

FIVE-YEAR ASSESSMENT OF THE EUROPEAN UNION RESEARCH AND TECHNOLOGICAL DEVELOPMENT PROGRAMMES, 1995-1999

Report of the Independent Expert Panel

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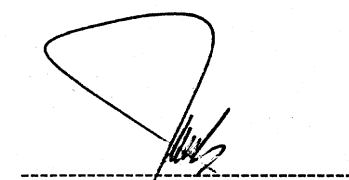
July 2000

THE FRAMEWORK PROGRAMMES' FIVE-YEAR ASSESSMENT PANEL

We, the undersigned, the Framework Programmes' Five-Year Assessment Panel, are pleased to present our report to the European Commission

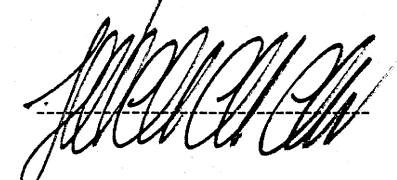
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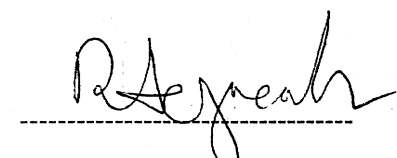
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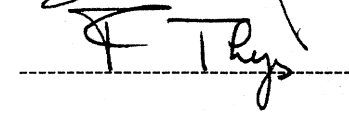
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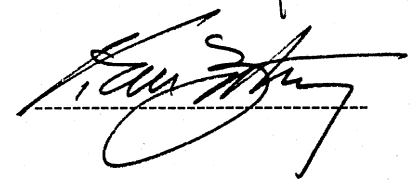
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Chairman's Introduction

New circumstances call for new goals. And new goals call for new policy tools.

Our Panel has been appointed to evaluate the performance over the last five years of a tool, the Framework Programme. But we felt obliged to go beyond this task.

You will find in our report the expected evaluation, an evaluation that shows lights and also darks. I hope that our suggestions make a useful contribution to the task of preparing the next Framework Programme and fine-tuning the current one.

Our main message is that if the European Union wants to face the challenges of the new economic situation and attain the goals outlined by Heads of Government in Lisbon, the Framework Programme alone is not enough to implement European research and technological development (RTD) policy. It needs to be complemented by other tools.

It is my conviction, shared by the members of the Panel, that these challenges will not be successfully met without a real European RTD policy, a policy which does not exist today. Improving and enhancing the Framework Programme will be necessary but it will not be enough.

Let me go further. The absence of research policy is due to the lack of a real strategy for the future of Europe. It is very difficult to imagine how the ambitious goals decided in Lisbon can be achieved if this void is not filled.

For this reason, an important part of the report is devoted to the threats faced by our industrial and scientific communities and to the actions which need to be taken both at the level of the Union and, in a co-ordinated form, at the level of the Member States. Looking from the side of economy, the most important threat is of Europe falling further behind other economic areas over the next decade. Looking from the scientific community, the fear is of Europe losing its place as a centre of excellence for the creation of knowledge. I am convinced that both threats are the same.

This report is a contribution to the work of the Commission and a plea to European leaders, both in the Union and in the Member States, for the substantial policy review needed in order to implement a coherent follow-up to the statements made in Lisbon.

Executive Summary and Recommendations

The EU currently faces great challenges. At the March 2000 meeting of the European Council in Lisbon, the Union set itself the goal of becoming the most competitive and dynamic knowledge-based economy in the world. This puts research and technological development (RTD) policy at the heart of development strategies.

The most important conclusion of our Panel is that the Framework Programme alone will not be enough to serve the goals set at Lisbon.

Although there is much to commend in past and current Framework Programmes, the challenges we face as we move towards the new economy call not only for the Framework Programme itself to become a much more flexible policy instrument, but also for additional instruments and actions.

RTD policy is inextricably linked with policies in other spheres, especially education and innovation. **Our Panel is convinced that the required changes need to be conceived within an overall strategy for Europe, articulated at the level of the EU and supported by all the Member States.**

Framework Tomorrow

The Framework Programme has helped academic and industrial partners all across the EU to tackle problems collaboratively. It has also contributed to the training of researchers and to the development of the European research infrastructure.

There is still a need for these activities and they deserve to be continued, but the scope of the Framework Programme should also be increased in line with the need to meet the Lisbon goals and the demands of enlargement. The Panel recommends:

Maintaining the emphasis on social relevance and continuing to use Key Actions as a way of focusing programmes;

Maintaining a strong emphasis on collaborative RTD projects supplemented by a variety of other actions;

Emphasising excellence and the participation of leading-edge researchers;

Encouraging participants to propose 'riskier' projects;

Enhancing measures encouraging the mobility of researchers within the EU and between the EU and elsewhere;

Retaining support for generic, competence-building RTD activities;

Increasing the emphasis on the research needed to support other EU policies.

But more is needed in Europe today. The EU Treaty allows for the use of other policy instruments to support scientific and technological activity. Some of these have been used, but **the Panel is convinced that existing policy tools need to be further exploited in a restructured and expanded Framework Programme.**

This under-utilisation is a consequence of the way the Framework Programme is determined and implemented. **The Panel recommends a major review of the systems and procedures used to decide overall goals, specify delivery mechanisms and implement programmes.** Specifically, we are convinced of the need to distinguish carefully between these activities and to allocate responsibility for them accordingly. **We recommend adoption of a European RTD strategy at the highest political levels. The Heads of Government should then delegate the task of formulating and implementing this strategy to the European Commission, supported by an appropriate advisory structure.**

These changes will necessitate a greater level of trust by the Member States in the ability of the Commission to deliver an effective Framework Programme. In particular, **the Panel sees no need to continue the Programme Committees.**

At the level of implementation, a review of the management and administration of the Framework Programme should concentrate on ways of **re-engineering existing structures and procedures to delegate responsibility for tasks downwards within the Commission, or externalise them.** At present there is excessive focus on adherence to procedures and not enough emphasis on ensuring overall goal attainment.

The changes recommended by the Panel to create a more flexible, expanded Framework Programme will require support at the highest political levels. This is because they call into question some of the basic principles governing the operation of the European Commission as a whole, not just the way research policy is formulated and implemented.

Beyond Framework

It will be necessary for Heads of Government to reconsider the priority attached to science, technology and innovation. These activities are critical to the development of the knowledge-based society envisaged at Lisbon. Accordingly, **the Panel recommends increasing the relative size of the budgets allocated to science and technology compared to other policy domains.**

The Panel is convinced that the percentage of GDP spent in the EU on public and private RTD should rise to at least 3% over the next ten years. Higher levels will be necessary without parallel efforts to avoid duplication of effort across the EU. Private sector RTD expenditure will need to be stimulated if Europe is to keep pace with its competitors. **The Panel recommends the use of indirect measures such as RTD tax incentives across the EU** in order to flag to the rest of the world that Europe is an attractive place to conduct RTD.

RTD policies in the Member States need to reinforce rather than duplicate each other. In the Panel's view, the European Commission has a key facilitation role to play in this area. The Commission should take the lead in outlining the steps needed to pool infrastructure and policy-intelligence resources across the EU. The Panel also urges all the Member States to lend their unequivocal support to these efforts.

The enlargement of the EU presents great social and economic opportunities for all, but only if appropriate actions are taken. The Central and Eastern European countries are waiting for the EU to take the lead by implementing a European RTD strategy which takes their needs fully into account. **The Panel recommends that support provided to these countries for RTD activities be channelled temporarily through the existing scientific Academies until new competitive structures for the organisation of science and industry can be developed.**

The Panel recommends urgent action to counter envisaged skill shortages over the next decade. This will involve measures to increase the attractiveness to young people of careers in science, actions encouraging retraining, and steps to ensure that the potential increase of scientific talent as a result of enlargement is fully tapped. The Panel also supports the creation of truly European centres of teaching and research excellence capable of attracting the best minds in the world to live and work in the EU.

Innovation is another policy area in which new initiatives are needed to improve the position of Europe. Innovation policy is linked with RTD policy but is much broader, involving financial, market, legal, fiscal and cultural aspects, and will require actions outside the Framework Programme. The Panel supports such endeavours and **urges the Commission to ensure that innovation-related activities are high on the agenda of actions supported by the Community Structural Funds and the Accession Funds for the applicant countries.**

Framework Assessment

The Panel's positive assessment of activities over the last five years is the basis for recommending continuation and expansion of the Framework Programme. The emphasis on collaborative RTD projects was much appreciated by academic and industrial participants, allowing them to undertake strategically important work which would have been difficult to undertake otherwise. Networking, training-related activities and adequate procedures for the involvement of SMEs were also widely regarded as successful features of the Framework Programme.

Concerning programme administration, many participants were dissatisfied with application procedures and, to a lesser extent, with payment delays. **The Panel recommends making procedures much simpler and easier to understand.**

The overall orientation of the Fifth Framework Programme was endorsed by the Panel, though the initial implementation of the programme was not smooth. The new matrix management structures put in place to ensure adequate communication within and across programme areas did not function well. **The Panel recommends an urgent re-engineering of the overall management and administration of the Framework Programme.**

The system of evaluation can be considered as well established. Impact assessment should become one of the most important elements of evaluation.

Main Report

Introduction

The Framework Programme is primarily aimed at improving scientific and technological capability and competitiveness in the EU via collaborative research and technological development (RTD) projects involving partners from the Member States.

This report, the second Five-Year Assessment of the Framework Programmes, reviews the performance of the Third, Fourth and Fifth Framework Programmes over the period 1995-1999. It covers relevance to European needs, efficiency of implementation and overall effectiveness and impact. As part of the Panel's mandate, we also make recommendations concerning the future implementation of the Framework Programmes.

But the report goes beyond this mandate. The EU currently faces a great challenge which necessitates a radical upgrade of the policies and policy mechanisms needed to ensure that scientific and technological advances continue to underpin economic progress. At the last meeting of the European Council in Lisbon in March 2000, the Union set itself a new strategic goal for the next decade:

“to become the most competitive and dynamic knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion.”¹

This is to be achieved via an overall strategy aimed, *inter alia*, at:

“preparing the transition to a knowledge-based economy and society by better policies for the information society and R&D, as well as by stepping up the process of structural reform for competitiveness and innovation and by completing the internal market.”²

This is an ambitious agenda, all the more so because there is evidence to suggest that the RTD community in the EU faces a number of severe challenges. A recent Communication from the Commission³ warned that the situation concerning research in the EU was worrying. In particular, even though Europe produces a third of the world's scientific knowledge, the Communication noted that:

*Average expenditure on research across the EU, expressed as a percentage of Europe's GDP, is significantly less than in either the USA or Japan;
The gap between the EU and the others is widening;*

¹ Presidency Conclusions - European Council, Lisbon, 23 and 24 March 2000

² Presidency Conclusions - European Council, *ibid.*

³ European Commission, 'Towards a European Research Area', Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions, Luxembourg: Office for Official Publications of the European Communities, 2000.

*The deficit in the trade balance in high tech products is widening too;
The number of researchers as a percentage of the industrial workforce
is much less in the EU than in the USA or Japan.*

These challenges will have to be overcome if the EU is to meet the ambitious targets set in Lisbon, and policies capable of attaining these goals will have to be formulated and implemented with some urgency.

The Framework Programme operates alongside the RTD policy instruments of the individual Member States. All these are implemented within broader policies aimed at industrial development, defence, health, education, the environment and all the other policy domains of concern to contemporary societies. Changes in all these areas are needed to deliver the transformation that the Lisbon goals demand. The Framework Programme alone will not be enough.

In this report, we assess achievements over the last five years and make recommendations for the remainder of the current Fifth Framework Programme and the shape and conduct of future programmes. But we also examine what the Framework Programme as a policy instrument can and cannot be expected to achieve before considering the most important additional policies and measures which will be needed within Europe if the EU is to create a dynamic knowledge-based society.

The Panel's Approach

The independent Panel was constituted in December 1999 and held 10 meetings prior to the formal presentation of its conclusions and recommendations to Commissioner Busquin on July 19th, 2000. It appreciated immediately that its mandate was both to assess the achievements of the Framework Programmes over the last five years and to consider the broader policy environment in which these programmes exist. A decision was taken at the outset to focus on both the past and, more importantly, the future.

The Panel reviewed evidence from several sources. The parallel Five-Year Assessments of the Specific Programmes constituted the main source of data on the performance of the Framework Programmes, including the early implementation of the Fifth Framework Programme. These data were complemented by the analysis of over 2,000 questionnaire returns from participants in the Third and Fourth Framework Programmes. The Panel and its members also conducted interviews with the Chairs and representatives of the Five-Year Assessment Panels for the Specific Programmes; with the Chair and Rapporteur for the 1999 Annual Monitoring Panel for the Framework Programme; and with key figures both within the Commission and within selected Member States. In addition, the Panel benefited from over 100 relevant reports and submissions including all the reports of the Annual Monitoring Panels for the five years covered by the Panel and many documents relevant to a discussion of future policies, notably the Communication on the European Research Area.

The Panel wishes to thank all those who contributed to its task, particularly the members of the Panels conducting the Five-year Assessments of the Specific

Programmes. For more comprehensive analyses of programme performance than is attempted here, the interested reader is referred to the individual reports of these Panels.⁴ We also thank the DG Research Evaluation Unit for its input and support.

Framework Achievements

The Panel's assessment of the Framework Programmes⁵ over the last five years is presented in two parts. The first part concentrates on programme performance within the Third and Fourth Framework Programmes. It draws heavily on the work of the current Panels conducting the Five-Year Assessment of the Specific Programmes, the assessments of past Annual Monitoring Panels and the questionnaire distributed to participants.⁶ The emphasis is on analysis rather than recommendation.

In contrast, the second part looks more closely at the early implementation of the current Fifth Framework Programme and makes recommendations which could be implemented during the course of the existing programme.

Programme Performance in the Third and Fourth Framework Programmes

Focus and Appropriateness

The primary focus on collaborative RTD projects and the secondary focus on activities such as the training and mobility of researchers were much appreciated.

The Panel greatly appreciated the focus within the Third and Fourth Framework Programmes on collaborative RTD projects. This allowed participants to undertake strategically important work requiring inputs from partners in other European countries. Much of the work would not have been possible in the absence of the Framework Programmes.

The type of work enabled by the Third and Fourth Framework Programmes filled a real gap in Europe, allowing academic and industrial researchers to conduct work of an applied nature. This 'basic technological research' effectively 'added science to engineering' and gave both a practical dimension to academic work and a theoretical underpinning to technological development.

The Panel also felt that the secondary focus on activities such as thematic networks and the training and mobility of researchers was appropriate. These initiatives were well received by the research community and the increased emphasis on activities of this nature in the Fifth Framework Programme was welcomed.

⁴ Short summaries of these reports can be found in Appendix I.

⁵ The structure and budgets of all relevant Framework Programmes can be found in Appendix II.

⁶ The main results of the questionnaire analysis are presented in Appendix III.

Similarly, the Panel agreed that the primary focus on improved competitiveness was appropriate during earlier Framework Programmes but that the subsequent shift to other programme goals of social relevance was timely.

Achievements and Effectiveness

The programmes strengthened scientific and technological capability across Europe.

The focus on collaborative work of a generic and applied nature primarily allowed participants to increase know-how and establish new networks. These goals were generally achieved and there is evidence to suggest that many of the links formed between academic and industrial researchers persisted beyond initial projects.

Because of their intrinsic nature, projects relevant to the policy goal of improved industrial competitiveness rarely led directly to short-term commercial exploitation. Many were nevertheless expected to underpin future competitiveness via their strengthening of internal scientific and technological capability.

The Panel concluded that the outputs and results of projects of potential relevance to other policy goals were not adequately communicated or utilised. This was due to a failure to establish appropriate links between the research and policy communities.

Overall, however, the Panel was satisfied with the achievements of the Third and Fourth Framework Programmes and convinced of their effectiveness.

Management and Efficiency

Recurrent problems continue to warrant an overhaul of administrative procedures.

Despite the achievements of the Third and Fourth Framework Programmes, the Panel notes that there was considerable criticism of certain aspects of the management and administration of these programmes. Application procedures in particular were difficult to follow and the accompanying documentation was often inadequate. There were criticisms too of the length of time between calls for proposals and the start of projects, particularly the length of the negotiations leading to final contract placement; of the costs and risks involved in developing proposals; and of low acceptance rates. Delays in the receipt of funding were another cause for concern, particularly for small firms.

These specific criticisms contrasted with more general praise for the assistance offered by Commission officials to participants over the lifetime of projects. The interface with the research community was handled well despite the fact that Commission staff faced heavy workloads. Much of the work was of a routine clerical nature and did not exploit the scientific and technological competence of project officers.

The Panel welcomed all initiatives over the last five years to resolve recurrent administrative problems, but notes that they did not go far enough. Many were still apparent at the start of the Fifth Framework Programme and will not be

resolved without a major re-engineering of the way in which the Commission functions.

The Initial Implementation of the Fifth Framework Programme

Background Information

The Fifth Framework Programme saw a much greater emphasis on problem-solving in areas of high social relevance, with focused Key Actions complementing Generic Research activities. It also saw a continued and strengthened role for 'Horizontal' activities relating to international co-operation, socio-economic research, the training and mobility of researchers, innovation and support for SMEs.

There were also important structural, managerial and administrative changes. The 'rationalisation' of previous Specific Programmes into a smaller number of Thematic (4) and Horizontal (3) Programmes allowed, in theory, greater budgetary flexibility within each of these new programme areas. A system of collegiate/matrix management was also introduced to oversee developments in these areas, with provision to ensure adequate communication and co-ordination both within these areas and between the Thematic and Horizontal Programmes. Finally, concerted efforts were made to improve a number of administrative procedures, particularly those relating to applications and their evaluation.

The Transition from the Fourth to the Fifth Framework Programme

Extra efforts will be needed to guarantee the successful implementation of the Fifth Framework Programme.

The transition from the Fourth to the Fifth Framework Programme was not smooth. It was complicated by the switch to an emphasis on social relevance and problem-solving and by the scale and nature of the organisational changes required by the Fifth's new focus and format. Lack of governance due to the resignation and subsequent delay in re-appointing the EU Commissioners also weakened overall management. The first calls were completed on time, but there were delays in the appointment of External Advisory Groups and continued efforts will be needed to ensure that the remainder of the programme runs more smoothly.

Focusing the Programme

Although welcome, the implementation of the Key Action concept could be improved.

In addition to supporting Generic Research, the Fifth Framework Programme was designed to attain a broad set of socio-economic goals via a focus on Key Actions in areas deemed to be of high social relevance. Participants were then asked at the proposal stage to demonstrate the relevance of their projects to these themes and to the attainment of broad socio-economic programme goals. The Panel welcomed the introduction of the Key Action concept but felt that more could be done to improve its implementation. Early indications are that the Commission could ensure the greater relevance of projects via the provision of better information to potential participants and more guidance to proposal evaluators

concerning the precise nature of European Added Value. At the moment this is ill-defined and the Panel recommends urgent clarification of the concept.

Implementing New Management Structures

The new matrix management structures do not work well and need to be reviewed.

The matrix management structures put in place by the Commission to ensure adequate communication and co-ordination within programmes do not function effectively and need to be reviewed. Although the structures enabled greater co-ordination across the various elements of one of the Thematic Programmes, communication problems were not adequately addressed in others. The absence of a clear attribution of responsibilities also created problems.

Matrix structures do not always function well within traditional hierarchical organisations. Neither is it obvious that the same matrix structures are equally suited to all programme areas. The reason why the new structures appear to be working in some areas but not others deserves to be investigated more fully and compared with examples of successful implementation in large, complex private sector organisations.

A similar rethink is needed concerning the interaction of the Thematic with the Horizontal Programmes. Although mechanisms are in place to ensure that the main themes and preoccupations of the Horizontal Programmes are considered and reflected in the activities of the Thematic Programmes, the Panel was not convinced of their adequacy.

Programme Administration

Extra steps are needed to lighten the administrative load on both participants and the Commission staff and to ensure that programme goals are met.

It is not clear that the Horizontal Programmes can adequately support the Thematic Programmes without structural and budgetary changes. Administrative budgets are too small and workloads too high for staff to fulfil this role. Budgets for the administration of the Horizontal Programmes should better reflect workloads within them.

Despite considerable preparatory efforts to increase transparency, standardise procedures and generally reduce the burden on proposers and participants in the Fifth Framework Programme, the expected reduction in administrative load was not initially achieved. In some cases it even increased. In particular, the amount of paperwork involved at the contract negotiation stage was unacceptable. Further efforts are needed to simplify and clarify procedures and paperwork.

The rules and regulations which govern the activities of Commission staff are too rigid. Too much effort is devoted to ensuring strict adherence to legal and administrative procedures and not enough effort to ensuring that overall programme goals are met. Administrative structures and processes need to be re-engineered to reduce workloads and allow Commission staff to concentrate on issues of governance, with tasks out-sourced wherever possible.

Framework Tomorrow

Preserving the Best of the Past

Maintaining Momentum, Scale and Emphasis

There is a strong case for an expanded Sixth Framework Programme with a primary focus on support for collaborative RTD projects.

The Sixth Framework Programme should maintain an emphasis on collaborative research which can best be performed with other EU partners.

The size of the ‘demand’ for Framework - as demonstrated by the number of proposals submitted – has not diminished. This, together with the fact that ‘demand’ is likely to increase within an enlarged EU, should be borne in mind when the size of the budget for the Sixth Framework Programme is being decided.

The Framework Programme contains a mix of instruments, from support for collaborative R&D projects in the area between basic research and commercial development to support for thematic networks, accompanying measures, fellowships and mobility schemes. All have a role to play within the Sixth Framework Programme.

Emphasising Excellence and Risk

The Framework Programme should retain its overarching emphasis on excellence, with extra efforts to ensure that ‘risky’ projects are not excluded.

The work conducted within collaborative projects funded by the Framework Programme needs to be of a high quality if the research base of the EU is to remain world class. The Framework Programme should therefore retain its overarching emphasis on excellence.

Collaborative R&D programmes are often justified in terms of their potential to encourage organisations to carry out ‘risky’ work with a high probability of failure but also a high pay-off if successful. In practice they rarely do, neither at a national level nor at an EU level. Instead their prime justification is that access to complementary sources of expertise allows organisations to pursue paths which are otherwise difficult to follow. There is a need, however, for ‘riskier’ research within the Framework Programme. More attention should be paid to the selection of riskier research projects.

Retaining Variety

The different types of actions currently supported within the Fifth Framework Programme should also be a characteristic of the Sixth.

Even though the primary focus of the Framework Programme should remain on support for collaborative RTD projects, it will also be important to retain and develop other activities. These include schemes which provide fellowships, encourage the mobility of researchers, and improve the utilisation of project

results. There should also be a clear strategy for the promotion of RTD co-operation with third countries and international organisations.

Many efforts within the Fifth Framework Programme are geared towards the creation of networks and clusters of related projects. Potentially these should lead to more widespread sharing and dissemination of methods and results and enhanced prospects for utilisation and exploitation. The results of these efforts should be monitored with care and continued in the Sixth Framework Programme if they prove successful.

Nurturing Human Potential

It will be important in the Sixth Framework Programme to incorporate new initiatives to counter expected skill shortages.

Schemes promoting training and mobility (as exemplified by the Marie Curie Training Fellowships) have attracted universal acclaim and are generally regarded as successful. The next Framework Programme should build on this success, while also recognising the weaknesses of the current programme. Additional initiatives will also be needed to counter expected skill shortages in some Member States, and particular attention should be paid to the needs of new Member States and applicant countries.

Recommendations for the future include provision for both PhD students and post doctoral scientists to undertake training outside their country of origin. Mobility should be encouraged not just within Europe but also more widely, with funding provided for European scientists to train in the US, Japan or elsewhere as appropriate. In order to prevent the brain drain of trained Fellows, extended funding should be made available to support their return to Europe.

This more global approach to training, while minimising the brain drain from Europe, is likely to disseminate expertise and innovative methodology in European institutions as well as laying the foundation for future international scientific collaborations.

The Sixth Framework Programme should also ensure that the RTD employment potential of women is fully realised by tackling inequalities in gender representation.

Keeping an Emphasis on Relevance

The emphasis on relevance should be maintained by keeping the distinction between Key Actions and Generic Research within strategic RTD programmes.

The overall emphasis on social relevance within the Fifth Framework Programme should be maintained in the Sixth Framework Programme, as should the distinction between Key Actions and more Generic Research. Key Actions are a good way to organise and maintain a focus on relevance.

A more nuanced approach should be taken at the selection stage to ensure that projects in particular domains are relevant to the specific aims of that domain and not necessarily to all the social and economic aims of the Framework Programme

as a whole. Projects aimed at supporting EU policies in fields such as health, environment, transport etc. are important for improving the quality of life and should not always be expected to improve competitiveness as well.

The next Framework Programme should place greater emphasis on research aimed at supporting EU policies. Improved mechanisms will be needed, however, to ensure that work programmes adequately consider the needs of policy-makers and that the results of these programmes feed more directly into policy-making.

It will also be important to involve 'customer' Directorates in the Commission more fully in the programme specification process if the Sixth Framework Programme is to be relevant to their needs. Although mechanisms are in place to ensure that the Directorates responsible for policy in areas such as environment, health, transport, energy and industrial development are involved in the consultation process, criticisms of lack of interest in the results of past programmes is strong enough to warrant that these mechanisms are reviewed.

The Panel is convinced that the best way of ensuring the social relevance of the Framework Programme as a whole is to structure work within strategic RTD programmes. These should be located in high-priority fields in which there is a specific need for actions which require a European dimension and which serve the needs of EU policy. As a rule, these fields should be sufficiently homogeneous in their technologies and markets to minimise overlap between them, but sufficiently wide to include all alternatives. They should be similar in nature to the existing programmes concerned with information society technologies and quality of life.

Within programmes, relevance should be assured by mechanisms which allow for true competition between rival technologies, with choice dependent on broad social requirements and not on more limited sectarian needs. In the energy field, for example, there should be more competition for RTD resources between fusion, fission, fossil and alternative energy technologies. In transport, there should be genuine competition for resources between land, sea, air and aerospace technologies.

Re-engineering for Flexibility

Greater Flexibility

The Framework Programme needs to become even more flexible and responsive to changing circumstances.

The Framework Programme has evolved from a simple policy instrument to support collaborative RTD projects into a much more sophisticated set of measures supporting a range of different activities. In this sense its flexibility and ability to meet new challenges has grown. The rationalisation of the Fifth Framework Programme into a smaller number of Thematic and Horizontal Programmes and provision for the annual revision of work programmes has also increased the ability of the Framework Programme to respond flexibly to changing circumstances.

There is still a growing need, however, for an even more responsive structure incorporating a richer set of instruments, modalities and activities within the context of the Framework Programme. To date it has not been possible for the Commission to take full advantage of a number of opportunities for enhanced flexibility which are inherent in the EU treaty. The Treaty makes provision, for example, for the Community and the Member States to co-ordinate their RTD activities; for the execution of 'variable geometry' actions involving only a limited number of Member States; and for the Community to set up joint undertakings or any structures deemed necessary for the efficient execution of Community RTD. To be more responsive to future challenges, these opportunities should be grasped more fully within the Sixth Framework Programme.

Separation of Functions

It will be necessary to separate strategic and executive functions.

The under-utilisation of the full set of instruments specified in the Treaty is a consequence of the way the Framework Programme is determined and implemented. All the Member States play a part in setting strategic directions and specifying the instruments to be used. This makes the whole process extremely complex and time consuming. In particular, the four-year planning cycle makes it very difficult to change direction and use fresh instruments in response to new demands.

One way of rectifying this is to separate the setting of high-level goals from specification of the instruments to be used to attain these goals. The former should still be done at the highest political levels and adopted by the Heads of Government. The latter should be the responsibility of the Commission. This clearer separation of strategic and executive functions would allow the four-year planning cycle for setting the overall strategic direction of the overall Framework Programme to be retained, but it would also free the Commission to launch a greater variety of individual actions on an *ad hoc* basis during this period.

The Panel recommends a major review of the systems and procedures in place to decide overall goals, specify delivery mechanisms and implement programmes. This should be followed by the further separation of strategic and executive functions, with executive responsibility for formulating and implementing the component parts of the programme handed over to the Commission.

Advisory Structures

New advisory structures are needed for each strategic programme area.

These changes will necessitate a greater level of trust by the Member States in the ability of the Commission to deliver an effective Framework Programme. In particular, the Panel sees no need to continue the Programme Committees.

New External Advisory Groups (EAGs) with clearly defined responsibilities should cover both Generic Research as well as Key Actions. They should be comprised of leading figures from each field, appointed for the duration of at least

one Framework Programme. Each EAG should also include more ‘users’ of the results and outputs of Framework RTD projects than is currently the case.

Improving Management and Administration

An urgent review is needed of the administrative structures and procedures needed to deliver an efficient and effective service.

The broad separation of strategic and executive functions outlined above would be greatly complemented by parallel attempts to improve the management and administration of the programme. Recognition is needed that:

More effort should be devoted to issues of governance and less to routine administrative tasks;

The main responsibility of the Commission is to deliver results and not simply to ensure that bureaucratic rules and regulations are strictly followed;

Greater delegation of responsibility is needed.

Administrative structures and processes need to be re-engineered to reduce workloads, with routine tasks out-sourced wherever possible. This will free up the administrative resources needed for Commission staff to concentrate on issues of governance.

The Commission needs to move to an administrative structure governed by an ethos of delivering results and value for money. At present it is dominated by an ethos which is concerned primarily with ensuring the legality of activities and conformance with established procedures. Too often this leads to inefficiencies and delays which obstruct the attainment of programme goals.

The administrative level at which many routine activities currently have to be sanctioned is too high. Operational responsibility should be devolved to lower levels within the overall Commission administration.

In the light of these considerations, the Panel recommends an urgent review of the whole management and administration of the Framework Programme with a view to the speedy implementation of a more efficient and effective service.

Monitoring and Evaluation

The Commission should focus on the assessment of impacts.

The system of evaluation involving annual monitoring and 5-year assessments of the Framework Programmes is already well established, but every effort must be made to avoid the danger of over-evaluating RTD activities and more emphasis should be placed on demonstrating the relevance of RTD efforts. For this reason, the focus of future evaluation should be on impact assessment and the adoption of appropriate methodologies for the task. Better information on the progress of projects is needed, but this must be collected without increasing the burden on participants and Commission staff.

Beyond Framework

Responding to the Challenge

The Framework Programme alone cannot deliver the vision of Lisbon.

The Framework Programme has a vital part to play in shaping the future of scientific and technological developments in the EU. The Panel believes that implementation of its recommendations will increase this impact. It also acknowledges that much more will be needed if the challenges confronting Europe are to be met and the goals set in Lisbon attained.

The EU has set itself the target of becoming “the most competitive and dynamic knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion”.⁷ This will require a new vision of how RTD activities within the EU should be structured and oriented.

It will also require:

An urgent response to the widening gap in expenditure on R&D which is opening up between Europe and the USA and Japan;

Greater efforts to ensure the coherence of EU and Member State efforts to support science, technology and innovation;

Increased efforts to counter expected skills shortages over the coming decade;

Improved European efforts to translate research into innovation and utilise innovative technologies efficiently and effectively.

A Strategy for Europe

A European policy for RTD only makes sense within the context of an overarching strategy for Europe.

Discussion of how Europe might respond to all these challenges has been stimulated over the last few months by the Communication from the Commission on the future of the European Research Area.⁸ This offers an exciting set of options and opportunities. Some of these can be grasped within the context of the Framework Programme as we know it. Others will require the Framework Programme to be modified, hopefully along the lines we have suggested in this report. Still more will require new RTD policies within the Member States.

But complementary changes are also needed in the many other policy spheres which are increasingly linked with developments in science and technology.

The most important message our Panel has to offer is that action will be required on a much broader political front than that of RTD policy. Crucially, the Lisbon

⁷ Presidency Conclusions - European Council, *op cit*.

⁸ European Commission, ‘Towards a European Research Area’, *op cit*.

goals will necessitate changes at Member State and EU levels in policy spheres such as education and innovation.

Our Panel is convinced of the importance of locating these policy developments within an overall strategy for Europe, articulated at the level of the EU and supported unanimously by the Member States. The aspirations expressed at Lisbon will remain at the level of rhetoric until there is the collective political will to realise them via the adoption of an effective European strategy involving policy changes across the board.

The Importance of Science, Technology and Innovation

Science and technology are too critical to be neglected in the highest policy circles.

Inputs from science and technology are increasingly important in determining policies in other spheres and more research is needed to underpin future developments in areas as diverse as health and defence. Science, technology and innovation are also increasingly recognised as the bedrock of modern economies, and they are certainly central to the development of a knowledge-based society.

Despite all this, the importance of scientific and technological activities is not adequately reflected in the political or budgetary priorities of governments. Even though the private sector is the largest single source of funding for scientific and technological work, the contribution of the public sector is critical. The Panel notes that public expenditure in many other policy spheres is far larger than in science-related areas. It recommends that Heads of Government increase national and EU budgets allocated to science and technology in order to reflect their crucial role in sustainable economic development.

Taking the Lead in RTD

Promoting private sector expenditure on RTD via indirect measures would signal to the world that the EU is serious about remaining a centre of scientific and technological excellence.

The widening gap in expenditure on R&D between Europe and the USA is in large part due to the growth of R&D expenditure amongst dynamic, high-tech firms in the most critical new sectors of knowledge-based economies. It is imperative for Europe to take the lead by stimulating similar growth in these areas if it is to remain a world force in science and technology.

The Panel is convinced that the level of public and private expenditure on RTD should rise to at least 3% over the next decade. Higher levels will be needed if greater efforts are not also made to reduce duplication of effort and counter the fragmentation of resources which exists in Europe.

The Panel is also convinced that public sector finance cannot and should not be used directly to close the growing gap between private sector RTD expenditure in Europe and the USA. More subtle and indirect ways of stimulating greater private sector RTD expenditure in Europe are required. The Framework Programme only stimulates firms to spend more on collaborative research. Encouraging firms to increase spend on work which does not require collaboration will require

packages of indirect measures. These should include tax incentives and personnel-based subsidies implemented at national and regional levels.

The Panel fully supports the speedy implementation of indirect measures across Europe, especially those leading eventually to harmonised tax systems across the EU. This will send a strong signal to the rest of the world that the EU is intent on strengthening its position as an attractive place to locate and conduct RTD activities.

In support of this recommendation, the European Commission should play a catalytic role via the specification of a simple tax credit system which can act as a model for the Member States to adopt.

Ensuring Coherence

The Commission has a key role to play facilitating the emergence of coherent policies for science, technology and innovation across Europe.

Science, technology and innovation policies within the European Research Area are formulated at regional, national and EU levels. This results in a rich mix of initiatives across the continent. This diversity is healthy in many respects, but it is also a potential source of duplication of effort and inefficient use of resources. The challenge for Europe is to avoid inefficiencies without destroying the innovative potential which stems from diversity.

To create synergy rather than duplication, there needs to be far more coherence between national and EU policies. This will require new ways of co-ordinating activities.

Co-ordination will require fresh approaches to policy formulation across the EU and will be particularly important in the formulation of coherent strategies to develop the European research infrastructure and to link elements of it together.

To date, EU support for the creation and operation of research facilities and the development of research infrastructures within the EU has been piecemeal. This stance should be revised and a more coherent approach taken to the development of a research infrastructure capable of supporting work across the whole European Research Area.

Within each Member State there are centres of excellence which, when considered at an EU level, lack visibility and the critical mass to focus on topics with a strong European or global dimension. Resources need to be pooled and critical masses created. This will involve setting up virtual centres of excellence via electronic networking and novel ways of supporting programmes of activity between centres.

A basic premise of knowledge-based societies is that well-informed, intelligent policy-making leads to better policies than those formulated in conditions of relative ignorance. National governments and the institutions of the European Union all thus collect and utilise 'intelligence' of relevance to their individual RTD policy-making activities. These efforts are inadequate at national and EU

levels and insufficient to develop a clear picture of existing activities, trends, capabilities and needs. Policy-making within the European Research Area would be improved by the creation of a shared intelligence base.

Ensuring coherence will not be easy. Member States will need to find new ways of collaborating in order to formulate mutually supportive policies. In the Panel's view, the European Commission has a key facilitation role to play in this area. It therefore urges the Commission to take the lead in outlining the steps needed to pool infrastructure and policy-intelligence resources across the EU. It also urges all the Member States to lend their unequivocal support to these efforts.

A Strategy for Enlargement

RTD support for Central and Eastern European countries should be channelled temporarily through their scientific Academies.

The situation concerning science, technology and innovation in many Central and Eastern European countries is perilous. Dependence on centralised planning has not been replaced by other adequate structures and many countries are now waiting for the EU to take the lead in elaborating an effective RTD strategy which can serve their needs and take advantage of the scientific and technological talent emerging from their educational systems.

The social and economic opportunities presented by enlargement should not be wasted. The Panel is aware that the transition to market economies is difficult and that it will take many years for appropriate scientific, technological and industrial infrastructures to emerge. The EU needs to take appropriate steps to ensure that the transition is successful.

During this transition period, the Panel recommends that advantage is taken of existing institutional structures until new ones can be established. The scientific Academies of many of these countries have traditionally taken the lead in setting the scientific and technological agendas of industry. Until such time as industry is in a position to dictate its own directions, the Panel recommends that support provided by the EU for RTD activities is temporarily channelled through the existing scientific Academies. Care should be taken, however, to ensure that this stop-gap measure does not reinforce existing institutional structures and delay the creation of new ones.

People and Education

Investment in people and education is a necessary condition for the long-term health of science and technology in the EU.

The people of Europe are its main asset and its future. To become a knowledge-based society, the EU will have to ensure that its people continue to create, utilise and benefit from scientific and technological knowledge. It will also have to ensure that the threat of related skill shortages over the coming decade is adequately countered and the attractiveness of careers in science and technology is promoted.

Critical policy shifts will be needed across the EU in all educational sectors. At primary and secondary levels, it will be imperative to avoid regimes which stifle creativity via an over-emphasis on the attainment of basic, standardised skill sets. At tertiary level, renewed thought must be given to the strengthening of truly European centres of teaching and research excellence of sufficient critical mass to act as magnets for leading intellects across the globe. Europe possesses many fine educational establishments, but none have the kind of track record in Nobel Prizes, for example, which the leading US institutions can claim.

The looming shortage of skills also calls for the whole European research community to adopt a more proactive approach to recruitment. The primary task is to ensure that young people are attracted initially to careers in science and technology, but more is needed. Traditional views of scientific training consider that an early intensive apprenticeship is sufficient to sustain a lifelong career. This is no longer appropriate in a fast changing world where short-term employment is the norm. Talent will have to be nurtured at all ages, with a particular focus on re-training modules, lifelong adult learning, increasing gender equality and female participation.

All these changes are outside the scope of research policy. Without them, however, efforts to build a secure position for Europe as the global hub of scientific and technological activity will fail.

Stimulating Innovation

New public-private partnerships and stronger links between different policy spheres are needed to stimulate innovation.

Improving innovation in Europe will call for the more efficient translation of research into innovation, the introduction of new mechanisms to stimulate the provision and use of risk capital for innovative firms, and measures to improve productivity via the effective use of new technologies in all sectors of the economy.

Most of the measures needed to stimulate innovation lie outside the realm of RTD policy. Successful innovation is dependent upon a variety of financial, market, legal, fiscal, and cultural factors as well as scientific and technological ones. Successful innovation policies have to embrace all these aspects and cannot be treated as mere extensions of RTD policy.

The prime purpose of the programme dealing with innovation within the Fifth Framework Programme⁹ is to stimulate the development and uptake of new innovation policies and practices. It can point the way, but in itself it will not be enough to bring about radical improvements in the innovation performance of Europe. More integrated innovation policies are needed which link RTD policy directly with policies in other areas. At the level of the EU, concerted action is required across the whole of the Commission to develop adequate innovation policies.

⁹ Horizontal Programme 2: Promotion of innovation and encouragement of participation of SMEs.

The implementation of successful innovation policies requires an effective link with actors in other policy areas and with institutions in the private sector, particularly those in the financial and commercial sectors. It is vitally important that these links are forged and that new partnerships are sought: between DG Research and other Directorate Generals capable of delivering innovation-related support policies (e.g. DG Regio); between all these Directorate Generals and EU financial institutions; and between the public and private sector more generally.

Exploiting the EU Treaty

The Framework Programme can be made more flexible within the terms of the Treaty.

The changes suggested by the Panel to improve the overall efficiency and effectiveness of the Framework Programme, particularly those which would make it a more flexible policy instrument or set of instruments, could all be effected within the terms of the existing EU Treaty. Article 166 provides for the Framework Programme to conduct all the activities listed in Article 164 of the Treaty, namely:

- The implementation of collaborative RTD programmes involving participants from Member States;*
- The promotion of RTD co-operation with third countries and international organisations;*
- The dissemination and optimisation of the results of RTD actions;*
- Stimulation of the training and mobility of the research community.*

Implementation of these activities has thus dictated the shape of the Framework Programmes to date. Further Articles in the Treaty, however, allow for other actions, e.g.:

- Article 165 calls for the Community and Member States to co-ordinate their RTD activities and allows the Commission, in close co-operation with Member States, to take any useful initiatives to promote co-ordination;*
- Article 168 allows for 'variable geometry' RTD actions, i.e. supplementary programmes involving the participation of certain Member States only;*
- Article 169 makes provision for the Community to participate in RTD programmes undertaken by several Member States, including participation in the structures created to execute these programmes;*
- Article 171 allows the Community to set up joint undertakings or any other structures necessary for the efficient execution of Community RTD.*

The Panel is of the opinion that these provisions of the Treaty have been under-utilised to date and should be exploited more fully during the Sixth Framework Programme. In particular, the Panel has reviewed and accepts the needs specified in the recent discussion paper on the European Research Area for greater and more enlightened efforts to co-ordinate RTD and related policies across the EU

and for a new approach to the consolidation of a truly European RTD infrastructure. Actions in support of these goals should be possible within the terms of the current Treaty if the political will exists to implement them.

The Panel also believes that the EURATOM Treaty should be integrated with the EU Treaty in its next formulation.

Conclusions

The Framework Programme has proved its worth and should continue, but it needs to be improved and enhanced.

Over the past twenty years our understanding of the complex relationship between science, technology, innovation and society has become increasingly sophisticated. So too has our appreciation of the fact that policies supporting science, technology and innovation need to be equally refined. Simple policies based on naive ideas of how science can be transformed in a straight-forward, linear fashion into technology, innovation, commercial success and hence economic well-being do not work. Supporting innovation in a complex world requires the use of a broad array of policy instruments.

The Framework Programme of the EU originally constituted a simple instrument designed to enhance competitiveness via support for collaborative R&D projects. Over the years, however, it has come to comprise a much richer set of policy instruments aimed not only at improving competitiveness but also at the attainment of a range of other EU policy goals.

On the basis of the evidence it has reviewed, the Five-Year Assessment Panel is convinced that solid progress has been made on many fronts over the last five years and that the support instruments employed within the context of the Framework Programme have proved their worth. The Panel is also convinced that the need for a Framework Programme and the type of activities it supports still exists and will continue to exist in future. Future policies, therefore, should build on past achievements by retaining, continuing and enhancing the basic elements of the Framework Programme.

The design of the Sixth Framework Programme should build on the base established in the Fifth.

In formulating the next Framework Programme, the Panel would like the Commission to build on the achievements of previous Framework Programmes by:

Increasing the scope of the Framework Programme in line with the need to meet the Lisbon goals and the demands of enlargement;

Maintaining the emphasis on social relevance and continuing to use Key Actions as a way of focusing programmes;

Maintaining a strong emphasis on collaborative RTD projects supplemented by a variety of other actions;

Emphasising excellence and the participation of leading-edge researchers;

Encouraging participants to propose 'riskier' projects;

Enhancing measures encouraging the mobility of researchers within the EU and between the EU and elsewhere;

Retaining support for generic, competence-building RTD activities;

Increasing the emphasis on the research needed to support other EU policies.

The Framework Programme also needs to become more flexible and responsive to changing circumstances.

To become more responsive to rapidly changing social, political and technological circumstances, the Framework Programme should encompass the whole range of activities provided for in the EU Treaty. At present this goal is frustrated by the complicated logistics involved in fully specifying the form and content of the Framework Programme to the satisfaction of all Member States prior to its start. The Panel believes that this situation could be avoided by further separating the processes of strategy formulation and execution, with broad objectives set at the highest political levels and executive responsibility for designing and implementing programmes in line with these goals granted to the Commission.

To accompany these changes, the Panel also recommends an urgent re-engineering of the whole management and administration of the Commission. Administrative structures and procedures should reflect an ethos of efficient problem-solving and not over-adherence to bureaucratic rules.

On its own, the Framework Programme will not be able to meet the challenge set by the European Council.

The Panel is convinced that the Framework Programme on its own can never be expected to achieve all that is sometimes expected of it. Improving the competitive position of EU enterprises and the quality of life in Europe, for example, will require much more than the type of support provided for within the Framework Programme or similar national programmes within the Member States. In particular, if the EU is to realise the ambitious goals set at the last European Council meeting in Lisbon in March 2000, science, technology and innovation will need to be given a much higher political priority than hitherto enjoyed and additional policy instruments will need to be employed.

Important additional steps will be needed.

The Panel is convinced that Framework Programme activities should be complemented across Europe by:

Greater recognition of the importance of science, technology and innovation as determinants of social and economic well-being;

Increasing the percentage of GDP spent in Europe on RTD to at least 3% over the next ten years;

The promotion of indirect measures stimulating private sector expenditure on RTD;

Actions to ensure that the Community and the Member States adopt a more coherent approach to policy development and implement mutually supportive policies;

Temporarily channelling RTD support to Central and Eastern European Countries via existing institutional structures until such a time as new structures emerge;

Encouraging the development of educational policies which will relieve expected skills shortages and lead to the creation of European centres of teaching and research excellence;

Effective measures and partnerships to ensure that innovation is stimulated and supported within the EU.

But all these steps need to be set within the context of a more coherent European strategy.

The Panel also believes that action at the highest policy levels will be needed to realise the goals set by the European Council at Lisbon. The EU can only become the leading knowledge-based society in the world if it adopts a much more clearly developed and articulated European strategy linking RTD policy with policies in other domains. Urgent steps should thus be taken to ensure that the elements of this strategy are debated at the highest possible levels and subsequently implemented.

Appendix I

Specific Programme Five-Year Assessment Summaries

Thematic Programme 1: Quality of Life and Management of Living Resources

P Olesen Larsen (Chair)

The efforts to promote the public understanding of the life sciences must be strengthened. A key challenge in EU research will be to address ethical perspectives, including the ethical perspectives of ecological problems, both in general and in connection with actual funding projects.

It is important to maintain the present distinction between policy-driven Key Actions and Generic Research. The Key Actions must be defined in concord with national programmes, i.e. in the context of the development of the European Research Area (ERA). EU funding should be considered together with national funding in each country.

Funding for generic life science research must be increased substantially within the next Framework Programme. One way to proceed would be to design a strategy that gives freedom to the researchers to define themes, size of teams and modalities of funding. We suggest that this part of the Framework Programme be called EUROEXCELLENCE. Another part of the next Framework Programme should be aimed at career advancement of young researchers through EUROEXCELLENCE CAREER AWARDS, guaranteeing funding for a minimum of five years in order to support a sustained research effort. A programme for EUROPEAN GRADUATE SCHOOLS should be started at Centres of Excellence in all Member States.

The next Framework Programme must provide support for the establishment, maintenance and especially use of key infrastructure elements and major scientific facilities. Areas requiring special attention are e.g. bioinformatics, DNA and protein chip technologies, proteomics, transgenic and other biological repositories, electronic publishing and access to information in electronic form.

The application processes must be made user-friendlier and the present methods and conditions for evaluation of applications must be reconsidered.

There is a need for a better understanding of European Added Value and for a more precise and operationally useful definition of this concept. It is necessary to pay greater attention to the need for continuity in EU funding. At the same time it is necessary to allow for more flexibility and to facilitate new initiatives within the frames provided by the Framework Programmes.

Thematic Programme 2: User-friendly Information Society

A Pompidou (Chair)

Over the period of the Five-Year Assessment there has been a fundamental shift in gear in the deployment of Information and Communications Technology. The central technologies bringing about the recent jump in capability have been the Internet and mobile communications creating a broad citizen appetite for new services, transforming whole industries and fuelling ever faster technology innovation. This situation deserves an increased attention to 'info-ethics'. The Panel regard the Community RTD investments as having served the EU well in advancing components of the technologies that have been central to this revolution.

The Panel's findings clearly demonstrate that ACTS/RACE 2, ESPRIT, TAP/STIG within FP3/FP4 can be considered successful. The establishment of bridges between researchers across the EU geared to a strong industrially backed programme was also seen as a substantial strength. The impact study shows that 30% of the participants stated that the impact of their RTD project would be 'high' or 'very high' in terms of competitive position; 65% had plans for future commercialisation.

The Five-Year Assessment Panel considers that the technical rationale for merging the content of the three prior programmes into a single IST programme under FP5 was sound although there have been considerable administrative challenges in achieving the integration. The Panel recommends:

- (1) The establishment of clear 'service levels' regarding the timeliness in the handling of the various administrative processes;
- (2) The appropriate investment in the database and workflow tools for the Commission should be made to support the service commitments;
- (3) The issue of 'risk absorption' and the approach to the increased involvement of small organisations should be reviewed in particular to attract more 'niche' players;
- (4) Based on a new communication plan, the marketing of the Programme should be improved to cover both the internal Commission dissemination of 'best practice' and all aspects of the external communication
- (5) Work should commence now on the establishment of a strategic framework for FP6 in line with the Panel's longer-term recommendations.

The Panel is of the strong view that a powerful and continuing RTD programme at the European level is of fundamental importance and that a path of evolutionary change is most appropriate for the future. The Panel considers that the pursuit of European Added Value could be defined in terms of two objectives: 'European Technology Leadership' and 'European Capability'. European leadership will require a far reaching approach to harnessing all the aspects of technology exploitation (legal framework, standards formulation, and influence on social policy). An enhanced European capability will require broader approaches. The

eEurope and European Research Area initiatives can be seen as powerful initiatives to provide additional focus to the IST agenda.

The Panel considers that clarification of the complex programme structure and strategy could be effectively achieved by distinguishing between three types of RTD: Core technologies; Integrating enablers; New/innovative products and services. RTD strategy can be established with a funding scale given to each category and by determining specific objectives, selection criteria, timeframe, legal and financial instruments for each. Fundamentally, it is recommended that the different frameworks of research type require variations in administrative approach and that attempts to apply a fully harmonised administration will fail in terms of focus and flexibility. In addition a declared and consistently applied framework for the strategic selection of the appropriate focus areas for the programme should be set up and regularly maintained.

Thematic Programme 3: Competitive and Sustainable Growth

S Barabaschi (Chair)

The general objectives of the programme are clear and relevant, but a more systematic operational formulation is required. The variety of objectives is in principle useful and well-shaped, but some of them are inherently difficult to measure and the corresponding achievements hard to assess. Further clarification of socio-economic goals and of the concept of European Value Added is required. At the stage of the calls for proposals, improvement is required concerning expected measurable performance and achievements.

The problem-oriented approach adopted in FP5 is appreciated, though it would be enhanced by further involvement of users, particularly in the TRANSPORT area. This involvement should be sought actively, e.g. through demonstration projects and thematic networks. Also, the results must be more widely disseminated through better co-ordinated actions between the Commission and the Member States.

The Panel endorses the findings of external evaluations and impact assessments which find that the quality of the scientific and technical work in FP3 and FP4 has been high. Quality has been enhanced by measures undertaken in FP5 to improve the mobility of researchers and their access to large-scale facilities.

The distinction between market-oriented and risky projects addresses a serious policy issue, since there has been a definite shift from FP3 to FP4 towards more market-oriented, more applied, and fewer risky projects. Accordingly, the proportion of projects achieving technological breakthroughs has declined while the share of projects resulting in incremental innovation has risen. In the long run, a strong basic research activity serving industry is of the utmost importance if Europe is to compete effectively with the rest of the world. To maintain a proper balance between 'technological breakthrough' and 'incremental innovation' projects, special calls for risky projects may be considered, incorporating different requirements and evaluation criteria.

Regarding programme management and administration, the Panel endorses the diversification of actions combining bottom-up open calls with top-down dedicated calls. The introduction of 'Expressions of Interest' should prove a useful source of bottom-up ideas. Although the contract administration procedures have been improved from FP3 to FP5, the delays between the end of negotiation and the effective signature of the contract should be improved. Proposal evaluation procedures have improved. The quality of evaluators can be improved further through an earlier planning of the evaluation periods and through increasing the number of evaluators coming from business and industry.

Specific points and recommendations concerning management include the following:

- (1) Reinstatement of SMT as an independent Specific Programme, as it was in FP4, is recommended;
- (2) The concept of the External Advisory Groups (EAG) has proven useful and should be extended to all activities, in addition to the Key Actions. In the Competitiveness and Sustainable Growth Programme, the business sector is better represented in the EAGs than in many other programme areas, but there is still scope for better representation of users;
- (3) Complexity in the application procedures should be reduced. Forms and information packages should be shortened;
- (4) The Evaluation and Impact Assessment reports in BRITE - EURAM/IMT have been very useful. Their conclusions should be diffused and 'best practices' spread to all Thematic Programmes;
- (5) The Annual Monitoring reports should give more attention to the following critical issues for the conduct of the programme: the preparation of calls, the clarity of stated objectives, the appropriateness of evaluation criteria, and the distinction between Key Actions and Generic Research.

Thematic Programme 4: Energy, Environment and Sustainable Development

Sub Programme: Environment and Sustainable Development
N Busch (Chair)

The environmental research undertaken within FP3 and FP4 addressed the principal environmental issues facing the EU. There has been marked improvement in the linkage between DG Research and the policy Directorates, primarily DG Environment. These policy links should be strengthened. However, a significant part of the funding should be redirected towards generic activities and long-term research.

The interaction on a strategic level between the Framework Programmes and national research programmes has been too limited. The Commission has a central role to play in the creation of a European environmental research strategy. The introduction of a European Research Area could be a means to this end that

necessitates a greater involvement of Member States in the administration of the Framework Programmes.

The effectiveness of the research outputs could be greatly improved if the Commission ensured that the research outputs are synthesised and packaged according to the different requirements of the users. A significant proportion of the budget should be allocated at Programme level for this activity. Problems remain with the availability of aircraft, ships, computers, databases, etc. to support the research projects. The EU should adopt a strategic role with respect to key infrastructure for environmental research.

The Eurocentric nature of the Framework Programmes is not conducive to the effective involvement of scientists from the developing world. The environmental concerns being addressed by the present EU members do not necessarily cover those of an enlarged Community. A review should be undertaken to identify the research needs of the pre-accession states.

The number of organisations participating in the research has grown steadily from FP3 through to FP5, i.e. the Commission has progressively expanded its environmental research outreach. Despite heavy workloads Commission Officers do a professional job. The efficiency of the organisation would be increased if greater responsibility for project management, finance and administration were delegated downwards. The Bidding and Evaluation procedures used for FP5 are viewed as transparent and fair, but the procedures followed pay insufficient attention to the strategic value of projects. The management structure in Energy, Environment and Sustainable Development does not work efficiently and should be reviewed. The structure of FP5 should be retained in FP6 with modification to the content.

Sub Programme: Non Nuclear Energy
M Weijnen (Chair)

The Five-Year Assessment of the non-nuclear energy programmes confirms the relevance of European RTD and demonstration support for energy efficient, new and renewable energy technologies. The environmental imperative (e.g. Kyoto emission reduction targets), liberalisation of European energy markets, privatisation of energy utilities, and decreasing public acceptance of nuclear energy, are part of a complex of reasons that justify a structural reinforcement of the non-nuclear energy programme in the near future. However, in order to establish a clean, affordable and reliable energy supply that can fuel a sustainable development of the European economy, the programme contents should be more responsive to emerging needs and its co-ordination and management structure must be made more transparent. It is strongly recommended that one single manager be made responsible for both the RTD and the demonstration elements of the ENERGIE programme, managed thus far by two Directorate Generals and in the past as separate programmes. Only then will overall strategy and planning receive proper attention in programme design and administration.

The impact of the NNE programme would greatly benefit from more strategic focus. This requires the Commission to be much more proactive in developing a strategic vision on the European energy system, selecting a limited number of

priority areas in consultation with policy makers and market actors, and allocating resources to these priority areas. Resources are also needed for monitoring of research progress at project and programme level, for information dissemination, exploitation of research results and impact monitoring.

Notwithstanding the significant contributions made by the NNE programmes in key energy technology areas, a larger and more clearly identifiable impact is needed in the future. Targeted projects seem a promising vehicle to reduce project management workload and to increase the programme's effectiveness in bringing about changes of sufficient depth and scale. The needs-oriented spirit of FP5 must be more thoroughly pursued, and requires better representation of socio-economic and other non-technical science fields in project teams and evaluation panels.

Turbulence in the energy sector requires flexibility in the programme to cater for emerging research questions, such as those induced by the penetration of information and communication technologies in the energy sector, the phenomenon of converging infrastructures, Third Party Access, and infrastructure capacity constraints.

Nuclear Energy

Sub Programme: Nuclear Fusion
A Airaghi (Chair)

The long-term objective of the European Fusion Programme is to embrace all the research activities undertaken in Member States (plus Associated countries) aimed at harnessing fusion, and to enable the joint creation of prototype reactors for power production to meet in the long term, the needs of society. As such, the Programme is probably the best example of European Added Value in the Community's R&D Programme. The major European activity at JET (the most relevant machine for supporting reactor-orientated fusion research world-wide) and in the International Thermonuclear Experimental Reactor (ITER) Project has brought world visibility and has established Europe in the leading role in fusion activities world-wide. The programme has achieved very important results, confirming fusion should now be considered as a credible option in the search for clean, large-scale power generation systems. Nevertheless, there are still a number of important scientific, technological and engineering issues to be addressed before a commercial power plant can be realised. The European Programme has contributed to the development of a strong and competent scientific, technological and industrial community which can provide all the manufacturing and technical support required to take the programme forward.

In mid-2001 the ITER Agreement, between the EU, Japan and Russian Federation will end and there are no indications of the willingness of the present partners to renew their collaboration. In this situation the Panel recommends that the European Programme should continue to be reactor orientated and the construction of the 'Next Step' should be started in FP6. In the context of the international collaboration the EU should, within the next two years, try to conclude negotiations on the legal and organisational structure of the future

venture, actively seek a European site for the New-ITER, conduct a thorough review of the financial issues, and examine in detail the recent interesting expression of interest received from other potential partners. In parallel, due to the uncertainty over the outcome of the international negotiations, Europe should study an alternative to New-ITER, which would be suitable to be pursued by Europe. In the meantime, in FP5, limited investment on JET should be allowed to exploit the full value of the machine. This will also enable the fusion community to further prepare for the operation of the 'Next Step'.

Sub Programme: Nuclear Fission and Radiological Sciences

L Patarin (Chair)

The Specific Programme in Nuclear Energy: Nuclear Fission and Radiological Sciences continues to provide results of high scientific value which are relevant to the needs of the European Union. Good achievements were attained during the last five years in the three fields which are essential for nuclear energy, science and applications to day in Europe: operational safety and future systems, waste management and disposal, radiation protection.

Scientific dissemination is satisfactory, but professional communication for non-specialist end users, decision makers and the public needs further action. Co-ordination can be improved.

Research on Partitioning and Transmutation systems has a very long term objective and should be grouped in the category 'Safety and efficiency of future systems'. Because the well being and safety of the nuclear activities depend upon a continuing supply of well trained professional force, the needs for training should be given a high priority. Many research areas are now concerned by risk governance, not only nuclear activities; the Commission should undertake very broad multidisciplinary studies on present society risks, including both technical and social factors.

The creation of networks as a means of increasing co-operation is strongly encouraged. Where large projects are let, the project co-ordinators need to be given clearly defined responsibilities.

Radiation protection is covered by two separate parts of the programme, with some confusion; it is suggested to group all radiation protection and radiological research separately from Nuclear Fission.

In conclusion, a forward programme of research in these fields into FP6 and beyond would have an effective European Added Value and would be a prudent investment. We recommend an increase in EU funding in this area.

Horizontal Programme 1: Confirming the International Role of Community Research

M Horvat (Chair)

Co-operation with third countries and international organisations developed impressively from FP3 to FP5, integrating all international RTD activities of the

Community into one single programme (INCO). As a very special characteristic, INCO encompasses both important policy support and development measures as well as targeted operational programme activities with all categories of third countries. Thus, INCO and its predecessors made essential contributions not only to the Community RTD policy but also to other EU policies.

INCO has been managed efficiently despite a very tight staffing situation. For the future, the Panel sees opportunities to better utilise synergies between the different programme areas and measures by taking an integrated approach. However, during the start of FP5, INCO was facing administrative problems that were caused by the general operational problems at Framework Programme level.

As for COST, the administrative arrangements should be reorganised and systematic procedures for the assessment and selection of new actions should be developed. EUREKA's re-launch and the synergies with EU RTD activities are areas of concern. In general, the Panel recommends to design a common umbrella for all international RTD activities where the EU is involved as an important flanking measure for the evolution of the European Research Area. The most important achievements of INCO concern the EU enlargement process, where INCO prepared the ground and supported the association of the pre-accession countries to the 5th EU Framework Programme. With regard to the non-accession Central and Eastern European countries and the NIS, both INCO COPERNICUS and INTAS are important action lines with opportunities for even more synergies in the future. INCO is the only multilateral programme for RTD co-operation with developing countries. In addition to important project oriented activities it is relevant in terms of the co-ordination of Member States' RTD activities in different areas of development research. INCO paved the way for the conclusion of agreements on S&T co-operation between the EU and industrialised countries and emerging economies, providing a sound basis for utilising the S&T knowledge base on a global scale.

Summing up, due to the specific function and role of INCO within and for the Community RTD activities, the Panel supports keeping INCO as a separate activity in the future.

Horizontal Programme 2: Promotion of Innovation and Encouragement of Participation of SMEs

C Mandl (Chair)

The importance of innovation should be further enhanced and promoted. In addition, the role of INNOVATION-SME should be strengthened significantly within FP5.

The Commission should define a clear strategic role for INNOVATION-SME. The programme should focus on those customers where the highest leverage effects can be achieved and where its core competencies can be used best.

The complex organisational situation of the programme should be clarified and simplified. Its structural complexity prevents INNOVATION-SME from

effectively managing its resources and from giving the appropriate transparency of its structure to its clients.

INNOVATION-SME should improve its co-ordination with other innovation related activities undertaken by the Commission and within Member States.

Permanent evaluation and self-evaluation mechanisms, based on an appropriate set of performance indicators, should be established across all activities and consistently followed throughout the lifecycle of the programme.

Appropriate evaluation procedures for the Commission staff, based on the ability to follow up and manage projects effectively, should be implemented. Training and measuring the performance of Commission staff is a serious issue whose examination would improve eventually the effectiveness of the programme.

Because the development of CORDIS will be financially constrained within the existing programme budget, the Commission should examine making the budget of CORDIS independent of the budget of INNOVATION-SME, while still retaining CORDIS as an activity within the overall programme. In addition, it is clear that CORDIS activities are not directly linked to innovation. In such an event, the Panel strongly recommends that the budget of INNOVATION-SME should not decrease.

Horizontal Programme 3: Improving Human Research Potential and the Socio-economic Knowledge Base

C Dupas (Chair)

The transition to a knowledge society as the basis for an improved quality of life in Europe and the enlargement of the European Union is a challenge which will require the strengthening of basic research capabilities, education and technological development in Member States and Associated States. Our assessment shows that the Human Potential Programme is a good instrument to cope with this challenge.

The Programme has been a very effective mechanism for:

- (1) Creating a small but significant population of mobile, high quality young and experienced researchers with international experience and for retaining these researchers within Europe;
- (2) Building inter-institutional links;
- (3) Stimulating networking and creating meeting points for European researchers (research networks, European infrastructures).

The Human Potential Programme is the only haven for basic research within FP5 without predefined themes, to a large extent guaranteed by its bottom-up approach. The Human Potential Programme must be maintained as such, even if more basic research has to be encouraged in the Thematic Programmes in the next Framework Programme.

The Panel supports the fact that the socio-economic dimension has been formally integrated into all the programmes under FP5. However it recommends that socio-economic research (SER) becomes (again) a Horizontal Programme in FP6, independent of the Human Potential Programme.

The Panel supports a stronger Human Potential Programme in FP6. Its share in the future Framework Programme budget should at least double the present level. The Panel recommends extending the mobility concept and increasing the flexibility of the grants, in an attempt to consolidate an increasingly open research area in Europe. A more ambitious approach to European research infrastructures is also needed. The Panel endorses a vision of European research networks linking relevant infrastructures and centres of excellence in a structured, coherent way. New European centres should adhere strictly to relevance criteria, in addition to scientific excellence, including contribution to public awareness and European added value. In order to increase the efficiency and impact of the future Human Potential Programme, the development of a European patent system and a common European status for researchers is strongly recommended by the Panel.

The Joint Research Centre

S Barabaschi (Chair)

The most significant event during the five year period was the granting of a new mission to provide customer-driven scientific and technical support for the conception, development, implementation and monitoring of European Union policies. This replaces the concept of a Joint Research Centre (JRC) carrying out increasing amounts of competitive and contract research aimed at increasing industrial competitiveness in the EU. Considering the size of the JRC and its budgetary resources, this was an unrealistic task and the JRC is now better differentiated from other EU research organisations. European added value is also more apparent.

Technical performance over the last five years has improved and some achievements are noteworthy. The JRC is also more outward-looking and networking with the outside world has developed at all levels, though much more could still be done to improve the visibility of the JRC and its services. The idea of a 'virtual JRC', networked with organisations in Member States, is strongly supported.

The creation in 1998 of the Institute for Health and Consumer Protection revealed certain staff deficiencies, notably in areas such as microbiology, genetics, and information technologies. Action has already been taken to redress these shortfalls and further restructuring and rationalisation of resources is under study.

To enable the JRC to carry out its new mission, pillars of competence are being developed in 'Safety of Food and Chemicals'; 'Environment'; 'Dependability of Information Systems and Services'; and 'Nuclear Safety and Safeguards'. These are priority areas for European policy-makers and are supplemented by two additional horizontal activities: prospective scientific and technological studies and the provision of reference materials and measurement methods for the Internal Market and international trade. To be really effective, much more pooling of

resources and networking between all JRC institutes is needed. Some of the activities of the Space Applications Institute overlap with those of EI and ISIS, and there should more interaction between the Institute for Prospective Technological Studies (IPTS) and other institutes. This would heighten the visibility of the JRC and provide specialist input to the IPTS.

A successful recent innovation has been the addition of Management Support Units to each institute. This has allowed greater delegation of authority to local directors in matters of staff and internal budget. Further efficiency gains can still be achieved by continuing the cycle of critical analysis followed by implementation.

At the JRC Headquarters, an internal audit group has been set up to monitor budgetary progress, identify possible problems and prepare for a Total Quality Management initiative. An analogous mechanism for central intelligence on project progress is yet to be established. Such a function is highly desirable.

The JRC should continue to provide support to Commission services and to policy-makers in the future. To help this process, the JRC should:

- (1) Allocate more resources to the management of interfaces with its institutional customers, pay more attention to their needs and translate research results and advice into user-friendly language;
- (2) Consider the whole project cycle when planning the provision of S&T support to EU policies, not just the R&D part;
- (3) Be more aware of outside opportunities, identify internal knowledge gaps and put synergies to work;
- (4) Ensure that the fullest use is made of the knowledge, skills and tools available in the European R&D community;
- (5) Ensure that JRC researchers become more aware of the need to network, both internally and externally
- (6) Continue to play an active part in the development of the European Research Area.

Appendix II

Framework Programme Structures and Budgets

Third Framework Programme	MECU	Fourth Framework Programme	MECU	Fifth Framework Programme	MEURO
I. Enabling Technologies		Activity 1		Thematic Programme 2	
1. Information and Communications Technologies Information Technologies, Esprit 3	1517	Information Technologies, IT	2062	User-friendly Information Society	3600
Communication Technologies, Race 2	548	Advanced Communication Technologies and Services, ACTS	671		
Development of Telematics Systems of General Interest	426	Telematics Applications	913		
2. Industrial and Materials Technologies				Thematic Programme 3	
Industrial and Materials Technologies, Brite/Euram	762	Industrial and Materials technologies	1737	Competitive and Sustainable growth	2705
Measurement and Testing	66	Standards, Measurement and Testing	184		
II. Management of Natural Resources				Thematic Programme 4	
3. Environment				Energy, Environment and Sustainable Development	2125
Environment	316	Environment and Climate	573.5		
Marine Science and Technology, MAST 2	117	Marine Science and Technologies	243		
4. Life Sciences - Biotechnology				Thematic Programme 1	
Biotechnology	184	Biotechnology	596	Quality of Life and Management of Living Resources	2413
Agriculture and Agro-Industry including Fisheries, AIR	373	Agriculture and Fisheries	658		
Biomedical and Health Research	149	Biomedicine and Health	374		
Life Sciences and Technologies for Developing Countries	125				
5. Energy				Nuclear Energy	979
Non-nuclear Energies, Joule 2	259	Non-nuclear Energy	1039		
Nuclear Fission Safety	69	Nuclear Fission Safety	171		
Controlled Thermonuclear Fusion	521	Fusion	846		
		Transport	263		
		Targeted Socio-economic Research (TSER)	112		
		Activity 2		Horizontal Programme 1	
		Co-operation with Third Countries and International Organisations, INCO	575	Confirming the International Role of Community Research	475
		Activity 3		Horizontal Programme 2	
		Dissemination and Optimisation of Results (Innovation)	312	Promotion of Innovation and Encouragement of Participation of SMEs	363
III. Management of Intellectual Resources		Activity 4		Horizontal Programme 3	
6. Human Capital and Mobility, HCM	556	Stimulation of the Training and Mobility of Researchers, TMR	792	Improving Human Research Potential and the Socio-economic Knowledge Base	1280
Joint Research Centre Programmes	545	Joint Research Centre Programmes	959	Joint Research Centre Programmes	1020
		Competitive S&T Support to Community Policies	136		
	6600		13215		14960

Appendix III

Questionnaire Highlights

Questionnaire responses were received from 2275 participants in the Third and Fourth Framework Programmes. Fifty-seven percent of the responses came from universities and research organisations; 38% from industry; and 5% from other organisations.

Benefits

70% *said that the benefits of participation outweighed the costs (72% of academic and 62% of industrial partners)*

Relevance

72% *said that the work conducted was of high strategic importance to their organisations*

70% *said that their projects were highly relevant to the RTD goals of the EU*

62% *felt that their projects were highly relevant to world scientific and technological developments generally*

Additionality

71% *would not have undertaken the work in the absence of the Framework Programmes*

29% *would have done the work but with reduced funds, lower objectives, fewer partners and over longer time-scales*

Motives and Goals

82% *said enhancement of their existing knowledge base was a very important goal*

68% *said the development or improvement of new tools was a very important goal*

67% *said access to complementary expertise was a very important goal*

60% *said the formation of new European research partnerships and networks was a very important goal*

51% *said access to additional funds was a very important goal*

Industrial Expectations

69% *of industry participants said the development or improvement of new tools was a very important goal*

57% *of industry participants said that the production of demonstrators, prototypes etc. was a very important goal*

53% *of industry participants said that the development of new products was an important goal*

48% *of industry participants said that the development of new or improved processes was a very important goal*

35% *of industry participants said that the development of new or improved services was a very important goal*

Nature of Work

68% *of participants classified their work as applied research (72% of academic and 62% of industrial partners)*

37% *classified it as basic research (47% of academic and 17% of industrial partners)*

59% *described it as long-term (62% of academic and 55% of industrial partners)*

Goal Attainment

95% *felt that participation had improved their scientific and technological standing (high impact for 55%)*

79% *were very satisfied with the quality of their project outputs, 69% with their utility and 60% with their timeliness*

94% *attained goals or exceeded expectations in terms of enhancing existing knowledge bases*

89% *attained goals or exceeded expectations in terms of the development or improvement of new tools*

90% *attained goals or exceeded expectations in terms of accessing complementary expertise*

88% *attained goals or exceeded expectations in terms of forming new European partnerships and networks*

Industrial Achievements

42% *of industry participants continued to develop project outputs in their R&D units*

34% *of industry participants continued further development in their business units*

75% *of industry participants said that participation had improved their competitive position (high impact for 30%)*

11% *of industry participants had already received significant commercial returns*

50% *of industry participants had already received some commercial returns*

69% *of industry participants said they had plans for future commercialisation*

Programme Management and Administration

65% *thought the whole application process was too slow and/or costly*

45% *of respondents thought that application procedures were difficult to follow*

35% *felt the accompanying documentation was inadequate or too complex to understand*

24% *were dissatisfied with payment procedures (31% of SMEs)*

10% *felt that the competence of Commission officials had been an important barrier to the success of their projects*

63% *were positive about the help they had received from Commission officials over the lifetime of their projects*