researchers to work with their scientific counterparts in these countries and to support the innovation activities of globalising European companies. Public RTD budgets are rising steeply in the growth economies, so they are interesting partners. Europe also has interesting opportunities to collaborate with developed countries outside the Triad. For example, Genome Canada offered many European countries bilateral collaboration under very favourable conditions but Europe did not benefit fully as the FP could not adapt to the proposed matching funding principle.

### 4.3.4 Policy advice: the Joint Research Centre

The Joint Research Centre (JRC) has seven institutes and functions as the Commission's 'government laboratory. It was allocated more than € 1.1bn (almost 6% of the total) from the FP6 budget and was free to compete for more.

> The thrust of the JRC's support to EU policies lies in the provision of technical support on issues related to environmental protection, safety and security of the citizens and sustainable development. This includes risk assessment, testing, validation and refinement of methods, materials and technologies to support a whole gamut of policies ranging from safety of food products, chemicals, air quality, water quality, nuclear safety, to protection against fraud. Almost all this support will be carried out in close collaboration with laboratories and research centres in Member States and elsewhere*e.*[95]

The JRC was heavily criticised in the run-up to the last Five Year Assessment for lack of customer orientation. A subsequent evaluation[96] of the JRC's directly-commissioned programme of work under FP6 observed that the JRC was implementing all the recommendations made to it under the previous review, it had carried out some reorientation of priorities and it had, maybe not surprisingly, enhanced its networks. Its work was described as good, very good and sometimes excellent in terms of the quality of the delivered science and policy support. Nonetheless, some rather worrying difficulties were also picked up. Amongst these were the JRC's inability to reallocate resources sufficiently from old to new activities, its failure proactively to develop its own plans taking changing needs and internal resources into account, the need to implement more flexible human resource policies and the need to modernise the organisation, notably through better integration of the JRC institutes. The Expert Group takes proper and respectful note of these findings, although given the absence of sufficient time to carry out its own detailed analysis is unable to provide a clear statement concerning the JRC's impact on and relationship with the FP overall. Further investigation is needed if the group is to fully understand the value derived from the rather significant share of FP budget that is allocated to the JRC. The Expert Group also suggests it is necessary to investigate whether JRC activities should continue to be managed as part of the overall FP or in some other way. If funding of JRC is to be continued within the competitive arena of FP, the Expert Group endorses the proposed move, which has

attracted attention elsewhere[97], to extend the scientific capacity and knowledge base of the JRC through allocating a portion of the budget to research.

### 4.3.5 NEST

New and Emerging Science and Technology (NEST) had a budget of €215m during the life of FP6 and was conceived as a way to use bottom-up research applications to help identify interesting directions for more focused investments. In addition to projects, it comprised an array of search mechanisms including expert workshops and dialogues with the thematic priorities intended to influence the direction of FP6 and its successors. In that sense, it was intended to combine the roles of search and 'focusing device'. Assessment was by interdisciplinary peer panel, as a deliberate attempt to avoid the lock-ins normally associated with peer review and programming. While NEST is seen as a precursor to the ERC, owing to the fact that it was researcher-governed, its contributions as a pathfinder and a source of strategic intelligence have yet to be evaluated, although it appears to be most promising. Its function has since disappeared and it is not evident why this happened. The group finds this surprising, especially as the NEST opened for the first time a possibility to finance collaborative frontier research in the FP, the function not yet undertaken by the ERC, which exclusively funds individual researcher grants. Given the importance of search and focusing devices in research and innovation policy, an evaluation directed at these programme objectives needs to be initiated quickly.

### 4.3.6. Gender

Gender in the FPs was placed on the policy agenda in 1999. The report's earlier discussion of female researcher's participation in FP6 indicates that this is increasing but with a considerable distance still to travel in order to make effective use of half the population's talent. While the Science and Society part of FP6 ran several activities such as networks, consultations and publicity actions concerning gender, none appears directly to have touched either national policy in the area or the way the FPs are run. The attempt to introduce gender action plans into the IPs and NoEs was only partly successful and many did not have such plans. Women's participation in the FP is now being counted (in FP7) but is not in any sense being managed.

The disappointing progress on female researcher's participation in the FP needs to be highlighted and remedied. The Expert Group further stresses the need for a stronger focus on gender action plans and for valid and high quality statistics on participation in FP7 by female researchers.

### 4.3.7. Conclusions on wider policy achievements

Overall, the available evidence leads this Expert Group to conclude that FP6 has reinforced the tendency of earlier FPs, which is to build networks that continue beyond the life of the individual FP. The ambition for FP6 to structure RTD policymaking and funding is difficult to achieve, but some progress has been made. The most sustained structuring influence of the FP may be its role in developing new research infrastructures more rapidly and effectively than under the past tradition of establishing separate international organisations for each new infrastructure.

It is difficult to see how critical mass can be built up more effectively until the European instruments move beyond networking existing capacity and start to build bigger concentrations of capability, for example through competence centres and other kinds of centres of excellence. The 'Re-launch' of the ERA in Ljubljana (2008) was a tacit recognition of the lack of progress.

FP6 has helped integrate the new Member States into the EU, but the rate of improvement is limited by their ability to build capacity. Other sources of money such as the European Structural Funds will need deliberately to be brought into play in order to support their integration into the European research and innovation system. But, for such support to be effective, in turn, a 'joining up' is required at the policy level and in terms of the RTD strategies and activities of new Member States and the EU.

Treating the 'rest of the world' as a monolithic group of 'Third countries' has been too shallow and non-strategic an approach. The group suggests that in future the EU formulate differentiated strategies for its research collaborations based on objective criteria relevant to the desired relationships with (a) developing countries, (b) growth economies and (c) industrialized countries outside Europe, US and Japan. (A recent Commission Communication, COM (2008) 588, proposes a framework for this.)

The policy advice element of FP6 has not been subject to independent evaluation. In particular, the promising and potentially crucial role of NEST as a pathfinder for the research-driven component of the FP has not yet been explored. This should be done as a matter of urgency.

# 5 Conclusions, recommendations and a vision for the Framework Programmes

## 5.1 Introduction

The EU's Lisbon Strategy and Barcelona goal represent Europe's ambition to move from a reactive and somewhat inward-looking position in the second half of the 'American Century' to a more dynamic, outward-looking leadership role in the new global order of the Twenty-First Century. The idea of a European Research Area (ERA) and the European Framework Programmes are key ingredients in this change, which need to be 'joined up' to a large number of other policies.

The complexity of this task inevitably means that the FP is diverse. Within a complex and changing environment, FP6 made many positive contributions to the competitive and intellectual vitality of the EU's scientific, technological and innovative performance as well as taking an important set of steps on the road towards ERA. It is inconceivable that more fragmented action, for example at the level of individual Member States, could have achieved as much.

The novel character of ERA means that important parts of FP6 had to amount to policy experiments, representing leading-edge thinking at the time of their launch. The role of our Expert Group is therefore naturally as much to distil lessons as to judge performance. Nonetheless, there are clear lessons for FP design, management and implementation – some of which have already been identified and have influenced the conception of FP7; others of which need to be taken up in FP8 and in the linkages between EU-level RTD policy, other policies and the Member States.

This final chapter offers the Expert Group's evidence-based **conclusions** about FP6's performance and its **recommendations** about what needs to be changed, assuming a continuation of its major thrusts. The chapter also offers a **vision** for the future of the FP. This vision reflects the Group members' considered judgement as participants in Europe's scientific and technological enterprise that attainment of the EU's Lisbon and Barcelona goals requires more ambitious, more outward-looking, more strategically directed, better evaluated and more flexibly administered FPs in the future.

## 5.2 Conclusions

### 5.2.1 Achievements of FP6: a positive balance

FP6 was a powerful mechanism for catalysing RTD in Europe that could only be undertaken via action at the European level. It built upon the activities of the Member States in order to become a key instrument in tackling sub-criticality in European RTD. The Expert Group believes that the activities under FP6, especially its core thematic priorities that constitute 65% of its total expenditures, have generated EAV, contributed generally towards increased industrial competitiveness, generated network externalities, and strengthened the knowledge infrastructure in Europe.

FP6 included first-rate projects, involving top-quality researchers and well-managed consortia. Collectively, these have contributed to the improved mobility of researchers and the internationalisation of research teams. This has helped Europe to

amend its capacity to perform internationally competitive research at the frontiers of science and technology and in research areas of social and industrial importance. While FP6 has functioned well in strengthening the ERA, it was successful only to a limited extent in bringing new knowledge all the way to the industrial sector.

In overall terms, FP6 achieved scientific and operational standards for competitive, merit-based selection procedures which were respected by the communities involved. The system needs further, continued evolution.

The Expert Group supports the view that bottom-up activities such as NEST need further analysis, but could be instrumental in encouraging the exploration of new research avenues and overcoming lock-ins, and that this instrument therefore needs further analysis.

The relationship between the JRC and the FP overall deserves further investigation while fairly significant continued development and improvement, including structural and strategic changes, are called for by the recent JRC evaluation.

FP6 took a considerable step forward towards coordination of EU and Member State RTD policies. Initiatives like the ERA-NETs and Technology Platforms have helped stakeholders identify and explain their needs jointly, easing the process of developing mutually supportive policies at European and Member State levels.

The Expert Group noted with some concern that the downward trend in industrial participation continued under FP6. The poor quality of data available makes it impossible to say reliably whether the goal of allocating 15% of FP resources to SME participation has been met. In any case, such a general goal is considered to be arbitrary and other ways to ensure sufficient participation by SMEs in the FP need to be developed.

Although some progress has been made towards an increased participation by female researchers in the FP, neither the level nor the rate of improvement are at this stage satisfactory.

### 5.2.2 Design of FP6: a mixed picture

While the overall achievements of FP6 were considerable, there is reason to believe that more transparent consultation with stakeholder communities and a more explicit 'programme logic' would have produced a design that is more robust overall FP design. Such an ameliorated, more transparent and probably also more detailed design would enable the FP to act more effectively as a 'focusing device', giving signals and incentives to link RTD to needs and opportunities.

The role of the FP in the 'policy mix' at EU and Member State level is not yet well defined. Given its small size compared with Member State expenditures, the FP needs to use its EAV in a more strategic way, setting an attractive and accepted European agenda rather than trying to implement such an RTD agenda by 'brute force'.

Many of the social and economic changes sought via the FP cannot be attained without greater consistency between research and innovation policy. Moreover, other policies such as transportation and energy would benefit from a more coordinated interface between FP research activities and regulatory and demand-side policies.

In future, more attention needs to be given to the relationship between the FP and activities in the Member States. The FP cannot be treated as either a substitute or coordinator for Member State R&D policies, nor as a remedy for local problems or cohesion issues. Instead, it should act as a 'coordinator' or 'lubricant' for multi-actor initiatives (like the ERA-NETs).

### 5.2.3 Implementation and management of FP6: room for improvement

The main novelties of FP6 in the thematic priorities – the new instruments IPs and NoEs – were not as successful as initially hoped for in structuring the research community and institutions in the way envisaged. The smaller-scale efforts at policy coordination and establishing focusing devices, such as the ERA-NETs and ETPs, have been more, and in some cases very, successful.

The human resource actions of the FPs are almost universally judged to be major successes. By establishing working relations across the Union's knowledge infrastructure, these actions have been a major driver towards an ERA and also provided opportunities for EU researchers to build long-term relationships with others outside Europe, even if the take-up of such opportunities by Europeans could be improved.

The research infrastructure actions are seen as successful and of high value for Europe., as they are *a priori* much easier to implement than the complex arrangements needed to run a particular research infrastructure through an independent organisation.

Complexity and lack of timeliness in administration remain stains on the reputation of the FP both within and outside Europe. These flaws are a significant disincentive to participation in FP programmes, and indeed have been cited as being among the major factors contributing to the continuing decrease in industrial interest in FP. In far too many ways, its implementation acts against achieving the objectives of the FP. The complexities of the application and contracting procedures raise significant barriers to entry at the proposal stage, especially for first time applicants, be these research groups, firms, or organisations from new Member States.

The Expert Group has not seen evidence that the Commission, the Council and the Parliament sufficiently recognise the requirement for management processes capable of handling the complexity and novelty of a large complex programme such as FP6, with many goals, new instruments and approaches. More flexible application and contract procedures are needed based on a fuller, experienced-based understanding of the operations of high-performance research management.

There has been considerable improvement in the way evaluation of the FP is organised in recent years. However, opportunities remain to improve these

processes and an increased exchange of good practice with Member States could be of mutual benefit.

The public accountability of the FP must be improved. Not through audit control, but through clear procedures and access to information at all stages and, where appropriate, through open access to the research results obtained through the FP funding.

### 5.3 Recommendations: looking towards future Framework Programmes

The overarching objective for future FPs, and indeed for all aspects of European RTD policy should be to improve the attractiveness of the European research ecology, making Europe the first choice for performing and capitalising on the fruits of research through knowledge transfer, commercialisation, social development and other routes. Procedures should be developed that are capable of providing substance to this idea. Based on these considerations the Expert Group recommends the following

1 Prior to proposing plans for FP8, the Commission should analyse and more clearly document the current and future rationale of the FP at both aggregate and micro levels. The number of goals set for a FP should be commensurate with the Commission's and other actors' capacity to manage towards these goals. The Commission should document and make more transparent the consultation processes involved in designing a FP at both the aggregate and the Work Programme level

2 An FP, however, needs to be more than a reflection of what competing beneficiary or stakeholder communities want of it at the outset. It needs the flexibility to evolve and change. The FP should not develop into a substitute for the RTD policies of Member States or for other local problems, but should be better synchronised with national research efforts in order to strengthen and structure the ERA. It should also consciously avoid monopoly. At present, the Commission and the FP have a hand in almost all European RTD cooperations, risking a monotony of thinking and ideas and precluding the benefits of diversity of the European research system.

3 The 'Third country' terminology must be abandoned as it stands in the way for strategic thinking. It should be replaced by three strategies: one for EU FP collaboration with the developing countries; one for collaboration with growth economies; and one for collaboration with industrialised countries outside the EU. The budget for cooperation with the major existing (such as US and Japan) and emerging economies (including India, China and Brazil) should be increased dramatically and strategies tailored to reinforce mobility with these countries and to engage them as partners in the mainstream of the FP, thereby strengthening both the quality and purpose of ERA. FP activities for collaborating with developing countries should concentrate on topics and technologies of relevance for development and where EU scientists are globally in the lead

4 A new bottom-up format (inspired by NEST in FP6) should be introduced to test research directions and original ways of achieving collaboration. The format's

characteristics should be swift and risk-taking, 'scientific excellence' being the only criterion for selection

5 SME participation in the thematic priorities is important and should be encouraged. However, the utility of an overall 15% target should be re-examined in favour of mechanisms which are more in line with the relevant industrial dynamics

6 The Expert Group recommends continuing the ESFRI process, including its roadmap and foresight activities, recognising that FP activities that support research infrastructures which serve multiple fields have proven highly effective

7 Steps must be taken to substantially increase the participation of female researchers in FP projects, by means of much more pro-active approaches such as (re)introducing specific gender equality actions in addition to quality criteria as a condition of funding in large instruments. Statistics must be systematically and continuously gathered, analysed and monitored and actions taken if progress towards equality is not being achieved

8 It is crucial for Europe's future scientific and technological vitality and competitiveness to ensure that research is seen by young people as an attractive career choice. Focusing the FP more strongly on addressing the major global needs and challenges could be one way of addressing this issue. Other elements would be to promote further the mobility of young European scientists and to allow more students and young researchers from scientifically emerging countries to study and work in Europe

9 Administration of the FP needs radical overhaul, not incremental tinkering. The Commission should engage external help to review its procedures – including its financial control procedures, with specific targets including reducing the 'headline' time-to-contract indicator by 50% and of moving from a cost basis in contracts to a price basis, so that cost no longer needs to be audited except perhaps for a small number of projects. In its support of scientific projects, the Commission should continue to change from a contract to a grant basis

10 The Commission should broaden its evaluation culture considerably, in order to measure and demonstrate the impacts of the FP. To date, evaluations of the FP have tended to focus on the planning and organisation of the most recent programme. There is a significant deficit in our understanding of the effects of the FP over time and on the wider context (including institutions; disciplines and technologies; industry; society at large; policy). While the programme-focused style of evaluation promoted by the Commission's internal regulations is of course important, it is hard to develop a good understanding of how the FP works and to improve it without also considering these other perspectives

During the interim evaluation of FP7, particular attention should be given to progress achieved in respect of simplification, the gender issue, and the issues of knowledge infrastructure and the inadequate level of industrial participation.

## 5.4 Vision

The Expert Group sees the spirit of Lisbon, Barcelona and the ERA as signalling a radical break from the introverted character of Europe's past RTD policies and a desire to engage with a fast-changing world.

Europe will build on its strengths to become a confident generator and user of knowledge in a global knowledge society. It will have the means to fulfil the role of being a strong partner in solving the global challenges which we must all face.

By delivering this vision of a stronger and more united Europe, the notions of *juste retour* and *subsidiarity* will have less meaning and EU research and innovation policies can focus more on activities of interest to the continent as a whole, without worrying about the boundaries between national and EU responsibilities.

Such a vision requires foresight and discussions of priorities that engage citizens as much as researchers and industrialists. It requires the promotion of risky research aiming at new knowledge, technologies and products. It requires the recognition that - unlike in the classical European perception - a continuum exists across basic and applied research and that inventive and innovative science are nowadays strongly interlinked and mutually important. It requires Europeans to care about the future of their continent but also to recognise the importance of development in other parts of the world – partly just because this is right and partly because European interests and ideals will be better served when Europe's neighbours are not poor. European collaboration and competition should represent the fundamental ingredients of Europe's path to global scientific and industrial excellence during the coming decades.

In fact, globalisation and the changes in power and capability among the major nations already make it absolutely essential that the EU shifts towards a more internationalist position.

**It is therefore time for a confident, scientifically capable, innovative European knowledge society to engage with the rest of the world,** rather than just defending itself and becoming preoccupied with merely local concerns.

This is not altruism but a necessity for survival: if Europe does not play the global game well enough, it faces only a future of decline. If Europe does not engage more effectively with the existing and emerging global economic superpowers, it will be left sitting at the side of the road.

This vision depends in part upon unlocking existing institutional structures. Companies learnt to be global a long time ago. Reforms in university and research institute governance, structures and funding are needed so that they have incentives to cross borders, build scale and specialise. It means openness to the global mobility of researchers, the use of all the talents within Europe and a research-friendly ecology. It requires the creation and growth of a greater number of technologically capable companies and industries empowered and equipped to take the risks associated with innovation, that are necessary for competitive success at a continental stage and beyond. It requires Finnish-style boldness to invest in knowledge even when, unhappily as at present, both national economies and the international economy are weak.

There is enough experience now of the governance of research and innovation systems that we know the importance of combining top-down and bottom-up approaches. A future Europe, able to take on a confident, outward-facing role in the world, will break with its tradition of rolling forward most of the content of the FP from period to period while constantly redecorating the surface, and will concentrate instead on two new lines of action.

First, there will be a top-down process by the Commission to convert the problems, concerns and questions of its citizens and other citizens of the world into a series of **Grand Challenges** and then act to meet them. Among these challenges are societal integrity (including overcoming marginalisation and unemployment in the labour market), global security, education, climate change, environment, energy, global economy, health and ageing. These challenges should be met via well established collaborative research projects of adequate size and funding while a limited number of challenges of paramount societal concern should be strategically addressed via joint programming initiatives.

Second, grand challenges should be met with **Great Ideas** from bottom-up activities initiated by researchers, universities, research institutes, companies and others who can offer interesting, high-quality research ideas. This implies something like a **European Research Council (ERC),** but one that is freed from the short-term constraints of being a budget line in FPs and which builds also on research that is both cross-disciplinary and cross-institutional by virtue of being carried out by Pan-European teams of scientists.

The **ERC** must be supported by a strong political mandate to play a role in funding European frontier research. To do this, the ERC needs operational freedom and financial autonomy. In our vision, the current ERC policy towards individual grants should be supplemented by **NEST – like** competitions, strengthening the idea of cooperation as Centres of Excellence Programs do. ERC and NEST-like projects or programs could be managed by an independently acting broad **Pan-European Agency** which functions on the basis of a strong Member State mandate and which is capable of handling increasing budgets in support of Frontier Research. The European Science Foundation (ESF) – in a suitably modified form – could take up such a role.

At the same time, an instrument could be created, which promotes excellence in the transfer of visionary scientific results (inventions) into industrial applications (innovation). This instrument could ultimately reinforce European frontier innovation. For this instrument to be effective, the same requirements for excellence in addition to relevance must be applied to industry and SMEs, as to all other participants of the FPs.

Future FPs and other means to develop the ERA also must be funded adequately. **The budget required to achieve a well-designed and well-implemented FP that addresses the Expert Group's more far-reaching vision, given the heightened context of ERA, will be significantly more than the funding provided to FP7. The Expert Group supports such an increase, recognising that investment in science and technology may be the best response and a visionary step in the present times of economical crisis.**

The Expert Group therefore envisages a future for FP8 based upon the objective of "**European excellence through Global collaboration and competition".** This objective has to be coupled with an open collaborative attitude to the 'rest of the

world' and adequate financial support, a transparent but consistent evaluation culture and flexible, less onerous administrative and contractual procedures to address both the demand and the supply sides of an EU RTD strategy. This will move the FP from being an incremental addition to national resources to something that is **Game Changing** in nature: perhaps two or three times its current size, valued for its contribution to new knowledge, enhancing the quality of life of Europe's citizens and solving global problems in partnership with the world. Participation in these endeavours will thus become a badge of honour for Europeans working in both academia and industry. The Expert Group looks forward to the day when the test of European Added Value becomes obsolete because each European project or programme, independent of its geographic origin will be considered beneficial for Europe and, therefore, fundable by Europe.

# Meaning of acronyms and technical terms

| | |
|---|---|
| ACARE | Advisory Council for Aeronautics Research in Europe |
| BERD | Business Expenditure on R&D |
| BRITE/EURAM | Industrial and Materials Technologies Programme in FP3 |
| CA | Coordination Action |
| CERN | European Organisation for Nuclear Research |
| CIP | Competitiveness and Innovation Framework Programme of the EU |
| CIS | Community Innovation Survey |
| COST | European Cooperation on Science and Technology |
| CRAFT | Cooperative research programme for SMEs within the FP |
| DoD | US Department of Defence |
| DG | Directorate General of the Commission |
| EAV | European Added Value |
| EC | European Community |
| EDTCP | European and Developing Countries Clinical Trials Partnership |
| EMBL | European Molecular Biology Laboratory |
| ERA | European Research Area |
| ERA-NET | FP6 instrument for cross-border joint funding of RTD |
| ERC | European Research Council – a budget line in FP7 |
| ESA | European Space Agency |
| ESF | European Science Foundation |
| ESFRI | European Strategy Forum on Research Infrastructures |
| ESPRIT | European Strategic Programme of Research in Information Technology (FP1) |
| ETP | European Technology Platform |
| EU | European Union |
| EU-15 | First 15 Member States of the EU |
| EUCAR | Joint R&D planning and lobbying organisation of the EU automotive industry |
| EURAB | European Research Advisory Board |
| EURATOM | European cooperation in nuclear energy |
| EUREKA | A European research and innovation funding programme jointly run by European countries |
| EUYRI | EU Young Research Investigator scheme |
| FP | Framework Programme |
| FP6 | Sixth Framework Programme |
| FYA | Five-year-assessment |
| GDP | Gross Domestic Product |
| GERD | Gross Expenditure on R&D |
| GSM | Group Spéciale Mobile – originally a working group on second generation (digital) mobile telecommunications; now the predominant standard |
| HRM | Human resource and mobility actions |
| ICT | Information and Communication Technology |
| INCO | International Cooperation area |
| IP | Integrated Project |
| IST | Information Society Technologies (part of the FP) |
| IT | Information Technology |
| ITER | New nuclear fusion research facility to be constructed in France |
| JET | Joint European Torus – existing European fusion research facility |
| JRC | Joint Research Centre |
| MCA | Marie Curie Action |
| MS | Member State |
| NEST | New and Emerging fields in Science and Technology |
| NMP | Priority 3 of FP6:Nanotechnologies and nanosciences, knowledge-based multifunctional materials, new production processes and devices |
| NMS | New Member State |
| NoE | Network of Excellence |
| NORIA-NET | Networks among Nordic research funders |
| NSF | National Science Foundation (USA) |
| NEST | New and Emerging fields in Science and Technology |

| | |
|---|---|
| OECD | Organisation for Economic Cooperation and Development |
| R&D | Research and Development |
| RAND | US research institute |
| RTD | Research and Technological Development |
| RTO | Research and Technology Organisation |
| S&T | Science and Technology |
| SMART | Specific, Measurable, Attainable, Realistic and Timely |
| SME | Small or Medium Sized Enterprise |
| SNA | Social Network Analysis |
| SRA | Strategic Research Agenda |
| SSA | Specific Support Action |
| STDI | Science and Technology for Development |
| STREP | Specific Targeted Research Project |
| TNO | Dutch organisation for applied research |
| VTT | Major Finnish research institute |

# Appendix A Mandate of the Expert Group

**Terms of reference for an experts group on the *ex-post* evaluation of the Sixth Framework Programmes**

## 1. INTRODUCTION & OVERALL OBJECTIVE

These are the Terms of Reference for an Experts Group set up by DG Research of the European Commission for the *ex-post* evaluation of the Sixth Framework Programmes.

**The overall objective of the Group** will be to provide an evaluation of the rationale, implementation and achievements of all dimensions and research fields of the EC and EURATOM Sixth Framework Programmes.

Via a combination of **collective and individual work** punctuated by several meetings, the Group will analyse existing evidence including evaluation and monitoring studies on the Sixth and previous Framework Programmes and their Specific Programmes, ad hoc analyses, statistical information and relevant policy documents and reviews.

The Group will prepare a **final report** in which it will provide conclusions and recommendations.

## 2. MANDATE, DELIVERABLES AND TIMETABLE

### 2.1. Context and Rationale

The EC and EURATOM Seventh Framework Programme Decisions[98] [99] provide in article 7(2): and 6(2) respectively: "*No later than 2010, the Commission shall carry out, with the assistance of independent experts, an evidence-based interim evaluation of this Framework Programme and its specific programmes building upon the ex-post evaluation of the Sixth Framework Programme.*"

The present paper relates to the *ex-post* evaluation of the EC and EURATOM Sixth Framework Programmes.

This shall cover the rationale, implementation and achievements of the Framework Programmes. The exercise should be completed in the last quarter of 2008.

Specific inter-institutional and Commission requirements further frame this evaluation; in particular those related to the Financial Regulation[100] and evaluation standards[101].

This *ex-post* evaluation covers the years 2002-2006, a period during which the European research landscape has changed significantly including:

- The EU underwent a period of major expansion with the joining of 10 new Member States;

- The size of the EU Budget allocation to research activities has grown substantially both in real terms and as a proportion of the overall Budget;
- A series of new policy initiatives including the Strategy for Jobs and Growth have further strengthened the position of research, technology and innovation at the heart of EU policy making;
- Growing competitiveness in world markets in high technology goods linked with the increasing globalisation of knowledge and research activities place ever increasing pressure on Europe to invest in and develop its research and technology base;
- The European innovation system has become increasingly dynamic with the emergence of new roles and linkages between the key institutions including firms, universities and research centres;
- Attempts to promote the growth of a European Research Area brought forth major new types of funding in new research areas, notably the key initiatives under the Sixth Framework Programmes.

## 2.2. Questions to be addressed

This *ex-post* evaluation covers all research programme activities under the EC and EURATOM Sixth Framework Programmes. The exercise should provide substantive answers to the type of evaluation questions listed hereafter.

- ***RATIONALE:***

- *Were the overall Framework Programme objectives adequately specified, notably towards achieving industrial competitiveness and the realisation of the European Research Area, and were the Framework Programmes the best means to achieve such objectives?*
- *Was the level of funding and other available resources adequate to achieve the objectives set?*

- ***IMPLEMENTATION*:**

- *Was the overall legal framework (including rules for participation and contracts), clear, appropriate and effective?*
- *Were the activities carried out efficiently and were they cost effective, taking into account particularly issues such as the overall cost of management against research funded; contractual and legal procedures; and the support given by the Commission to assist programme participants?*
- *Were the policy instruments and the modalities for implementation clear, appropriate and effective?*
- *Did the Framework Programmes attract (and target) the best and most appropriate researchers and research organisations with an effective balance between the academic, industrial (including SMEs) and research organisation sectors?*

- ***ACHIEVEMENTS:***

- *Did the research activities achieve their objectives and were they the most appropriate means for achieving the objectives set?*
- *To what extent were there unexpected results?*

- *What are the major results in particular in terms of scientific, technological, socio-economic and environmental outputs, in terms of international co-operation, knowledge transfer and innovation, pre-normative activities, accessibility, dissemination and uptake of research, human resources development, mobility and training, and in terms of supporting and enhancing co-ordination of research activities in the context of the European Research Area?*
- *Were the results and their effects and impacts globally satisfactory from the point of view of direct or indirect beneficiaries and stakeholders?*
- *How and how far have the activities contributed to improved EU research competitiveness at international level? Is there evidence to believe the research has contributed or will contribute in future towards EU research leadership in specific areas?*
- *How and how far have activities contributed to EU policies in general and to the EU's strategy for sustainable development?*
- *Is there evidence of structural change, including in particular networking, integration and co-ordination of research, at a national or at an international level as a result of Community research activities?*
- *Did the programmes provide value for money? Is there evidence the activities will have lasting impacts?*

The Sixth Framework Programmes *ex-post* evaluation also assesses the follow-up and implementation of recommendations from previous evaluations.

### 2.3. Deliverables and Timetable

The Group is requested to address to the Commission a report, of maximum 50 pages plus Annexes, which includes an analysis of findings and a set of conclusions on the basis of evidence. The main section of the report should be prefaced by a largely self-contained executive summary, not exceeding 5 pages.

The report is to be made publicly available.

The Group starts its work in early 2008 and its final report should be addressed to the Commission by November 2008 at the latest.

### Meetings

The Group will meet up to a maximum of seven times, between April 2008 and November 2008.

Meetings will be normally held in Brussels.

## 3. OPERATION OF THE EXPERT GROUP

### 3.1. Number, identification and selection of experts

The Group will comprise up to fifteen independent experts[m]. It will include the relevant expertise to ensure informed analysis on all of the areas covered by the Sixth Framework Programmes and will also include acknowledged experts in programme evaluation and management.

The independent experts will be appointed on the basis of the following criteria:

- high level of expertise in the fields of research and technological development in particular, as attested by higher education qualifications of at least doctoral level and/or proven by having won prizes and awards at national, European and international level and/or as evidenced by experience and skills which are widely recognised;
- appropriate range of skills in the different fields covered by the Commission and EURATOM framework programmes, combined with the ability to examine related questions and analyse the general context (legislative, political, etc.) into which they fall

Provided that the above two conditions can be satisfied, other criteria are also taken into consideration:

- appropriate balance between academic and industry expertise;
- ability to assess the societal dimension and strategic relevance of the framework programmes and specific programmes;
- a fair balance between men and women;
- a reasonable balance of geographical origins;
- regular rotation of experts.

Experts are identified from a list, continually updated by an open-ended call for applications (OJ C 305 of 14.12.2006), for the constitution of Expert Groups assisting the Commission's services for tasks in connection with the Seventh Framework Programmes[102].

### 3.2. Working method

The Chairperson of the Group decides on its working methods; s(he) is however requested to ensure that the Group members and the supporting expertise are best exploited to allow for such in-depth analysis in all the areas covered by the Framework Programmes. The Group includes a highly qualified rapporteur.

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[m] The experts cover overall the following areas: life sciences, information society technologies, nano-technologies and nano-sciences, aeronautics and space, food quality and safety, sustainable development, citizens and governance, international co-operation, innovation, human resources in research, nuclear energy and fusion energy, research infrastructures and the research activities conducted by the JRC.

The **rapporteur** will prepare the final report of this Group, on the basis of all members' written contributions and of relevant material and events identified by the Group members and/or the Commission. He/She will highlight and exploit main points of reports presented by experts, create PowerPoint presentations and draft summaries of the discussions held at meetings.

**Commission staff responsible for the Expert Group** is in regular liaison with the members of the Group and notably the rapporteur to ensure the smooth running of the Group, and they attend the meetings to provide appropriate information and orientations.

The **rapporteur** will take **responsibility for preparing (compiling and editing) the Expert Group report, in close cooperation with the other members of the Group**. The Commission staff responsible for the Expert Group will also provide input to the production of the report, notably through the collection of factual evidence.

Appropriate independent experts can be invited to participate in one or more of its meetings.

### 3.3 Expert support and evidence-base

The Group will carry out its activities through an independent, robust, evidence-based process.

The Group is assisted by independent supporting expertise in the form of up to 6 evaluation experts which, on the request of the Group, provide independent information and analysis.

A comprehensive set of studies encompassing monitoring and impact assessments of previous Framework Programmes as well as Specific Programmes and contextual and methodological analysis is carried out or commissioned by the Commission and delivered to the Group progressively according to the availability of data from the various activities. The Group may appoint an expert from their midst or among supporting experts to follow the running studies, as appropriate. The studies provide the Group with a knowledge base to support its work.

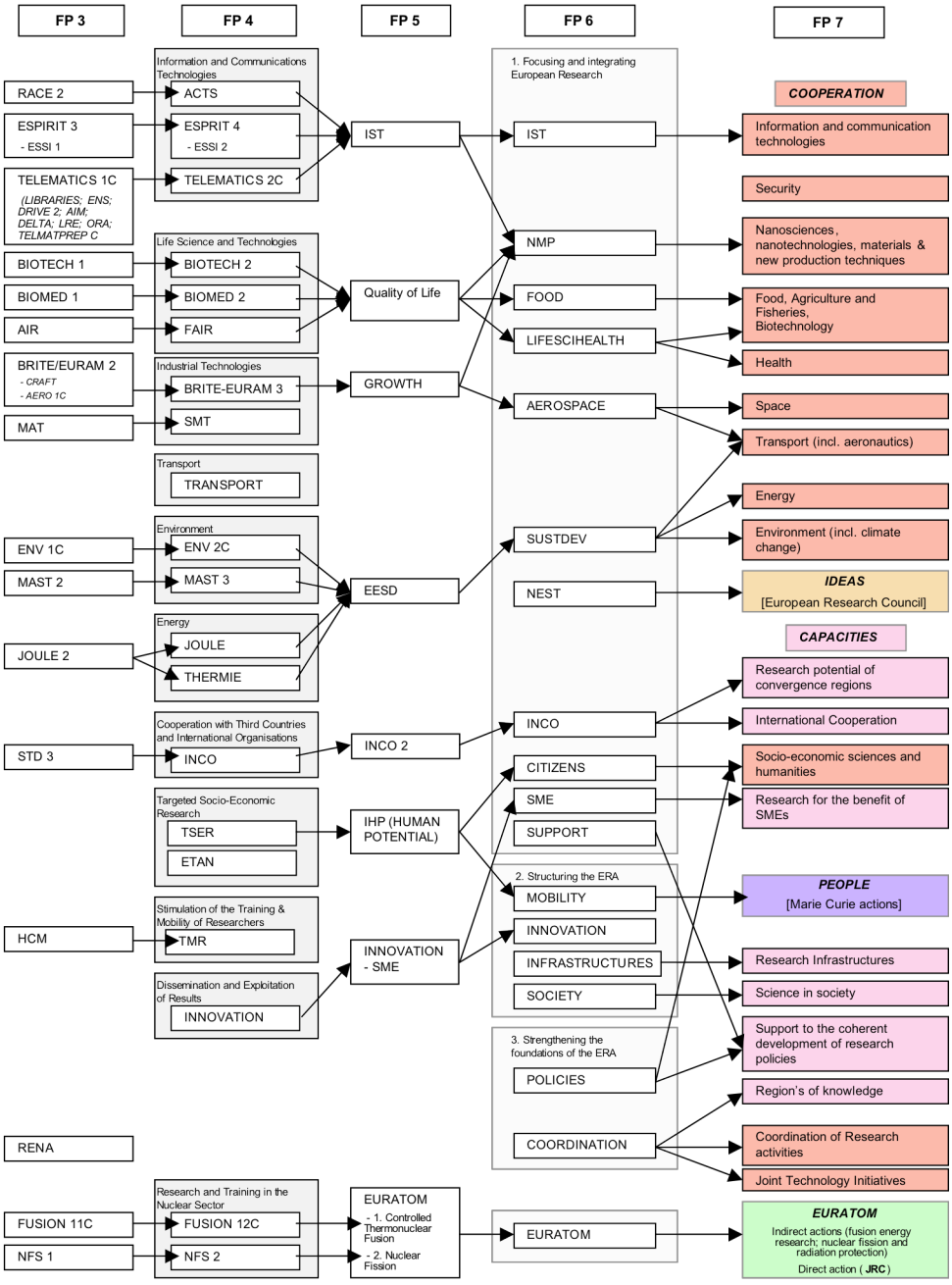
The Commission will provide the Group with all necessary information, in particular:

- Reports from the above mentioned studies and ad hoc analyses;
- Report from the mid-term evaluation of new instruments under the Sixth Framework Programme (FP6);
- Monitoring Reports and Commission services' replies;
- Previous Five-Year Assessment reports and Commission replies;
- Relevant policy documents and reviews, including the Framework Programmes, the spring reports to the European Council, annual reports on research activities, S/T indicators, benchmarking and mapping data;
- Targeted evaluations and studies carried out by Framework Programme thematic activities, including the *ex-post* evaluation of the Joint Research Centre;
- Statistical information on the implementation of the activities.

In addition, national authorities may also provide national impact assessments and other national evaluation data, as appropriate. This information base is to be made publicly available.

The Group is invited to establish contacts with national experts for the exchange of information and discussion. The Commission services may, at the request of the Group, convene ad hoc expert meetings on emerging issues.

# Appendix B Concordance between Framework Programme Thematic Areas



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