

Research after Maastricht: an assessment, a strategy

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the Council and the European Parliament
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Contents

Foreword		5
Introduction	— 1992: A pivotal year	7
Chapter I	— The world competitive context	10
	A — The global dimension	10
	B — The industrial and technological dimension	12
	C — The industrial enterprise dimension	14
Chapter II	— The role of Community policy	15
	A — Increasing demand	15
	B — Improving supply	16
	C — A policy for the system: standardization	18
Chapter III	— Beyond 1992: A Community strategy	19
	A — An assessment: darkness and light	19
	B — An objective: to reorientate our activities	22
	C — A constraint: rapidity and effectiveness	23
	D — A principle: subsidiarity	24
	E — An opportunity: the coordination of national policies	26
	F — An ambition: making a success of Maastricht in research	27
Chapter IV	— A coherent framework of proposals	32
	A — The position of research in the 1993–97 financial perspectives	32
	B — Towards the fourth framework programme	33
	C — Linking decisions for 1993–94	36
Annexes		42

Foreword

This document may prove useful from two points of view.

First and foremost, it will be of interest to all those directly involved in Community research and technological development activities. It analyses the relationship between research and competitiveness; it describes the framework within which Community activities are now conducted; it indicates the objectives, instruments and prospects in an open and critical way. There is a state of flux at present; while the third framework programme (1990 to 1994) is in full swing, work has already begun on preparing the fourth (1994 to 1998).

Secondly, this document is of interest to all those concerned with the future of the Community after Maastricht, a Community which is transforming itself into a European Union. Research offers significant insights in this connection. The 'research' part of the Treaty has been amended, and while the changes are not earth-shattering in absolute terms, as with music very small differences of emphasis may alter the overall effect. This document also gives an idea of the Commission's response to the decisions taken at Maastricht. The impact of the Delors II package, which contains an entirely new part devoted to competitiveness, can be seen in terms of its research implications.

It is too early as yet to say what action will be taken on this document, which has the status of a Commission communication to the Council and the European Parliament. Parliament and Council will have the final say. In a way, the uncertainties surrounding its fate make it even more interesting to those who will follow its progress with curiosity and interest, including the Commission, which drafted and proposed it.



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1992: A pivotal year

1. The timetable for the third framework programme (1990-94) for research and technological development envisages an evaluation during 1992 at the mid-term of its activities.

The Council's decision on this third framework programme (Article 5) requires the Commission to assess its progress, during its third year of execution, against the criteria for the choice of Community activities for research and technological development. The Commission must, in particular, examine whether the objectives, priorities, and financial resources are still appropriate to the changing situation. Article 5 also requires an evaluation by the Commission of all the specific programmes implemented under the framework programme for 1987 to 1991. This evaluation is being transmitted simultaneously to the Council in a separate document.

2. Events now, however, require changes to these initial plans. A different destiny is now emerging in 1992. In particular, two groups of factors have played a paramount role in influencing this change.

3. The first group are essentially internal. The complexity of the legislative procedure introduced by the Single European Act and the emergence of interinstitutional problems slowed down the adoption of the specific programmes for the third framework programme and delayed their implementation. The framework programme could only effectively be started in 1991 and then only for some of the specific programmes.

This delayed start to the programmes prevents a true evaluation, in the strict sense, at the mid-term. Therefore, the exercise originally foreseen for 1992 has, from this point of view, considerably altered.

Nevertheless, the Commission intends to use this opportunity to submit general reflections on the role and objectives of Community research and technological development following on from the first, second and third framework programmes.

4. The second group of factors are due to external and more general influences. These have more important consequences for Community R&TD activities during the coming years and determine the most pressing tasks to be accomplished in 1992.

In this respect, all the decisions reached at Maastricht need to be considered, and they can be best illustrated by the means of three concentric circles.

5. The outer circle consists of the ultimate establishment of the European Union flowing directly from economic and monetary union and political union. A higher level of ambitions has been set and the external responsibilities of the Community considerably increased. The scope of Community competences has been widened. However, links between national and Community actions are better defined for areas of shared competence: the principle of subsidiarity formally appears as a governing principle in this process.

6. The middle circle covers those policies having as their ultimate goal the strengthening of European competitiveness. Support for international competitiveness of European industry must be a priority for the Community system. The principles introduced into the EEC Treaty by the Single European Act are repeated, confirmed and extended in the text agreed at Maastricht. Some other related provisions are to be found alongside those affecting research and technological development (Title XV), and are assembled in two new Titles, 'Trans-European networks' (Title XII) and 'Industry' (Title XIII). Training activities developed under the European Social Fund are now more closely linked to the objective of improving the competitiveness of the European system. It is also worth recalling Article 130b which requires that the objective of economic and social cohesion be taken into account at the stage of formulation of other Community policies as well as at that of their implementation.

These new elements of the Treaty, essential for the new ambitions of European Union, cannot be sustained in an economically uncertain Europe. The Community dimension must, therefore, be used better and more often than previously to meet the challenges of international competition.

This theme was already anticipated in the Commission document of November 1990 on industrial policy.

7. The inner circle contains the core of the provisions specifically affecting research and technological

development. The Treaty of Maastricht gives R&TD policy a double perspective which may be summarized as follows: strengthening its industrial dimension and extending its scope.

On the one hand, the Treaty confirms, in the new Article 130f of the EEC Treaty, the objective of strengthening the scientific and technological bases of European industry and for it to become more competitive at the international level. This objective is further developed in Article 130 which forms the new Title 'Industry'. There it is declared that the Community and Member State actions are to be aimed at fostering better exploitation of the industrial potential of policies of innovation, research and technological development.

In addition, a new paragraph 3 has been added to Article 130f explicitly unifying Community research and technological development policy, whatever the area of activity involved. As a consequence, R&TD policy has acquired a horizontal dimension cutting across other Community policies. Its scope is extended, its role strengthened.

8. To implement this new approach, it is necessary to replan our activities in the light of the objective changes. We must choose our course to determine what adjustments and retuning to make. The priority must be to decide our strategy. Reorientation is our task. In the perspective of such a reorientation, we must consider three crucial decisions to be taken during 1992.

9. The first concerns the multiannual attribution of resources for the different Community actions in the scope of the new financial perspectives for 1993 to 1997. At this stage, the new approach to R&TD policy must be supported as much by the increase of financial resources to be allocated, as by the identification of the specific budget for the different activities.

10. Secondly, the fourth framework programme covering the period 1994 to 1998 must be developed. The Commission proposal for a single legislative process approving the framework programme, as well as the specific programmes, was not adopted in the new Treaty. The double legislative process has been maintained (Article 130i) with the emphasis being put on the adoption of the framework programme itself in co-decision with the Parliament and by unanimity of the Council. For the specific programmes, a simple consultation of the European Parliament is foreseen. As these procedural requirements will inevitably result in long delays, the Commission cannot, there-

fore, afford to delay the submission of a proposal for a Council decision. Additionally, the principle of 'rolling programme', which, up to now, has governed the series of framework programmes, must be maintained. Against this background, to achieve the timely implementation of a framework programme covering the period 1994 to 1998, the legislative process must be completed in 1994.

11. Thirdly, to avoid a reduction of available resources for Community R&TD in 1993 and 1994, a decision must be taken on the ultimate financing of the third framework programme. This is the first occasion that the second paragraph of Article 130i of the Treaty needs to be applied.

When the third framework programme was adopted, the Commission maintained a reserve concerning the Council decision to allocate ECU 5.7 billion for 1990 to 1994, instead of the ECU 7.7 billion proposed. This issue has again become pertinent. Absence of a legislative decision resolving this matter has resulted in a distortion between the budgetary decisions and the existing legislative decisions. To avoid a new conflict, advance interinstitutional agreements on this issue would be extremely helpful.

12. Tackling these three fundamental problems in a rational and positive manner presents a major challenge for the new Community strategy aimed at maximizing the impact of the completion of the single market on industrial competitiveness. The objective of this document is to present the Commission's reflections on the principal issues of research and technological development policy in a coherent manner. It sets out the preliminary reasons for the three decisions outlined above.

The first chapter examines the current Community situation in science and technology by comparison to its large partners; on the basis of a range of indicators, necessary decisions can be made on the extent to which factors at the root of technological progress are sufficiently in place within the Community.

The second chapter examines the different aspects of the Community response to the challenges of international competitiveness. R&TD policy is central to this response, but it is not always necessarily found in isolation. Its strength also lies in the synergy with other actions conceived, initiated, and developed by the Community as a public institution.

The strengthening of the industrial dimension of Community R&TD policy is dealt with in the third chapter. On the basis of an overall evaluation of the

results of research policy five years after the entry into force of the Single European Act, a conceptual framework is outlined to reorientate the Community strategy and a new approach is proposed, combining continuity (traditional R&TD programmes adapted dynamically to take full account of the changing environment) and novelty (identification of technological priorities on which to concentrate our initiatives).

Finally, in the fourth chapter, the Commission presents a preliminary outline of proposals it intends to

formulate: proposals for the completion of the third framework programme and for the fourth framework programme. This outline includes indications for the future resources for R&TD activities, conforming to the Commission proposals on the financial perspectives for 1993 to 1997.

13. The views and evaluation of the other institutions on this approach are an essential input and contribution. The Commission will orientate the definitive content of the proposals in the light of the conclusions of the discussions starting from the basis of this document.

The world competitive context

14. This chapter takes as its starting-point the Commission communication COM(92) 2000 of 11 February 1992 and entitled 'From the Single Act to Maastricht and beyond: the means to match our ambitions'.¹ This communication sums up the results of action undertaken by the Community to respond to the objective and provisions of the Single Act (first Delors package).

It also contains an analysis of the new Treaty provisions as they follow on from the fundamental decisions taken at Maastricht. Finally, it indicates the major post-Maastricht priorities and the range of measures which, in the opinion of the Commission, will need to be taken in the next few years (second Delors package).

15. COM(92) 2000 identifies three major priority areas for future Community action: its international responsibilities, its cohesion, and its competitiveness. For some of their aspects, these three priorities interact. Here we will concentrate on the problem of competitiveness.

16. The Commission document summarizes its opinion as follows: 'The single market and 1992 has proved to be a spur to significant progress. In recent years, however, European industry has shown signs of weakness. The indicators are clear: Europe's competitive edge has been blunted, its research potential is being eroded, and it is not in a strong position with regard to future technology'.

17. This overall judgement needs to be justified in detail. The underlying factors determining competitiveness are many and various. They deserve to be analysed individually.

A — The global dimension

18. A preliminary approach to the problem is to rely on the classical input/output model. This is to measure what is brought into the technology cycle (R&TD expenditure and human capital) and what is obtained as technological output (patents, high-technology products). These indicators, which provide useful information despite their limitations, show that

the Community's technological potential is not well enough nourished by R&TD expenditure. Furthermore, the transfer to the market of our technology efforts seems to be slower than it is for our competitors.

R&TD expenditure

19. Calculating the ratio between total R&TD expenditure and gross national product shows that the EC has a relatively much lower level of R&TD overall than its two major competitors. In 1991, the percentages were 2.8% in the United States and 3.5% in Japan, while the Community's was 2.1%. In fact, the Community's current level is similar to that of Japan's 10 years ago. Only a few countries, such as the United States, Japan and Germany, exceed 2.5% of GNP. The average annual rate for growth in R&TD expenditure in real terms in Japan since 1976 (7.4%) is much higher than that of the United States (4.6%) and the EC (4.1%).

20. It may be useful to examine the constituent factors which go to make up these global figures. In the field of academic research (basic research of a general scientific nature, usually done in university centres) the Community seems to make the greatest relative effort in GNP terms at 0.4% compared to 0.3% in the United States and 0.2% in Japan. As a result, it is second in the world so far as scientific production is concerned, publishing almost four times as many articles as Japan. Overall, it can be said that European science is in a good second place behind the United States. However, this relative position does not seem to be reflected in industrial competitiveness.

21. One important distinction which must be made within R&TD itself concerns the respective role of public and private funding. Countries where private companies finance a large proportion of R&TD are by definition more likely to produce results which are more directly related to industrial activities and more readily usable by industry. R&TD which is financed

¹ Supplement 1/92 — Bull. EC.

by the public sector is, on the other hand, generally less close to the market place. This trend is even stronger in the case of R&TD carried out by public institutions. In the United States and Japan, 50% and 75% respectively of R&TD is funded by private enterprise. In the Community, the corresponding figures range from 70% in Belgium and 65% in Germany, to 25% in Portugal and 20% in Greece. The European average is about 50%.

As to where these R&TD expenses are incurred, the proportion of work carried out in government institutions is around 10% in the United States and Japan. The corresponding figure for the EC (25% in France and Italy) is much greater.

22. To sum up, the Community R&TD effort is insufficient compared to that of the USA and Japan. Although Europe is relatively strong in basic research, R&TD directly related to industry turns out to be less developed than it is for our competitors.

Human capital

23. Whilst the demand for research personnel is constantly growing, the supply can hardly keep up, especially in Europe. The number of researchers and graduates is currently around the million mark in the USA and 600 000 in both Japan and in the Community. The annual growth in this number has over recent years been 3% in the USA and 5% in Japan. In the Community Member States, it varies from 4% in France, Germany and Italy to 0.1% in the United Kingdom. If the growth rate of the last few years is maintained, the demand for research personnel between now and 1995 will amount to some 300 000 extra researchers in the United States, 150 000 researchers in Japan, and 100 000 researchers in the Community. This demand will be difficult to meet, especially in Europe. The number of technology students in the United States and Japan is far superior to that in the Community.

The inadequacy of supply is felt in most fields, but the situation is particularly worrying in certain sectors: information technologies and electronics, systems engineering, biotechnology and advanced materials.

24. As Table 1 of Annex I indicates, this lack of dynamism in Europe shows up to some extent in the orientation of academic research. Taking all disciplines together, Europe would seem to have less

strength than Japan and the United States in advanced sectors of research. The position varies between different scientific disciplines, but Europe's weakness is particularly marked in physics. In contrast, the position of Japan is exceptional in most disciplines (except biomedical research). These facts would seem to suggest that Japan manages to overcome its relative lack of resources devoted to basic research through having made a highly directed selection of research themes, ahead of its comparative advantages.

Patents and the technological balance

25. In earlier paragraphs, the input to R&TD was discussed. Now it is time to turn to the output: patents and the interchange of high-technology products.

26. The more resources are allocated to science and technology, the more private enterprises are expected to try and arrange the benefits of their innovations on several markets. The patent is the main method which companies use to protect their innovations.

An examination of patents taken out during the last few years would suggest that there is a lack of dynamism in Europe in the field of innovation. It is noticeable that the number and the proportion of foreign patents taken out in the United States (where the biggest patent office is to be found) have increased continuously over the last 25 years. In 1991, for the first time, this proportion was greater than that of patents taken out by American firms. This phenomenon is a reflection of the internationalization of markets, as well as the reduction in the gap between the United States and other industrialized countries. Within this overall change, however, the position of Europe is being eroded. Over the last few years, Japan has managed to take out more patents in the United States than the 12 countries of the European Community put together. It should be remembered that during the 1970s Japan took out only half as many patents in the United States as the European Community did.

The large-scale market penetration by Japanese firms of Western technology markets has not been accompanied by a similar penetration by Western firms of Japanese markets. In fact, the registration of patents at the Japanese office is totally dominated by Japanese enterprises and innovators (around 90% of those requested and more than 80% of those

awarded). This is simply a reflection of the general asymmetry of relationships between Japan and the rest of the world so far as market access conditions and commercial penetration are concerned.

27. Another, complementary, indicator is the technological balance of payments which covers the purchase and sale of 'non-incorporated' technology in the form of patents, licences, knowledge or technical assistance.

Summing exports and imports, Europe represents nearly half of all such transactions at world level. In other words, the countries of Europe, taken together, show considerable capacity for the production, assimilation and dissemination of technological knowledge. However, Europe suffers from a major deficit in its technological balance. At the end of the 1980s the ratio between 'non-incorporated' technological exports and imports was, for Europe, 0.7, while it was 0.8 for Japan, and 2.6 for the United States.

28. If the international trade in high-technology products corresponding to the purchase and sale of 'incorporated' technology in products is examined, a similar result may be seen. Whilst, at the start of the 1970s, the ratio between the export and import of these high-technology products was 1 for Europe, 2 for the United States, and almost 3 for Japan, the start of the 1990s sees it less than unity for Europe and the United States, and greater than 5 for Japan.

29. Examining these indicators shows that there is a clear gap between, on the one hand, the efforts of Europe in basic research and investment in R&TD, and, on the other hand, its performance in innovation and competitiveness. This is illustrated in summary Tables 2 and 3 of Annex I.

B — The industrial and technological dimension

30. An analysis of overall indicators thus shows that the competitive position of Europe has declined over the years. Now a more detailed, mainly qualitative, examination will be undertaken. This should make it possible to show how the R&TD efforts of the three competitors have been turned into technological advantages.

31. In this respect, two particularly significant facts emerge from Commission document COM(92) 2000:

- (i) between 1985 and 1990 the Community's trade balance in manufactured products dropped from ECU 116.0 billion to ECU 50.5 billion;
- (ii) high-technology products represented almost one-third of American exports in 1990 (31%), more than one-quarter of Japanese exports (27%), but less than one-fifth of European exports (17%).

The remainder of this document will be devoted to identifying the factors responsible for this poor performance. The following analysis shows that, besides these weak points of the European industry, there are also strong points which can be consolidated by Community actions.

Upstream: our technological position

32. Through a study of patents, we may clarify the sectoral position of the three trading partners by calculating the 'revealed technological advantages'. These more or less correspond to comparative advantages in trade. Studying them shows that in comparison with the end of the 1960s, the United States has changed its areas of specialization from electronics and automobiles, to activities which are linked to defence and raw materials. (mainly energy). Japan, meanwhile, has gone the other way, building up its specialization in electronics and automobiles. This change has been accompanied by a decline in chemicals and continuing weakness in the raw materials sectors, as in defence technologies.

European specializations are more varied. Thus, in Germany, they show up in strong positions in chemicals, mechanical engineering, automobiles and defence, coupled with a decline in electronics. Italy and Spain are both relatively strong in mechanical engineering, automobiles, finished chemicals and textiles. France has a dominating position in areas linked to public procurement, both military and civil. The United Kingdom has developed its strengths in defence and areas based on basic science, such as finished chemicals, while weakening in electronic components and equipment. The Netherlands, meanwhile, maintains its specialization in electrical and electronic technologies.

33. Despite Europe's achievements in R&TD and the possession of certain relative technological advantages, its position, in terms of absolute advantages, is worrying. Qualitative analyses show that,

particularly in advanced technologies, our position as one of the three trading partners is relatively weak. According to an American study carried out by the National Critical Technologies Panel, the United States is ahead of Europe in most of the 'critical' technologies, both in terms of the level attained and in developing trends. Exceptions to this situation are the fields of 'digital imaging technology' and 'flexible computer-integrated manufacturing' (see Table 4 of Annex I). In a number of technological sectors (electronics, semiconductors, advanced materials), Europe is behind Japan.

34. The Commission's services, working on the basis of a range of more detailed studies, have produced a series of tables clearly showing both the Community's relative position and the industrial prospects in various sectors. Overall, this work tends to confirm the trends outlined above, even though it demonstrates that the position is actually more complicated. As an example, in the field of advanced materials, Europe seems to be behind, except in the metals and magnetic material sectors. In the field of information technology and communications, Europe has fallen well behind in the new generation of electronics and components. In other fields, particularly software and computer-integrated manufacturing, the Community's position remains satisfactory (see Tables 5 and 6 of Annex I).

One important feature of all the technologies so far mentioned is that they tend to group together ('technological clusters') within the productive system. If companies wish to remain competitive, this grouping should take place internally and transform their productive capacity.

Downstream: our position in technological markets

35. An examination of world trade in high-R&TD-intensity products shows that at the start of the 1970s, out of total OECD exports of these products towards the rest of the world, the United States accounted for one-third, the Community (excluding intra-EC exchanges) one-quarter, and Japan about 16%. At the end of the 1980s, the proportions were the following: Japan accounted for one-quarter, the United States, nearly one-third, and Europe, less than one-fifth.

This change confirms Japan's place as leader so far as the diffusion of technology at world level is con-

cerned. It also reflects the decline in the American position *vis-à-vis* Japan and other Asian countries.

36. Europe's strong points are mainly in the medium-R&TD-intensity industrial sectors (while its position in advanced industrial sectors is declining). In the case of Germany, Holland, and Belgium, these strong points are, for example, chemicals, machine tools and electrical machinery. The United Kingdom has had a tendency to play a major innovating role in certain advanced technologies, but has not always achieved market leadership for the corresponding products. France's strengths in high-R&TD-intensity industries such as aviation, telecommunications and defence are, to some extent, linked to huge expenditure from public sources.

From the Community's point of view, the image which clearly comes across is of complementarity between the strengths of different countries, so far as both basic research is concerned, and industrial structures. For each major scientific discipline, it is usually possible to find one or two centres of excellence in Europe.

37. An examination of 'rates of sectoral self-sufficiency' (the ratio between national production in a particular sector and apparent consumption in that sector) even shows that in Europe there generally exists at least one 'centre of competitiveness' for each sector. As a consequence of this situation, the Community, taken overall, does possess the means to attain a good general industrial balance. In this respect, it is the opposite of the United States, although it not in as good a position as Japan. So, whilst its performance in ground transport, particularly cars, is much better than that of the United States, it is still much worse than that of Japan. Chemistry and pharmaceuticals, on the other hand, are clear strengths for Europe and its rates of self-sufficiency are much higher than the Japanese and American figures. So far as the aerospace sector is concerned, it is evidently a highly successful field for Europe. Here the Community is now in a position to rival the United States. This was certainly not the case at the start of the 1970s. Electronics, on the other hand, is Europe's 'Achilles' heel'. No country has shown itself capable of developing a 'centre of competitiveness' despite all the resources which have been mobilized.

38. At this juncture, we may conclude that Europe does possess a certain number of specialist fields which constitute a major asset for its position in the future world technological system. Identifying national specializations has implications for Community policy. What it has to do is, in effect, to

exploit this diversity. This exploitation must be accompanied by a new effort likely to have positive 'spin-off' effects on the whole range of European industry.

C — The industrial enterprise dimension

More a problem of strategy than of research

39. The dynamism of industry is the crucial factor in the success or failure of an innovation policy. It means that strategic choices have to be made.

Whilst European research is not sufficiently reflected in international competitive advantage, this does not mean that it is inferior in quality to that of Japan or the United States. The examples of Ariane and Airbus, telecommunications, chemicals, the Scandinavian robots, all prove this point. However, the problem is Europe's weakness in integrating R&TD and innovation in an overall strategy which both exploits and orientates them. It is simply not enough to innovate in order to produce efficiently, even less so in order to respond to the needs and aspirations of consumers. In other words, it is not R&TD which directs the strategy and organization of a company, but rather the opposite. In this respect, Europe has much to learn from its competitors, primarily Japan.

40. The demands of world competition mean that it is time to move from the 'Fordist' model of production, with mass production of standardized products, to flexible models which combine economies of scale and of scope where the search for quality and variety in goods means a constant renewal of products. A very well known example is that of 'lean production'

which, in contrast to mass production, allows major savings in personnel, stocks and time.

The strategic capability of an industrial enterprise also depends on external factors like access to a big market and sophisticated demand, a solid scientific and technological basis, high-quality human resources and an industrial fabric which is itself dynamic and regularly rejuvenated by the appearance of new companies. In all these respects, Europe is in a far from strong position *vis-à-vis* the United States and Japan.

41. One well known industrial strategy is to be the first to exploit an invention and/or an innovation ('first mover advantage'). In the context of a rapid and continuous innovation process which is characterized by a shorter and shorter life-cycle for new products the initiator can pre-empt the new market. Taking out a patent is, thus, a possible indicator of the technological superiority of enterprises in their particular field of activity.

42. To be the first in the field, even supplied with a patent, does not, however, in itself mean the ability to acquire a distinct competitive advantage. The advantage of being the first to arrive will be wiped out through any inability to move rapidly from a technological breakthrough to continuous production of high-quality products at competitive prices in response to the new markets. Analysis of the fate of certain major American inventions and innovations serves to confirm this. Examples are frequent in the field of mass electronics goods and the semiconductor field. The conclusion which must be drawn is that the main problem for European enterprises is, basically, not the level of their R&TD expenditure. It is rather their poor capacity to transform their R&TD activities into inventions, and their inventions into market share and profit.

The role of Community policy

43. It is now time to move from analyses to political considerations: from an analysis of the level of European industry's competitiveness to a description of those policies which can improve it; from diagnosis to treatment.

44. The basis of Community research policy is new Article 130f(1) of the Treaty, which it is useful to quote here in full: 'The Community shall have the objective of strengthening the scientific and technological bases of Community industry and encouraging it to become more competitive at international level, while promoting all the research activities deemed necessary by virtue of other Chapters of this Treaty'.

While this Chapter concentrates essentially on the industrial aspects of Community policy, it is also necessary to continue the traditional support for other policies, for example for R&TD actions aimed at responding to certain needs of society, or actions related to the area of rural development, including demonstration projects, in order to support the common agricultural policy. These different aspects of research policy will be examined in Chapter III.

45. We must base this on a certain number of clear principles. These principles, the major guiding principles for Community action, are expressed in document COM(92) 2000 in the following way:

'Responsibility and initiative must lie in the first instance with firms themselves. Action undertaken by the public authorities and by firms must stay within the four corners of the Community's international commitments, the rules governing the operation of the single market, and the rules on competition. Otherwise one man's gain will be another's loss and there will be no all-round increase in industrial competitiveness. Community instruments will have to retain their horizontal character, while taking account of the Community initiatives to be proposed under the structural Funds'.

46. The 1980s were characterized by a return to the idea of the market as both regulator and motor of economic efficiency. It is now generally recognized that industrial dynamism calls for the creation of an environment which is competitive, open and applicable to all, on an equal basis. The completion of the internal market will have a major role to play for the

industrial development of the Community. (Commission communication 'Industrial policy in an open and competitive environment', November 1990.)¹

The Community, and its policies, can have a particularly positive impact on the competitiveness of Europe's industries and economies in three ways: increasing demand, improving supply, and unifying the system.

A — Increasing demand

47. The large European internal market is not simply the sum of the 12 national markets. It has its own significance. In a very real sense there is Community added-value. This has been quantified, particularly in the Cecchini report ('1992: the new European economy', March 1988).

Of more interest here, rather than the general macro-economic effect of expanding global demand, is one effect in particular. That is the acceleration of the specific demand for goods and services needed for the integration of the national markets into a large single market.

48. The project to complete the single market by 1993 was first conceived with a fundamentally legal and regulatory viewpoint. The basic idea was mutual recognition and minimal harmonization of legislation.

Over the last few years it has become obvious that this was indeed a necessary pre-condition, but not in itself sufficient. To achieve European integration, it is equally important to make sure that the material basis of the large market is in place: interconnecting infrastructures, based on the idea of interoperability.

The new Treaty has a special Title devoted to all the large networks in the fields of transport, energy and telecommunications. In the specific case of computer networks, the Community is already involved,

¹ Supplement 3/91 — Bull. EC.

through anticipatory and innovatory activities, in the promotion of the necessary research activities, in the framework of a specific European programme called 'the European nervous system'.

49. The process of breaking down barriers and enlarging European markets means that, in certain fields of activity, the volume of demand will become sufficient to enable local producers to benefit from reduced costs. Such demand makes it possible to obtain profit margins which are big enough to obtain new resources which can be mobilized for the financing of R&TD, and to prepare the next generation of products. It is thanks to their large integrated domestic markets that American and Japanese enterprises have been able to penetrate the European market on such a competitive basis. In contrast, this European market is still frequently limited to the national context. This is all the more of a handicap when it is considered that these effects are dynamic and cumulative.

50. A fundamental role in technological innovation is played by purchasers of new products or processes. Through a whole series of feed-back mechanisms, users can cause producers to transform their innovations to take better account of the needs of the market (since the penetration and spread of products and processes go through many stages of testing). Companies which encourage these interactions are in a position to achieve major competitive advantage in terms of extending their markets geographically and expanding the range of products and services which they sell.

51. It is, lastly, important to understand the role of leading-edge users: the quality of demand is just as important as its quantity. In this respect, it has been calculated that, *vis-à-vis* new products, European demand is generally two or three years behind the American and Japanese markets. Generally, the potential European client waits before becoming a purchaser until new products have been commercialized in markets outside Europe. (Commission communication: 'The European electronics industry and information technology: observations, issues, proposals for action', April 1991.)¹

B — Improving supply

52. The Community is also called upon to take action so far as supply is concerned. Basically, it is private firms which should be mainly responsible for

this task. It is they who must place competitive products on the market, develop the necessary know-how, promote process innovation, improve the quality of products, reduce costs, increase the level of market penetration, etc.: all these are aspects of improving demand.

But there is a role for public authorities. It is these which must bring about the creation and maintenance of an overall economic environment and a respect for free competition, which is necessary so that firms can effectively develop supply policies. And this is very much the Community's task. The Treaty clearly confirms this, especially in the version adopted at Maastricht.

53. Support for R&TD activities is at the heart of public authorities' responsibilities in this field. Even those countries which are rather reluctant to talk of 'industrial policy', such as the United States, have recently greatly built up their own R&TD programmes with this in view. The programmes have been clearly orientated towards industrial technologies and considerable financial resources have been allocated.

In December 1991, for example, the American Congress approved the 'High-performance computing programme and the national research and education network'. This Federal programme constitutes an investment of USD 2.9 billion over six years.

54. As soon as the question of public support for R&TD activities is raised, then the problem of the extent to which the character of the work is more or less precompetitive always comes up.

These reflections on the Community's R&TD strategy provide an opportunity for some clarification of this problem, obscured as it often is by ideological prejudice of every kind.

55. There can be no doubt that the Community should only support research which is precompetitive research? Precompetitive applies to those R&TD activities which private companies can carry out jointly, before separately developing and marketing their own products. These activities are most appropriate to problems where it is more logical, because of their nature, scale or cost of work involved, to solve them working together, rather than in isolation. Whilst this is perfectly clear conceptually, the demarcation line between precompetitive research and

¹ Supplement 3/91 — Bull. EC.

product development research is, in practical terms, rather flexible.

In this respect, the Japanese example is very illuminating. The proportion of R&TD activities jointly carried out by private enterprise is much higher than in the United States or in Europe. This is well illustrated by the automobile industry. In Europe, in key technological sectors such as electronics for cars, cooperation between different companies is more or less non-existent. But that is not the case in Japan: there large companies take advantage of the complex structure of the industrial system in this field to launch R&TD initiatives which bring together both the manufacturers and the users of integrated circuits.

56. R&TD cooperation plays a complementary role to individual R&TD activities in private enterprise. It has a positive role in 'technology supply'. The R&TD activities of a company can have major effects externally on other companies in the same sector and other sectors of activity capable of benefiting from the research efforts without contributing to them. According to certain studies, the rate of return of a company's R&TD activities is, over a wide range of activities, about 11%. If the positive spin-offs for other enterprises and sectors are taken into account, it is between 20 and 25%. This could explain why there is a tendency for under-investment in 'own production' of knowledge, both scientific and technological. By partially internalizing these external effects through precompetitive cooperation in R&TD, firms become more capable of obtaining for themselves the profits brought about by their activities. The tendency towards under-investment is, therefore, reduced.

57. The Community is in a position to play a valuable catalytic role in raising the level of precompetitive cooperation between industrial companies as a reaction to the main horizontal technological priorities upon which the international competitiveness of European industry depends.

Such encouragement is perfectly compatible with the competition policy. The 1968 Commission communication on cooperation between firms, as well as Regulation (EEC) No 418/85 on R&TD agreements, look favourably, obviously under the conditions laid down in them, on cooperation in research and technological development and the shared exploitation of results. Such cooperation generally helps promote technical and economic progress, mainly through spreading knowledge more widely by avoiding double work and allowing greater rationalization of

product manufacturing. Users generally also gain from these advantages, thanks to the introduction of new or improved products or a reduction in their cost due to new or improved processes. Using the instruments referred to, competition policy has the task of ensuring effective competition as the motor of the economy, while allowing cooperation in R&TD where it is necessary and not a threat to the maintenance of competition.

58. The horizontal nature of Community instruments is confirmed by the Delors II document. This is particularly true in the case of generic technologies — those technologies whose impact has an effect on a whole range of other technologies used by the productive system, and hence the whole industrial system.

59. Generic technologies very often require a multidisciplinary approach, a large amount of capital and of R&TD, the ability to devise and set up new networks to ensure the dissemination and the implementation of a whole series of institutional innovations, especially so far as training and new qualifications are concerned. Bearing in mind their generic character, their external effect on a whole range of industrial activities, and, given their cumulative nature, their capacity to bring about the emergence of complementary technologies, and, lastly, given the speed with which they change, it is obvious that these technologies have a major role to play in the competitiveness of the productive fabric.

An economy which wishes to maintain its dynamism and its leadership must, therefore, inevitably take on the responsibility of ensuring that these technologies are mastered. With this aim, public authorities must take measures which make it possible to overcome problems linked to the difficulties of gaining access to these technologies, to the limits of their dissemination, and to the unbalanced competitive condition between major economic zones and to the dangers of cumulative dependence.

60. The promotion of comparative advantages and mastery of generic technologies can, in fact, be combined. A whole range of cross-sector generic technologies can, upstream, play a key role in maintaining and developing, downstream, competitive advantages. The development of the clean car thus calls for a range of horizontal technologies. So, what is needed, is to ensure that manufacturers have access to this set of generic technologies through greater cooperation between the producers and users of these new technologies.

C — A policy for the system: standardization

61. The policy of developing standards is a major instrument of any industrial policy which wishes to influence the system as a whole. In fields where markets are becoming global, it is essential that European standards should be fixed, and that they should be compatible with international standards. As the communication on industrial policy showed, common standards strengthen competitiveness by reducing production costs, by encouraging the emergence of new markets and by supporting the preferences of consumers.

62. Pre-normative research does not just contribute to the completion of the single market. It also means that the Community can take up its responsibilities in fields such as safety, health and the environment. Completion of the single market has been up to now, and in many areas still is, hampered by the existence of standards which are still not harmonized at Community level, or by the absence of recognized standards. The technical specifications established by different manufacturers here become barriers to free trade. The most flagrant case has long been information technology hardware and software. Each manufacturer, working according to its own standards, produces hardware which is not compatible with that of its competitors. Fortunately, in this field at least, Community-level harmonization is well advanced.

The normalization of information technology components and telecommunications interfaces also has fundamental importance for Community R&TD programmes in this field. In the absence of such normalization, research projects could give rise to projects for which there is no market. Care must also be taken that new products arising from research projects carried out by an industrial consortium do not, in their turn, lead to technical barriers. This is why a policy has been adopted in several Community programmes of making sure that the people responsible for preparing standards have access to the results of research projects, when these results are likely to have an industrial and commercial impact.

63. The rapid incorporation of R&TD results in standardization activities helps to ensure that all these benefits are achieved. These include reduction of the costs involved in interoperability, rationaliza-

tion of production by reducing the diversity of products, a more effective transfer of information and the establishment of references which are generally recognized by health and safety legislation.

The establishment of standards cannot be separated from the resources necessary to implement them. The link between R&TD activities and standardization activities must be close, as indeed it has been for HDTV. It has to start up right from the very first phases of research. The establishment of standards must be done in parallel with the implementation of R&TD work. It is equally necessary to develop testing and measuring work which makes it possible to check the way in which they are applied.

64. Up to this point, emphasis has been placed on the role of the Community as far as harmonization and standardization are concerned. But Community activity related to the system covers a much wider field. The Community system is an integral part of the world system. Problems with external relations may, therefore, manifest themselves. Community action is essential to avoid the appearance of imbalances, inequality, and asymmetry. At a multilateral level, this involves the provisions of GATT, so far as public support for R&TD activities is concerned. But it is also true at a bilateral level.

65. Going beyond the Community area, there is also the question of cooperation in research and technology at world level. The huge costs associated with certain large-scale research work (thermonuclear fusion, but also human genome), the increasing world shortage of highly qualified human capital, and the international nature of environmental problems, are all explanations and justifications for undertaking research at the world level.

Two problems should be mentioned here. In the first place, over and above discussion about 'techno-globalism', many firms retain their national identity and enterprise culture. In the second place, even in those national research programmes which are characterized as 'strategic', transnational cooperation is far from being the norm. On the contrary, the participation of foreigners is frequently excluded. This is even more true where the research is likely to lead to commercial applications. It is vital, therefore, to take policy initiatives to develop common rules which make it possible to overcome the obstacles to world cooperation.

Beyond 1992: A Community strategy

66. On the basis of the analysis of the Community standing in R&TD, and of the new industrial and societal challenges to tackle, it is desirable, five years after the entry into force of the Single European Act, to take stock first of all of the activities already undertaken. Subsequently, it is essential to define, with scrupulous respect for the principle of subsidiarity, the necessary activities to be undertaken. The timespan involved concerns the mid-1990s to the end of 1998, namely the threshold of the third phase of economic and monetary union: a single currency and a European central bank.

A — An assessment: darkness and light

67. During the 1980s, Community R&TD policy progressively introduced its own methodologies; an appropriate administrative structure was put in place; numerous transnational networks were created, associating researchers, laboratories and enterprises in the scope of the different programmes. The Single European Act identified R&TD policy as one of the policies to accompany the implementation of the single market. Its importance was recognized in the 1988 Interinstitutional Agreement through the increase of the proportion of Community resources allocated to R&TD. This research budget has increased from 2.6% in 1988 to 3.8% of the total Community budget in 1992.

68. It is not one of the aims of the present document to deal with the questions related to the evaluation, in the proper sense of the word, of Community R&TD activities. The exercise of evaluation of the 1987-91 framework programme should not be considered to be over. It has none the less already given rise to a whole series of documents. These are collected in 10 volumes, which the Commission is currently transmitting to the other Community institutions.

69. The stage of evaluation is an integral part of R&TD activities. This is the case for the research activities of firms. It is still more so for those of public bodies. In the case of Community activities, improvements in this area are necessary, in terms of both methodology and organization.

In terms of methodology, it is necessary to give more weight to the evaluation of the economic effects of outputs of research: patents and the technological balance. It is on the basis of these parameters that the effectiveness of the measures undertaken is measured. It is the increase of competitiveness, as measured by means of internationally recognized indicators, which in the last resort justifies the involvement of public money in research activities.

In terms of organization, it is necessary to stress the independence of the evaluation exercise. This should be a permanent and horizontal aspect of research activities, rather than an internal addendum to the administrative and practical functioning of each of the programmes. The restructuring under way of the two Directorates-General responsible for Community R&TD will make it possible to achieve improvements in this area. In the coming months, measures will be taken in terms of administration and of work-methods, to make the evaluation activity consistent and more effective.

70. In the context of the present document, it may be useful to recall some of the salient points of a summary evaluation of Community activity. Among the strong points, generally recognized as the main result achieved, one may cite the 'Europeanization' of research ('Communitization' of research or introduction of the Community dimension into research activities).

71. A document produced annually by DG XII, containing disaggregated statistics on the implementation of the second framework programme, gives for each programme the extent of transnational cooperation which has been stimulated by Community initiatives. An analogous document will soon be produced by DG XIII as well. From the DG XII document, we may cite a few figures, to give an indication. The participation of SMEs appears to have been significant: they represented around 15% of the total number of participating organizations and a similar percentage of the financial resources used. Without putting in question respect for the criterion of 'scientific excellence', Community action has been able to extend to certain less technologically developed regions, at the same time drawing in the most advanced research organizations.

Community R&TD activities have also made decision-makers, practitioners and users of research conscious of the European dimension of the problems on the agenda. They have significantly accelerated the tendency to build and progressively extend transnational R&TD networks, generating a specific value-added. New synergies have developed; useless and expensive duplications have been avoided; the implementation of networks has increased the potential and actual benefits of research activities. Community activities have also generated a value-added with a more general character. Cooperation in R&TD has fed into industrial cooperation in the broad sense. The portfolio of firms' clients and suppliers has been enriched. It has expanded beyond the national base and taken on a European character. Joint ventures have been established. Initiatives on a Community scale have multiplied.

72. Another positive aspect should be stressed. This is the contribution of R&TD to 'disseminated innovation'. The estimation of the economic benefits of the value of Community activity on the basis of the value of patents resulting from research projects involves a complicated calculation. The most recent evaluation work, including that devoted to the second framework programme included in the volumes referred to above, establishes on the other hand quite clearly the following conclusion: Community actions have contributed strongly to ensuring the penetration of new technologies into the tissue of different sectors of European industry.

This is especially true for the programmes devoted to diffusing technologies. Two programmes have this characteristic: Esprit for information technology and Brite/Euram for industrial and materials technologies. The important point here is not the absolute level of results obtained or the aspect of being ahead of competitors: it is the breadth of the potential range of applications. This is actually often very large, as the work involved contributes to innovation in many parts of the industrial system. Before facts refuted such an analysis, one used sometimes to speak of 'mature' sectors (textiles for example), in which European industry should supposedly have given up investing, in favour of new technology sectors. Reality has developed quite differently. The continuous incorporation of new technologies in traditional industrial sectors has become a European 'speciality'. Community research initiatives certainly strengthen European know-how in this area.

73. By referring to the 'scientific and technological bases of Community industry', Article 130f(1) connects the 'scientific dimension' of Community R&TD

policy to industrial development. A broad interpretation of this Article is none the less required. Besides the programmes which have direct benefits for industry, there exist programmes which through their scientific content have an influence on the whole of society. The evaluation criteria applied cannot therefore be the same.

In fact, not all these programmes have an equal technological content. This content is important for some aspects of Community R&TD activities in the area of life sciences, for example there is an important technological content for bio-engineering. This is much less clear for the 'clinical' part of biomedical research. As is well illustrated in the international literature on the subject, other evaluation criteria must therefore be used in this case. In the particular case of Community actions the activities' benefits for society, the breadth of the response which they give for emerging needs, as well as the manner in which they satisfy the subsidiarity criterion, are taken into account.

Concerning support for the scientific community, the main effects will be achieved by means of the new specific programme which will soon be implemented. One can none the less not deny the positive results of the activities undertaken up to now. The perception of the Community reality has been strengthened; the level of integration of activities has grown significantly.

74. The state of Community research, none the less, has less healthy aspects as well. Besides the strengths, real weaknesses are also apparent. These are to be found in the area of choices and concrete orientations for programmes and projects; in the area of administrative methodologies; and, finally, in the area of legislative and institutional mechanisms.

75. As concerns choices and basic orientations, the main problem is the insufficient account taken of technological priorities. In the context of bracing international competition, actions dealing with technologies of limited importance can be useful in terms of disseminated innovation. They are however not enough to take up the challenge represented by the main technological priorities. A hundred application projects for integrated circuits in the most varied areas have of course positive effects: they encourage process and product innovation. But if Community industry allows itself to be left behind in the area of the production of integrated circuits, the harm done is double: the Community becomes a pure demand market for this particular product; and a basic know-how is lost, with this loss giving rise in turn to the loss of know-how in other technological application

areas. Overall, Community research is characterized by the insufficient number of real technological priority projects. This problem is aggravated by the tendency to continue to finance projects through pure inertia. The resources available for really important projects are thereby reduced. This has been one of a series of difficulties from which, for example, the Jessi project has suffered, in the sector of microelectronics. The problem, however, exists beyond this sector. The lack of selectivity, the tendency to disperse rather than to concentrate, the excessively weak perception of the true nature and real size of the technological challenges posed at world level — these must be deplored across the board.

76. Despite the effort undertaken in the opposite direction in the Commission's proposal, this tendency to dispersion is apparent up to and including the third framework programme. The length of legislative procedures, the additional fact that compromises almost always operate in the same direction — that of widening the field of action — have encouraged this tendency. The initial proposal was to concentrate the activities in six specific programmes, against 37 in the second framework programme. In the decision finally adopted, 15 different specific programmes finally constitute the third framework programme. The same problem appears at the level of the thematic content of each of the programmes. Two programmes which were conceived as totally new, 'Telematic systems of general interest' and 'Human capital and mobility', were in the end used to recover and pursue activities under way, and given objectives only partially corresponding to those of the programmes as they were originally conceived.

77. In the area of administrative methodologies, the document COM(92) 2000 stresses the handicap represented by the fact that 'working methods which dealt effectively with the problems confronting the Community 10 years ago, in the field of information technology for example, can no longer contend with the research requirements of firms or the speed of technological change'. The judgment contained in this document stresses the rigidity of the administrative chain of command, which inhibits its ability to adapt to outside developments (evolution of the industrial system of critical technologies, changes in competitiveness).

Based on a different approach, the evaluation report drawn up in 1989 by a group of five independent personalities, and discussed in Council during the examination of the proposal for the third framework programme, came up with identical conclusions. Besides certain positive elements, this report stressed several

negative aspects: the proprietary mentality of the services, the tendency of the programmes to self-perpetuation, the lack of mobility and low the level of rotation of personnel.

78. Two extra factors further complicate the situation. Especially harmful is the resistance, shared by the committees, to accepting the idea of a 'bottom-up' procedure. The programmes are designed within a circle which remains closed. The elaboration of proposals is very unreceptive to outside influences. Another element with negative effects is the compartmentalization of administrations and ministries which is noticeable in the Member States. More systematic and sustained exchanges between the administrations covering research and industry could help dialogue with the Community on the different levels required and a better understanding at the Community level of the real needs of industry. Initiatives have recently been taken in this direction. It would be appropriate to go further still.

79. Where legislative and institutional mechanisms are concerned, mention should be made of the complex and lengthy procedure followed, and the fact that it overlaps with the annual budget procedure, giving rise to a perennial source of potential inter-institutional conflict. Problems arose in this connection throughout the course of the procedure for the adoption of the third framework programme.

This said, it has been possible to bring the legislative operation to a proper ending, notably because of intensive and very useful concertations between institutions which have played a role on several occasions. We must now face up to the still more complex procedure introduced at Maastricht. This point will be treated in depth in Chapter IV.

80. Evaluation reports are normally carried out from the internal perspective of the research activity itself. Whilst these are important, this perspective does not enable the evaluation to take account of the full scope of activities required, but not yet accomplished.

In this respect, the Commission must also highlight the absence of the implementation of some Articles of Title VI of the Treaty. Amongst these is Article 130h, which will be treated in more detail later, relating to the coordination of national policies. Other Articles also remain unimplemented, in particular the three Articles directed to the modalities of implementing the framework programme: Article 130l on supplementary programmes; Article 130o on joint undertakings; with regard to Article 130m, its provi-

sions have not formally been applied, even if some actions which have been carried out can be seen as an application of its provisions.

The Treaty of Maastricht has retained these Articles. Little used until now, and also unlikely to be used in future, these Articles correspond to schemes from the early history of Community research, still experimental, and before the shared-cost programme — which guarantees the necessary flexibility and efficacy — had become the typical method of Community intervention in the scientific and technological area.

81. On the basis of the previous remarks, and the results of evaluation work, a series of conclusions has begun to emerge.

Community research strategy must be replanned in order to respond better to the challenges of international competition. Research programmes with industrial aims, characterized by a 'technology push' approach, must take more account of market expectations and their priorities.

A new approach to research and innovation based on the concept of a continual cyclical process, rather than a linear scheme, must underlie all the Community activities. Objectives of Community programmes must be refined and concentrated around technological priorities. More integrated coordination of research activities with other Community policies is essential.

A careful scrutiny of the financing methods is required. The management of programmes must be reformed: simplification of procedures, better interface between evaluation and the implementation of programmes, and greater transparency in the selection process.

B — An objective: to reorientate our activities

82. The relaunch and reorientation of Community R&TD policy appears at the pivotal stage of two major phases in the history of the Community. Structural and financial measures which enabled the implementation of the decisions of the Single European Act will now be succeeded by those facilitating a positive application of the decisions taken at Maastricht. The Single European Act established the Community's economic and social area in introducing

new Titles into the Treaty; the European Council at Maastricht is now committed to organize it.

83. During the last two years, and after a marked absence in the 1980s, the idea of a need for a European industrial policy has reappeared. In the 1970s, industrial policy was characterized by a *dirigiste* and sectoral approach. Today, it is recognized that public intervention in this area must take the form of horizontal activities to achieve the right climate and balance for maximizing the productivity and competitiveness of European industry. It is currently this approach which generally finds support. On the basis of the Commission communication on the European electronic and informatics industry, the Council adopted a resolution on 18 November 1991 applying this concept of industrial policy to the information and communications technology sectors. Moreover, this approach has been formally endorsed at Maastricht.

84. The reorientation of Community R&TD policy must combine continuity and innovation. Some traditional programmes will be continued, but revised and adapted in a critical and dynamic way to take account of the changing environment. An element of novelty will take the form of priority technology projects, having, as an objective, the development of key technologies and reinforcing the effect of R&TD investments on industrial competitiveness.

The definition of technological priorities will be one of the main innovations for future R&TD activities. It is desirable to concentrate on generic technologies which are directly and indirectly most useful for all industrial participants, avoiding a scattering of resources, in the framework of a 'bottom-up' approach, it is essential to ensure the availability of these technologies for the support of industrial research projects initiated by enterprises themselves, and which are based on their competitive advantages and designed to respond to market demands.

85. Against this background, two complementary routes must be followed: from R&TD to the market, from the market to R&TD.

From upstream to downstream, Community intervention must enable the mastering of a range of generic technologies for which access is essential for the competitiveness of the European productive web. Such mastery of generic technologies would make possible various industrial applications downstream, capable of helping change the pattern of competitive advantages. In the best case, mastery of these technologies will enable European competitive advan-

tages to be developed or reinforced. However, an equal risk exists in the absence of industrial take-up to exploit the results obtained, and it is, therefore, necessary also to consider the downstream/upstream relationship.

86. From downstream to upstream, the challenge is to identify industrial projects emerging from enterprises and based on their existing or emerging competitive advantages.

The availability of generic technologies can prove crucial for the maintenance or development of a European competitive advantage in an industrial sector downstream. The development of the clean car depends primarily on the will of the automobile industry, with its competitive advantages. Once a project has been identified downstream, it is, however, necessary to enable the interested enterprises to have access to a range of horizontal technologies, including in this case, new materials, as well as electronic components. By ensuring greater cooperation between producers and users of these new technologies, and by exploiting in a coordinated way the industrial potential of Community R&TD policies, the efforts of the constructors can be reinforced.

The absence of intersectoral technological coordination can, on the other hand, have serious effects.

87. Priority technology projects spontaneously emerging from enterprises constitute an effective means to bring together, through the Community framework, all the necessary expertise — whether or not involved at the outset of the proposal — and to integrate it under a coherent industrial strategy. Their implementation, involving private and public (national and Community) participants, will be organized so as to concentrate important resources for precise objectives, in respect of which the separate components must be conceived and integrated.

88. Community priority technology projects will enable a better synergy with Eureka. Oriented towards the pursuit of Community objectives, notably in the areas of industry, health, security, environment, and the internal market, they are initiated for the benefit of Community industry. Interfaces with Eureka projects will be established in conformity with the principle of subsidiarity, and aimed at eliminating duplication.

89. Priority technology projects will enable the combination of the advantages of industrial imagination and credibility, and of support from the framework of Community activities. Given their new character, it is

essential to summarize briefly the principle characteristics of these projects.

Proposals from industry must firstly be consistent with the themes of the framework programme covered in the technical annexes of the specific programmes. It is then the Commission's job to evaluate and discuss with the various parties involved what degree of priority the initiatives proposed have, in the light of the priorities defined in the framework programme as well as the breadth and pertinence of their implications.

In the framework of this approach, the enterprises will indicate the industrial objectives pursued and the necessary conditions for success, particularly in areas where the Community can make a significant contribution (R&TD, transfer of technology, etc.).

The proposals must address technological problems corresponding to industrial priorities; especially problems where a solution will also enable progress in other areas and will increase the global competitiveness of the system. The selection of proposals will be made in the context of a close dialogue between the Commission and the Committees.

In some cases, the projects will cover areas where several Community programmes intersect; in others, they will fit within the area of a single programme.

For the application of this new procedural approach (research — innovation — market), it will be essential to ensure that there is an industrial network for the exploitation and diffusion of results; in this respect, all the participants interested in the use of technologies under consideration will have the possibility to be involved in the project from the start (cooperation between producers and users).

C — A constraint: rapidity and effectiveness

90. The post-Maastricht exercise is not an academic exercise. It is the response to the ambitions inscribed in the Treaty. A constraint, which expresses itself in two complementary conditions, must be borne in mind. The first condition is the rapidity of our actions, the second is their effectiveness.

91. As concerns rapidity, Maastricht does not help us. As will be explained analytically later in Chapter IV on proposals, three Council decisions are needed

to implement R&TD activity. In particular, the first of the three (the framework programme) will take place under the untried and unique procedure set out in the Treaty, the procedure of co-decision accompanied by the requirement of unanimity. This raises the risk, already partly present in the third framework programme, of an interminable procedure and of an uninterrupted spiral of phases of decision-making. The rules of international competition are merciless and the new orientation of the Treaty would be fruitless if one did not make particularly great efforts to lighten the weight of this procedure. The new situation must be faced fair and square. The three institutions will need to concert on the new procedures and on methods to accelerate them, without violating any of the prerogatives provided by the Treaty for each of the institutions. On this subject, the last paragraphs of this document will make a specific proposal.

92. As far as efficiency is concerned, the risk is on the level of concrete choices of execution. Dispersion of themes, the scattering of resources, weak selectiveness and unchannelled growth are the dangers generally inherent in research activities supported from the public purse. There are means to counteract this tendency. They consist in a combination of a 'top-down' and a 'bottom-up' procedure, with a clear definition of the areas of activity within the technical annexes of the specific programmes; and in tighter control of procedures within the Commission.

D — A principle: subsidiarity

93. The challenge of competitiveness requires, above all else, that a rational solution be found to the problem of the relation between resources and objectives. Community resources in the area of research are limited. As the objectives are of major importance for our European destiny, the resources could be increased. However, such an increase is only justified if accompanied by greater discipline in the use of the resources. One can imagine a future for Community R&TD activities, but not an unlimited expansion like an oil stain. The increase of resources must be selective. Now, more than ever, selectivity is a condition for effectiveness. It would be conceptually inadequate and politically impractical to decide an increase of resources based on mere chance, purely ambitions of expansion, or the simple need of perpetuating existing activities. Opposition to such types of expenditure is absolutely essential.

94. The European Council at Maastricht laid down a fundamental principle for Community activities:

the principle of subsidiarity. This principle is a guideline to enable increasing selectivity for Community actions. It regulates the distinction, crucial both institutionally and politically, between national and Community actions. But where should the demarcation line be drawn? In areas of non-exclusive Community competence, can Community actions be developed at will? Can they expand into any area? Or, on the other hand, must they be linked to specific needs whose existence is necessary for them to be acceptable?

95. 'In areas which do not fall within its exclusive competence, the Community shall take action, in accordance with the principle of subsidiarity, only if and in so far as the objectives of the proposed action cannot be sufficiently achieved by the Member States and can, therefore, by reason of the scale or effects of the proposed action, be better achieved by the Community.' This is the wording of the second paragraph of Article 3b of the Maastricht text.

96. We now find explicitly stated a principle already considered, with good reason, to be a classic criterion for the interpretation of the Treaty. Its first expression was found in Article 130r (Title VII 'Environment') of the Treaty as amended by the Single European Act. But its application goes much further.

97. It is now desirable to consider the consequences of the application of the principle of subsidiarity in the area of research and technological development. A purely mechanical application would not be right. Nor should the discriminating capacity of this principle be reduced to presuming the presence of subsidiarity every time that, and simply because, the particular action has a transnational character. Transnationality can, in fact, be a simple expedient to obtain at Community level finance not available at national level.

As drafted, the principle nevertheless gives ample scope for interpretation. In Article 3b, qualitative expressions appear, such as: 'in so far as'; 'be sufficiently achieved'; 'be better achieved'. The interpretation is not always easy. However, the formula used in the Treaty contains two important criteria for judgment, and we need to concentrate our attention on these. They relate to, firstly, the scale and, secondly, the effects of the relevant action. These two criteria are to be approached separately: one, or the other. They do not necessarily need to be present together.

Subsidiarity is respected, and the Community can legitimately intervene, when the action can be better achieved at Community level by reason of its scale or

effects. These two criteria provide useful and important guidelines for the principle's practical application. An important remark of general relevance for the application of the principle of subsidiarity is called for here: the recognition of Community competence does not necessarily imply a budgetary intervention by the Community, which may also act in a regulatory or coordinating role.

98. Before dealing with some examples, two clarifications are necessary.

Firstly, the principle of subsidiarity does not correspond to the demarcation between public intervention and direct action by enterprises and other research operators, but rather between public intervention at the national level and at the Community level. The text of Article 3b is very clear on this point. The distinction is between Member States and the Community. Public interest due to the excellence of the action, the importance of the objectives or the quality of the participants is not enough. All these may justify a national intervention. But for Community intervention to be legitimate, an additional specific quality is needed, linked to the scale and/or the effects of the action. Whilst importance and excellence constitute necessary conditions, by themselves they are not sufficient conditions to satisfy the principle of subsidiarity.

99. The second clarification concerns the level of disaggregation — programme, sub-programme, project — to be taken into account in deciding whether the principle of subsidiarity has been respected. This issue is particularly pertinent, and as an example, we can consider the case of specific programmes.

Within the third framework programme, each of the 15 specific programmes constitutes too vast an umbrella for reasonable conclusions to be drawn. The scale and general character of the programme could erroneously come down favourably on the side of subsidiarity. The same remark applies to certain sub-programmes within the larger specific programmes. At the other extreme, if the starting-point is the usual project of normal size, too restrictive conclusions could be drawn. The project considered by itself in isolation may not satisfy *stricto sensu* the criteria of subsidiarity. But taken as part of a more complex activity, the project could well present the required characteristics.

100. A certain number of cases can be identified where subsidiarity is, so to speak, intrinsic to the type of activity; cases in which the criteria of scale or effects are plainly present, separately or in combination.

First case: 'big science' activities. A characteristic of these initiatives is that they are almost always international, often taking the form of 'mega-projects', involving numerous participants and major investments, sometimes extremely high over the medium and long term. The research and technological activities may be concentrated in one large installation (for example, the JET facility for controlled thermonuclear fusion) or dispersed (research on the human genome, work on global change).

Second case: priority technology activities. All technologies do not possess the same importance for the competitiveness of the industrial system. There are some key technologies, of particular priority. These technologies have the characteristic of being able to affect several industrial sectors. Their development normally requires heavy investments, cooperation between leading participants, including non-Community partners, and necessitates efforts in the medium and long term. The most commonly known examples are found in industries relating to electronic components, advanced software, new industrial technologies with an environmental component, advanced technologies with an impact on transport, or molecular biology.

Third case: R&TD activities destined to structure the single market. Common policies, old or new, will contribute to structure the single market, whose internal barriers will soon be broken down, but which is not as yet sufficiently integrated. These policies (from transport to the reformed CAP, from environment to trans-European networks) require back-up from a large number of research and technological activities covering different areas. For example, they include research on the non-food uses of agricultural products, advanced systems of surveillance through tele-detection, R&TD activities necessary for the development of a unified air traffic control system, and the interconnection of informatics networks for public administrations.

Fourth case: activities of prenormative research. Health, security, protection of the environment are natural sectors for Community regulation. Due to the increasing demands of society, such activities tend to cover even wider and more complex areas. But to determine the standards, norms and rules depends upon the acquisition of scientific and technological data. Specific prenormative research activities are, therefore, essential. This type of research concerns a large number of areas and of problems, from software and telecommunications to the harmonization of European norms for clinical and pharmacological protocols. Following the radical transformations of

recent years, the JRC will contribute to implementing prenormative research in which its essential characteristics of independence and neutrality will be a vital guarantee.

Fifth case: activities to foster a European scientific community. Human resources constitute a powerful factor for competitiveness. The national scale alone is insufficient to develop them. It falls to the Community to develop an integrated system of networks and of stimulating measures to foster the scientific community. Programmes for the mobility of researchers, such as those within the human capital and mobility initiative in the third framework programme, fall within this objective.

101. The five cases quoted constitute paradigms of actions for intrinsic subsidiarity. They do not, however, provide an exhaustive list of research and technological activities for which the criteria of subsidiarity can be successfully applied. A vast zone of Community activities exists where the presence of subsidiarity will have to be determined case by case. But the criteria always remain the same: those of scale and of effects, with, more often than not, the second, rather than the first, being applicable. But they have to be applied with precision. One can in this case talk of derived subsidiarity because it flows indirectly from the characteristics of the activity under consideration.

More generally, the analysis must be made at the level of 'core themes'. In future, a rigorous screening will be required. Not all the core themes currently present in the third framework programme appear to satisfy equally the criterion of subsidiarity. Nevertheless, it is also desirable to avoid a watering-down which may compromise the impact of projects.

102. The application of the principle of subsidiarity constitutes a key to enable the problem of financial resources to be adequately tackled. The accent must be put on the concentration of available resources for the actions fully justified at Community level. On the basis of a scrupulous scrutiny of needs and opportunities, reasoned decisions for expansion can be taken. The current level of Community expenditure on research and technological development is approximately one-thousandth of the GNP of the Community. Whilst nothing prevents this limit being exceeded, we nevertheless have an obligation to justify all our increases.

E — An opportunity: the coordination of national policies

103. Article 130h features amongst the modifications introduced by the Treaty at Maastricht. It is not a small amendment which can pass unnoticed.

First introduced in the Treaty by the Single European Act with all the other provisions of Title VI, this Article (Article 130h) concerns the coordination of national policies: 'Member States shall, in liaison with the Commission, coordinate among themselves the policies and programmes carried out at national level'. With an obviously prudent use of language, there follows, 'In close cooperation with the Member States, the Commission may take any useful initiative to promote such coordination'. This problem of the coordination of national policies has recently been raised at the initiative of the last presidencies of the Council. The issue most specifically raised concerned the elaboration of positions, as common as possible, on questions linked to initiatives with an intergovernmental character, such as ESA (European Space Agency), CERN (European Organization for Nuclear Research), EMBL (European Molecular Biology Laboratory), ESO (European Southern Observatory), ESRF (European Synchrotron Radiation Facility) and Eureka. Generally, however, few firm conclusions have, up to now, been reached in this area. The coordination of national policies remains a promise.

104. The Maastricht decisions clearly alter this perspective. The coordination of national policies essentially ceases to be entrusted solely to the good intentions of Member States. The reworded Article 130h provides: 'The Community and the Member States shall coordinate their research and technological development activities so as to ensure that national policies and Community policy are mutually consistent'. The second paragraph remains unchanged.

Although the concept of coordination has not changed, the subject and the object of the coordination have. The subjects are no longer the Member States amongst themselves, but the Member States on the one hand and the Community on the other hand. The object is no longer the national policies, but the national activities on the one hand and Community activities on the other hand. One further difference emerges: mutual consistency between national policies and Community policy.

105. This qualification of consistency as an objective is the essential element of the new version of Article 130h. There exists an erroneous interpretation of the principle of subsidiarity: it puts national activi-

ties and Community activities on the same level, almost with indifference. In this case, they both have the same importance: where the first ends, the other begins. The Community is reduced to a supplementary source for national actions.

106. The correct interpretation is, of course, very different. A line of demarcation between national activities and Community activities exists. As the means for Community research is always limited (less than 4% of the total financial resources allocated for R&TD in the 12 Member States), it is unimaginable to resort only to this source of funds, even for activities of intrinsic subsidiarity. National financing is also necessary to implement the activities of 'big science', projects of 'technological priority' or activities aimed at structuring the large market. For this reason, it is essential to assure the mutual consistency underlined in the new Treaty. Mutual consistency and 'non-exclusive competence' are linked. The demarcation line flowing from the principle of subsidiarity is not automated and mechanical, but it is a juridico-political decision. The two parties, on the different sides of the line, should not form two separate worlds, but on the contrary, should form a coherent group.

107. In its new form, Article 130h represents an important opportunity. Due to the interface established between national policies and Community policy, their coordination must now be turned into a practical reality as soon as possible. In this context, it is desirable to pursue with vigour the initiatives proposed to the Council.

However, the level at which the coordination is carried out is fundamental. An appropriate permanent organ has been suggested. It will be much more effective if it consists of representatives of ministers. In effect, this will avoid a confusion between the coordination of policies (now under consideration) and the coordination of implementing measures. Useful precedents can already be found within the Council — General Affairs, Economic and Financial Affairs, and Agriculture. The Commission must, for its part, ensure that the task conferred by the Treaty becomes a new policy priority. This requires an important commitment and new working methods.

108. Those responsible for research in EFTA will be associated with this exercise in conjunction with the implementation of the Treaty on the European Economic Area. For these countries, the coordination foreseen by Article 130h assumes, in a certain way, an even greater significance. Although associated with Community R&TD policy at the framework pro-

gramme level, the EFTA countries do not benefit from the synergies developed by the Member States of the Community during 10 years of common effort. A permanent forum for consultation and concertation could be a very useful instrument to exploit the full potential of the plans of the EEA.

109. The new external responsibilities of the Community imply the launch of unprecedented initiatives towards Central and Eastern Europe. Problems linked to the creation of opportunities for the scientists in these countries, especially the CIS, spring to mind. In this area also, coordination will be essential for the co-existing national, intergovernmental, and Community initiatives.

F — An ambition: making a success of Maastricht in research

110. The text agreed at Maastricht sets out an overview of our ambitions. Economic and monetary union, political union, progress of the Community towards the European Union: these are the main headings. But the new ambitions of the Community are equally relevant for the different Chapters of the Treaty, amongst which, as we have noted, is the Chapter devoted to research and technological development.

111. The three pillars of the Delors II package (cohesion, competitiveness, external responsibility) have a fundamental coherence: a more competitive and cohesive Community is a stronger Community, hence better able to play its international role.

In this perspective, the two internal pillars, cohesion and competitiveness, do not appear exclusive, but complementary. Their synergy should be better exploited.

The instruments of structural policy can contribute to creating the conditions which can allow an increase in the participation of less developed regions in Community programmes, by helping put in place the infrastructures and human resources without which research and innovation activities cannot be carried out. The actions carried out should contribute to raising the public and private organizations of these regions to the level of scientific excellence required to benefit more from Community research policy. The latter, in conformity with the new Article 130b, will take into account the objectives of cohesion, in both its development and its implementation and will con-

tribute to their realization. The aim will be to maximize this synergy in all activities directed at the dissemination of research results, access to technologies, mobility of researchers and support for the scientific community.

112. The follow-up to Maastricht has a single guiding principle: to place our activities on the same level as our ambitions. 'The means to match our ambitions', is the expression which appears in the title of document COM(92) 2000, setting out the presentation of the Delors II package. Its execution appears to be politically less easy than might have been expected. Maastricht was produced by history. The realization of Maastricht will be produced by will, by the coupling of wills.

Some risks of disruption exist. The stagnation of the economy, the general concern about the costs coming from changes on the international scenario, the reticence expressed by public opinion: these factors all contribute to explain an atmosphere marked more by hesitation than impetus. But we should not abandon the tasks already started.

113. To recall the ambitions of Maastricht leads us directly to the heart of the issue: the future Community R&TD strategy, its legislative expression, and its means of action in financial terms and programmes.

With the third framework programme barely under way, we are already heading towards the fourth programme. One of the annexes to this document sets out an initial overview of the state of advance of the specific programmes currently running. But as previously indicated, to attempt a true mid-term evaluation at this stage is not possible. Nevertheless, on the basis of the circumstances outlined, and the reflections set out above, a strategy can be conceived and constructed in a conclusive manner.

114. The premises for this strategy are identified by the fundamental ideas emerging from the previous paragraphs: the strengthening of competitiveness as a unifying objective; the central role of the principle of subsidiarity; the essential emphasis on technological priorities; a balanced solution between 'top-down' and 'bottom-up' approaches; increased selectivity for programmes and projects; coherence with the objectives and policies of the Community.

An additional point must be strongly emphasized: any attempt to define the main thematic contents of future Community activities does not make much sense without also identifying the means of overcom-

ing trends in the opposite direction. It is legitimate to demand to see the results of the review of activities currently under way before any discussion on the content of the fourth framework programme. It should not be overlooked that in 1989 the mid-term review of the second framework programme identified a number of negative features central to the Community activities: the trend for self-perpetuation of activities; the existence within the administration of a 'proprietary' mentality over the programmes; the weak selectivity of some programmes and projects, etc. On the contrary, we must endeavour to avoid a scattering of our resources and efforts and to ensure that Community activities assume a greater transparency. These two ideas must influence the updating of the thematic content of Community activities.

115. This said, the Commission proposes a strategy for future Community activities based on three pillars: the unification of Community research and technological development policy; the concentration of the resources on a few large themes; the international dimension.

The unification of research and technological development policy

116. Article 130f constitutes the basis for Community policy in this area. The text adopted at Maastricht introduced a very important innovation in this Article: it affirmed the horizontal nature of Community R&TD activities with the characteristic of potentially intersecting with all common policies. A link was established in both directions. On the one hand, research spreading out to the different common policies (first paragraph); on the other hand, the research aspects of these common policies collected, in a unified manner, in the provisions of the new Title XV of the Treaty (third paragraph).

117. An immediate consequence is that Article 130i of Title XV establishes that all the Community R&TD activities will be covered by the framework programme. Whatever the form and whichever common policy is involved, all the Community research and technological development activities must now be included in the framework programme.

These activities include, to use the traditional terminology, fundamental research, basic industrial research, applied research, technological development and, under the new Article 130f(3), all demonstration projects.

This applies equally to R&TD aspects of other existing major policies, such as the environment, energy, transport, or health. Also affected are the research aspects of other Community activities carried out on the basis of Article 235, rather than a specific legal basis. Finally, this applies for all the activities known as 'non-framework programme' which are significant and therefore require a legal basis.

118. The principle of the unification of Community R&TD policy also has implications for the structure and working methods of the Commission services. These working methods, as well as the internal organization of the Commission services, have a major impact on the effectiveness of research policy. This is particularly true in the light of the reorientation of research activities proposed in the present document.

The European Parliament and the Council have on several occasions stressed that it is necessary to ensure that the Commission's working methods and administrative procedures are adequate to increase the competitiveness of the Community effort. The Commission is examining this point and is ready to undertake a modernization of procedures and structures.

A renewed thematic framework

119. The very notion of a framework programme implies the concept of a coherent thematic architecture. The central problem is one of choices. Some activities should be carried out, some are impossible to carry out, and some should not be carried out. This document already contains a number of indicators to guide the selection of the themes. It should be stressed that the indications and examples given here are illustrations to clarify the argument and not binding on future decisions which will be taken in the appropriate forms.

120. The application of the legislative procedures foresees, with good reason, a phase of evaluation and a general discussion with the Community institutions prior to the submission of the Commission's proposals. For some time, the Council has envisaged a discussion of the future themes of Community action for its agenda on 29 April 1992. The Commission is, therefore, waiting for some indications to emerge from these discussions before formulating its proposals for the fourth framework programme, and to adapt the third framework programme. However, at

this moment, some general reflections can prove useful.

121. It is necessary to overcome the temptation to want to cover the entire field of research. Themes for programmes with a vertical character should, therefore, be chosen with particular attention. Within each specific programme, it is essential, having examined the activities under way, to keep very much in mind the following points: a minority of our activities can be considered as having reached their end; therefore, their continuation should not be proposed. A majority of our activities, constantly updated, can be continued. A limited number of original themes will take account of the new needs and perspectives.

The biggest danger arises from the risk of 'self-perpetuation' of actions. Our credibility is at stake. To involve here, as is sometimes done implicitly, constraints linked to personnel issues (of whom some could find themselves at risk of not being employed or of being under-employed) is to admit bad management. On the contrary, mobility, rotation and flexibility of employment are signs of good management.

122. Against this background, the thematic choices must focus essentially on two main areas. Firstly, science and technology for industrial innovation.

The usual interpretation of Article 130f(1) referring to 'the scientific and technological bases of Community industry' is still valid and can be taken as a basis here. The reference to 'scientific basis' fully justifies support for fundamental research. With the exception of 'curiosity-oriented' research, no fundamental research sector can, a priori, be excluded from Community intervention. The only limitation envisaged stems from the thematic fields to be defined. The accent on competitiveness, in any event, obliges us to use a considerable proportion of the resources for the priority technology projects (PT projects) referred to earlier. However, even these projects must be conceived within chosen thematic areas and not just for any sector.

123. Secondly, science and technology for society and for Europe.

The fields of activities of the second framework programme (1987 to 1991) covered certain aspects of the 'quality of life'. With the new wording of Article 130f ('promoting all the research activities deemed necessary by virtue of other Chapters of this Treaty'), the tasks of Community research extend beyond the area just centred on the needs of industry. Research is to be put at the service of a whole range of wider prob-

lems, centred on Europe and on society. However, the Europe envisaged here is not abstract, but is the Europe which results from the common policies. The needs envisaged are not the general needs of society, but those for which the Treaty legitimately foresees a Community intervention. Therefore, some new horizons open up for Community research. Science and technology can, in fact, be applied in the scope of multidisciplinary approaches to numerous problems currently becoming more and more acute: the important theme of the city, to be considered in all its aspects (of living, communication, work, environment, health) as a global 'habitat' of a growing share of the population; and correspondingly, for rural areas, the affirmation of a balanced vocation which, on the basis of the reform of the CAP, aims at a new model of productive use of agricultural territory.

124. The framework programme not only sets out a series of vertical activities in a number of specific areas: it also includes some horizontal activities and instruments. The idea of renewing the thematic framework also applies to these horizontal activities.

125. For example, we can ask whether the current instruments and mechanisms are adequate to enable SMEs to benefit fully from Community research policy. A special effort should be made to facilitate their participation in the specific programmes of research. Furthermore, in the area of technological innovation by SMEs and the dissemination of results, the determination and imagination necessary to improve the results do not always measure up to the numerous declarations of intention. Two matters now merit consideration:

Firstly, at Community level, we do not possess sufficient financial instruments of the venture capital type to help the research efforts of SMEs so that they may better exploit their innovatory capabilities. Could we not contemplate establishing for SMEs a special 'kiosk' working on simple rules?

Secondly, concerning the dissemination and exploitation of research results, progress has been achieved in this area with the activities under the third framework programme. In addition, the Commission will shortly be adopting the measures required to apply the Council decision on the dissemination and exploitation of results of the specific programmes of research and technological development. Can we always be sure that the current combination of a central action and activities at the programme level constitutes the best possible formula?

126. In the updating of the thematic content of the framework programme, the evaluation of programmes under way will play a fundamental role. Evaluation activities must, therefore, be better defined and implemented. We cannot consider these to be solely an internal question for the management of individual programmes. A framework of common rules and criteria must be established, thus enabling the transparency, the credibility and the efficacy of evaluations to be improved.

International cooperation

127. On this point the Treaty is completely explicit. Article 130g mentions the promotion of cooperation in the field of R&TD with third countries and international organizations as the second of four general activities to be developed and put into operation by the Community.

128. The issue for consideration here is the form that cooperation takes, at the international level, between the Community and other entities. During recent years, responsibilities of the Community on this level have significantly increased. The text adopted at Maastricht has endorsed this principle. The document COM(92) 2000 presents cooperation as corresponding to the main priorities for the coming years.

129. Until now, the forms under which international cooperation in science and technology with the Community has been carried out have been very varied. Schematically they can be grouped into the following three types:

- (i) Cooperation implying the participation of third countries or organizations and firms from third countries in the activities of the framework programme. The provisions of Article 130m foresee the possibility to conclude international agreements for this objective. The Treaty creating the European Economic Area assumes a particular importance because it opens the way for the EFTA countries to participate in the framework programme as a whole.
- (ii) Participation of the Community, in cooperation with third countries, in non-Community initiatives, particularly intergovernmental cooperation programmes such as COST and Eureka.

(iii) Cooperation in which the Community intervention essentially takes the form of a financial contribution to pilot projects, workshops and study grants. This is particularly the case for part of the cooperation actions with the developing countries. This scheme will also be used in the scope of cooperation actions with Central and East European countries.

130. For the first type of activity, the Community expenditure is financed within the framework programme. For the second and third types of activity, the financing is identified separately in budgetary lines outside the framework programme. It is now necessary to apply the provisions of the new Treaty. Those among these activities which need a legal basis must be brought within the framework programme. They will give rise to some specific programmes of a horizontal nature. One of these programmes will encompass all the activities of international cooperation.

131. It will, therefore, be possible to organize this area of activity, whose importance will increase, in a

rational scheme. Scientific and technical cooperation with industrialized countries, developing countries and Central and East European countries, including the new republics of the ex-Soviet Union, is set to develop and intensify. In this last area, the Community is simultaneously committed to bilateral actions, as well as special initiatives developed in a multilateral framework.

132. Finally, we should mention the participation of the Community in consultation and concertation activities carried out within different international organizations. The OECD plays a particularly important role in this framework. The ministerial meeting of the OECD on 10 and 11 March 1992 has demonstrated the increasing tendency of industrialized States to jointly examine and seek to resolve the major problems arising at the international level. This is confirmed, in particular, by the decision agreed in the area of 'big science': a procedure has been established for a permanent scientific, technical and economic evaluation of initiatives in this sector. Results are particularly awaited in the area of 'mega-projects', which are too costly and on too big a scale to allow duplication and dispersal of efforts.

A coherent framework of proposals

133. As stated in the Introduction, some important choices must be made during 1992 in Community R&TD policy. The preceding Chapters set out the elements providing the conceptual basis capable of providing the foundation for the exercise beginning with this communication.

134. This Chapter describes the main principles of the framework, into which will be integrated the proposals the Commission intends to submit, following the discussion to be held within the different institutions.

135. Essentially, some decisions must be taken on three interdependent questions.

The first concerns the position of research and technological development within the new 1993-97 financial perspectives.

The second relates to the fourth framework programme: its characteristics regarding the years to be covered, structure, financial resources and procedures for implementation.

The third concerns the particular measures to take for the period 1993-94 to ensure a progression from the third to the fourth framework programme guaranteeing continuity of R&TD activities.

A — The position of research in the 1993-97 financial perspectives

136. The reform of the finances of the Community effected in 1988, and as formalized in the Interinstitutional Agreement of 29 June of the same year, stresses the principle of a five-year reference period. The first period finishes with the current exercise in 1992. The Commission is, therefore, now required to agree its financial perspectives for the five-year period 1993-97.

137. The Commission has elaborated a detailed proposal on this issue, the main principles of which are outlined in the document COM(92) 2001 of 10 March 1992 'The Community public finances from now to 1997'. It is this document which forms the

reference source for the following text, in the same way that document COM(92) 2000, referred to on several occasions, forms the reference source for the content and objectives of Community research policy following Maastricht.

138. The new financial perspectives identify three priorities: 'Actions for social and economic cohesion' (heading 2); 'Strengthening the competitiveness of the Community economy: research and technological development, trans-European networks' (heading 3) (but also heading 2 for training and reconversion activities connected with industrial change); 'External policies' (heading 4 and new reserve for exceptional expenditure in this area under heading 6). In the other areas: 'Common agricultural policy' (heading 1), 'Other internal policies' (heading 3) and 'Administrative expenditure' (heading 5), the growth of annual expenditure will be markedly more limited.

139. Research and technological development expenditure is classified under heading 3, 'Horizontal internal policies'. This includes 'Horizontal actions conducted in application of the principle of subsidiarity at the level of the whole of the Community and particularly aimed at giving complete efficacy to the large internal market and to improve the competitiveness of industrial enterprises'. R&TD represents an important proportion of the total means foreseen for the five-year period for all the horizontal internal policies. In the document COM(92) 2001, this importance is clearly linked with the issues referred to under the heading 'A new approach to R&TD policy'.

In addition, R&TD is the only policy amongst the different policies covered by heading 3 to have a separate indicative figure in the total.

This peculiarity is commented upon with precision on page 27 of the document. The text reads: 'A new ceiling for Community expenditure will be set, as required by the new Treaty, when the new framework programmes are adopted. It would therefore seem neither necessary nor useful to establish a specific subheading for this category of expenditure in the new financial perspective. However, when the new financial framework is defined, a decision will have to be taken on what is to be earmarked for implementation of research programmes, it is accordingly proposed that a footnote be added to the "Internal policies" heading specifying the planned budgetary

allocation for research with a statement to the effect that the three institutions undertake to regard the amounts given there as guidelines for the research framework programme'.

140. Having provided these explanations, at this stage we can outline in a simplified version the table

of financial perspectives as it appears in the document COM(92) 2001 (for the complete version, see Table 7 of Annex I).

Financial perspective

(million ECU, 1992 prices)

	1992	1993	1994	1995	1996	1997
<i>Commitment appropriations</i>						
1. Common agricultural policy	35 348	35 340	37 480	38 150	38 840	39 600
2. Structural operations	18 559	21 270	22 740	24 930	27 120	29 300
3. Internal policies ¹	3 991	4 500	5 035	5 610	6 230	6 900
4. External actions	3 645	4 070	4 540	5 060	5 650	6 300
5. Administrative expenditure	4 049	3 310	3 465	3 720	3 850	4 000
6. Reserves	1 000	1 500	1 600	1 200	1 300	1 400
Total	66 592	69 990	74 860	78 670	82 990	87 500
<i>Payment appropriations required</i>						
	63 241	67 005	71 650	75 110	79 060	83 200
¹ Indicative amounts, R&TD policy:	2 448	2 730	3 040	3 380	3 770	4 200

141. To avoid any ambiguity, it should be stated that the figures mentioned for R&TD policy also include the amounts attributed to actions classified as 'outside the framework programme'. The amount mentioned for the current 1992 financial year (ECU 2 448 million) can be divided into two parts: ECU 2 102 million for expenditure on the framework programme; ECU 346 million for expenditure outside the framework programme.

There is no doubt that the provisions of the Treaty require all the R&TD activities of the Community to be included within the framework programme. It is in this manner that the proposal for the fourth framework programme must necessarily be formulated. The problem is to assure a transition from the present, to the future, situation. The principle that the figures mentioned in the financial perspective cover the totality of R&TD expenditure cannot be questioned.

As mentioned in document COM(92) 2001, the provisions of the new Treaty requiring the inclusion of all R&TD activities in the framework programme necessitate the inclusion of expenditure for scientific cooperation with third countries in heading 3 rather than in heading 4 (External actions), which will cover

those actions for third countries which consist exclusively of aid or assistance for the recipients.

142. An examination of the figures appearing in the R&TD item in the financial perspectives shows a significant progression. R&TD expenditure increases from ECU 2.4 billion in 1992 to ECU 4.2 billion in 1997. The annual increase is about 11.5%. The increase from 1992 to 1997 is about 71.6%. In 1997 R&TD expenditure will reach approximately 5% of the total Community budget.

B — Towards the fourth framework programme

143. As soon as they are adopted and formalized in a new Interinstitutional Agreement, the 1993-97 financial perspectives will assure the availability of annual resources for R&TD expenditure. This expenditure must be organized according to the current scheme for the 1990-94 framework programme, and for the next framework programme, the fourth. Between now and the final adoption of the financial perspectives, the Commission must pay attention to the coherency of its proposals.

144. As stressed in the Introduction, the Commission intends to formulate two plans to assure a harmonized evolution of Community R&TD actions: rapid submission of a proposal for the fourth framework programme; submission of a proposal complementing the third framework programme. It is more logical initially to raise the question of the fourth framework programme, subsequently returning to the problem arising from the last two years to the third, which will in a certain sense be the key years for Community research.

145. In the third Chapter of this document, numerous elements are outlined which give an idea of the strategy into which, in the Commission's opinion, the fourth framework programme must be integrated. We will not, therefore, return to this issue. However, four points will be dealt with: the reference period for the new framework programme; the legislative procedure; the structure; the estimated expenditure.

The reference period

146. One of the characteristics of the three successive framework programmes was the application of the rule of the rolling programme, by which two consecutive framework programmes have one or two years in common.

The concern to avoid a hiatus in activities combining novelty and continuity, as well as a number of administrative constraints, justifies this rule.

147. The principle of the rolling programme must continue to apply for the passage from the third to the fourth framework programme. The Commission, therefore, proposes that the fourth programme cover the five-year period from 1994 to 1998. The complexity and length of the adoption procedure proposed by the new Treaty, to be very plain, presents a problem for implementing such a formula. However, it is within the framework of the existing procedures that work has to be carried out. It would be politically wrong to renounce in advance the aim of starting the fourth framework programme in 1994.

The legislative procedure

148. The decisions taken at Maastricht maintain the principle of a double legislative procedure (frame-

work programme and specific programmes). By comparison to the current situation, the respective importance of the two events is, however, reversed. The framework programme is adopted on the basis of the most cumbersome procedure: co-decision (Article 189b) and unanimity of the Council. The specific programmes are adopted on the basis of a simple consultation of the European Parliament and a qualified majority in Council.

149. Besides this major innovation, the new Treaty introduces a second less important, but not insignificant, innovation. Up to now, the rules covering the participation of undertakings, research centres and universities in Community programmes, were agreed within the Decision adopting each specific programme (currently the first paragraph of Article 130k and the second paragraph of 130q). The text of Maastricht modifies this position.

A new Article 130j has been introduced providing:

'For the implementation of the multiannual framework programme, the Council shall:

- determine the rules for the participation of undertakings, research centres and universities;
- lay down the rules governing the dissemination of research results'.

In accordance with Article 130o, these decisions are taken by the Council on the basis of, in the terminology of the Single European Act, the cooperation procedure (in the terms of the new Treaty, the procedure foreseen in Article 189c).

150. In accordance with the new Treaty, the obligatory legislative acts for the implementation of the framework programme are, therefore, three in number:

- (i) a Council decision on the framework programme, under the co-decision procedure;
- (ii) a Council decision on the rules for participation and on the dissemination of results, under the cooperation procedure;
- (iii) a Council decision on each specific programme under the consultation procedure.

Serious difficulties likely to compromise the objectives of the Treaty can only be avoided by a spirit of cooperation between the institutions, without disregarding their respective prerogatives, and by the over-

riding interests of the Community being taken into consideration by the representatives of each institution. The final pages of this document, therefore, set out a precise proposal on this issue. The effective start of the fourth framework programme in 1994 presumes, in effect, an appreciable acceleration of the administrative procedure.

The structure

151. The text of the Single Act gave no further indication of what should be understood by the term 'activities'. The general thinking of Title VI 'Research and development' suggests that what was meant was simply activities undertaken for the sake of the objectives defined in Article 130f (1). All the same, the definition of the concept 'activities' did not play a key role since both the 'activities' and the 'programmes' themselves were only given an *estimate*, by the legislative authority, of the sum deemed necessary, the determination of the definitive sum being left to the budgetary authority.

The position is quite different with the text adopted at Maastricht: only the specific programmes adopted by the Council still foresee an estimate of the necessary means. The framework programme and each of the activities can no longer be financed other than in conformity with a maximum overall sum fixed by the legislative authority (third indent of second paragraph of Article 130i(1)). The devolution of the respective powers of the legislative authority and of the budgetary authority could henceforth no longer be left to the discretion of one or the other, nor to the Commission when it presents its proposals. This is why the new text of Article 130i provides an objective criterion applying to all the institutions: the actions involved are the four 'activities provided for in Article 130g'.

152. It would be useful here to quote in its entirety Article 130g. Although remaining unaltered, it acquires in the new Treaty a considerable significance, unknown until now:

'In pursuing these objectives, the Community shall carry out the following activities, complementing the activities carried out in the Member States:

- (a) implementation of research, technological development and demonstration programmes, by promoting cooperation with, and between, undertakings, research centres and universities;

- (b) promotion of cooperation in the field of Community research, technological development and demonstration with third countries and international organizations;

- (c) dissemination and optimization of the results of activities in Community research, technological development and demonstration;

- (d) stimulation of the training and mobility of researchers in the Community.'

153. The activities which can be the subject of a framework programme are, therefore, these four activities and these four only. With the removal of ambiguity and arbitrary identification of the activities, the text of Article 130i, fundamentally innovative by comparison to the current wording, makes a link between the different activities and financial and budgetary elements. As specified in paragraph 3: 'The framework programme shall be implemented through specific programmes developed within each activity. Each specific programme shall define the detailed rules for implementing it, fix its duration and provide for the means deemed necessary. The sum of the amounts deemed necessary, fixed in the specific programmes, may not exceed the overall maximum amount fixed for the framework programme and each activity.'

154. Having regard to the preceding paragraphs, the structure of the fourth framework programme will necessarily be fundamentally modified by comparison to the third programme. In the case of the first activity (R&TD programmes), there are currently five different activities (the first five activities of the third framework programme); the second (Cooperation with third countries) is actually partly implemented 'outside the framework programme'; the third (Dissemination and exploitation of results) is the subject of its own specific programme; the fourth (Training and mobility of researchers) corresponds to the current sixth activity of the third framework programme.

A fundamental rewriting is, therefore, required. In the new context, the significance of an expression such as 'the broad lines of such activities' becomes much more comprehensible. What the framework programme and its annex will contain (the term 'technical annex' applies only to the annexes of specific programmes) is the description of the broad lines of a strategy, not the palimpsest of the specific programmes for their 'specific' details.

155. Some remarks are necessary on the subject of the problem already mentioned of the actions outside

the framework programme. These activities have always raised certain problems: uncertainties as to their legal basis, the lack of a clear strategy, the annual character of spending despite the continuous nature of the activities. For the sake of coherence all these activities have been collected under the heading 'Actions of promotion, accompaniment and follow-up' and broken down into the following categories: support for scientific and technical policy; support for other policies; international cooperation.

All these activities must clearly be integrated into the fourth framework programme in principle from 1994. Beyond the transitional phase mentioned above, a formula should not be difficult to find on the basis, for example, of the concept of 'Actions of promotion, accompaniment and follow-up'. Nothing prevents adding a horizontal programme, aimed at supporting vertical programmes, to the specific programmes relating to the first activity.

156. The same approach is in principle valid for other actions which have hitherto been categorized outside research, but which, after a technical and juridical examination, could be included there, as specified in the new Treaty. On the administrative level, an appropriate form of management must, therefore, be found; on the legislative level, a formula permitting compliance with the principle of the unity of the R&TD policy which is emphatically stated in the new Treaty.

Estimated expenditure

157. The adoption of the decisions of expenditure for the second and third framework programmes has given rise, it must be admitted, to a series of difficulties. These difficulties were essentially linked to the coexistence, in the procedures used since 1987-88, of three types of different decisions, each one possessing particular constraints: decisions on the general financial perspectives of the Community, i. e. fixing ceilings for the different categories of expenditure (those for research being orientations at the same time); decisions linked to the legislative acts in the area of R&TD (the amount deemed necessary for the framework programme and the specific programmes); decisions taken in the framework of the annual budgetary procedure (on the credits corresponding to the breakdown of the budgetary line 'envelopes' and the distribution of the multiannual amounts by year).

This triple decisional structure has given rise to numerous problems, sometimes very acute. Interinstitutional conflicts have resulted from them, necessitating a recourse to multiple concertations, in particular, and repeatedly through the procedure of the triologue.

158. Following the decisions taken at Maastricht, the situation could improve. The establishment of a consolidated framework of expenditure constitutes a first positive point. Within the scope of the Interinstitutional Agreement destined to formalize the 1993-97 financial perspectives a consensus could, however, be reached between the three institutions on the amounts of expenditure to be foreseen for R&TD for heading 3 'Internal policies'. In the new Treaty the expression 'amount deemed necessary' is maintained in the case of the specific programmes, but it is replaced by 'maximum overall amount' for the framework programme in its totality, as for each of the four activities which it will consist of. Realism, however, obliges us to admit: all the issues of potential conflict between the multiannual legislative procedure and annual budgetary decisions, even in this new context, are far from over. For this reason, as will be recalled in the conclusion of this document, the Commission considers it should indicate its availability and interest to follow a procedure of interinstitutional concertation in advance for the application of the provisions of the new Treaty.

159. As regards the estimated expenditure, particular attention must be paid to the critical year of 1994. All steps must be taken to complete, before the end of the current Parliamentary term, the procedure for the adoption of the fourth framework programme. However, even in the best hypothesis, this will enable in 1994 only a start to its implementation. Only a small proportion of the means foreseen within the financial perspectives can, therefore, be used. The central problem thus becomes that of the complementary financial measures for the last two years of the implementation of the third framework programme (1990-94).

C — Linking decisions for 1993-94

160. From the preceding paragraphs, it can clearly be seen that the years 1993 and 1994 will be the critical years for the evolution of Community R&TD expenditure. A contraction of research expenditure during these two years would be incoherent with the proposal contained in document COM(92) 2001. To

avoid this, the Commission proposes the only reasonable solution: a supplementary financing of the third framework programme for the years 1993 and 1994.

161. As set out in the first pages of this document, the Commission estimated, at the time of the adoption of the third framework programme, that ECU 5.7 billion would not be sufficient to cover the needs of R&TD policy during all the five years, and maintained a reserve on the amount adopted. At that time, the Commission stated that ideally a further sum of ECU 2 billion should be added to the amount adopted. Having regard to the interinstitutional compromise that, in a realistic perspective, can be reached, nothing obliges us to use the totality of this amount for a net increase of the envelope of the third framework programme. Certain activities, as we know, are in fact financed outside the framework programme. Whilst awaiting the implementation of the fourth framework programme, some transitional solutions could be found in this framework, based on the use of the financial margins fixed for R&TD in the Interinstitutional Agreement. From the sum mentioned, there could, therefore, be deducted for the complementary financing of the third framework programme, all expenditure corresponding to activities provisionally remaining 'outside the framework programme'. Within such a scheme, different practical solutions can be negotiated.

162. For the complementary financing of the third framework programme, recourse must, however, be had to a procedure never used until now. In the old, as well as the new, version, the Treaty foresees 'the framework programme may be adapted or supplemented as the situation changes' (Article 130i(2)).

To be practically applicable, an operation of this type must not imply modifications of the specific programmes, but must be limited to an increase of the total financial allocation, accompanied by a redistribution of the complementary resources between the specific programmes.

To be politically practical, such an operation must be effected in the framework of close interinstitutional concertation. In this context, the possibility to increase the resources of different specific programmes in a modular, rather than a linear, manner could also be discussed.

163. To facilitate the holding of such a concertation, the Commission prefers, at this stage, not to

advance any figure and does not wish to proceed to a technical analysis of the possible evolution of the expenditure. The preceding pages contain all the basic elements for an exercise which, for its continuation, requires the independent evaluations of the other institutions.

164. The Commission is convinced that there is sufficient matter here for a broad and deep interinstitutional concertation. Recourse to this procedure is justified by the provisions and the spirit of the Treaty adopted at Maastricht, and the interest and necessity to reach an agreement in advance, each time the need arises whilst fully respecting the prerogatives of each institution. Amongst the issues capable of being the subject of this concertation, can be mentioned, by way of indication, the following:

- (i) fixing a calendar for the legislative procedure for the adoption of the fourth framework programme, including for its commencement, fixing the most appropriate date for the submission of the proposal of the Commission; an informal examination could usefully be held before the formal start of the procedure on 1 January 1993;
- (ii) the problem of the link of the procedure for the adoption of the framework programme in co-decision, with the procedure of cooperation foreseen in the new Article 130i (rules for participation in the R&TD programmes and for the dissemination of results);
- (iii) the principles, modalities and problems of the distribution of complementary financing of the third framework programme;
- (iv) against the uncertainty of the decisions which will be taken in respect of the financial perspectives and the content of the next interinstitutional agreement, the problem of fixing the budget for the activities provisionally undertaken outside the framework programme;
- (v) content and modalities for presenting the report that the Commission must, in accordance with the new Article 130p, present to the Council and European Parliament, at the start of each year, from January 1993.

165. On all these issues, and some others, a triangular discussion would promise to be most useful. It should be able to reach conclusions between now and the end of the first half of 1992, a pivotal year for the research and technological development policy. The Commission is waiting to be able to submit the totality of its proposals in the light of the elements which, it is hoped, will emerge from this discussion.

Table 1 — *Specialization indices with regard to recent research topics (average for 1988-89)*

Subject	EEC	United States	Japan
All subjects	0.94	1.11	1.04
Average for eight subjects	1.01	1.06	1.12
Clinical medicine	0.98	1.06	0.98
Biomedical research	0.97	1.13	0.86
Animal and plant biology	1.16	1.0	1.23
Chemistry	1.01	1.11	1.15
Physics	0.84	1.06	1.39
Geosciences — space	1.00	1.08	0.95
Engineering sciences	1.12	1.01	1.28
Mathematics	1.03	1.04	1.14

Source: Observatoire des sciences et des techniques (OST) (1991).

Table 2 — *From academic research to scientific impact*

1988	Spending on academic research			Share of scientific output		Relative yield from spending on academic research (6)=(5)/(3)	Comparative scientific impact (7)
	Share of GDP (%) (1)	Million USD (2)	Share of total for the triad (%) (3)	World (4)	Triad (5)		
EEC	0.38	10 525	39.9	27.1	38.2	0.96	1.0
USA	0.29	13 032	49.4	36.2	51.2	1.04	1.4
Japan	0.18	2 836	10.7	7.7	10.8	1.01	0.8
Triad — Total	0.30	26 393	100.0	71.7	100.0	1.00	
OECD				100.0			1.0
World							

Source: OST *Science et technologie. Indicateurs 1991-92*, September 1991. Columns (1) to (3): Table 4.14, p. 138; columns (4) and (5): Table 4.5, p. 134; column (7): Table 4.7, p. 135.

Table 3 — *From research and development to invention and innovation*

1988	Spending on research and development			Researchers and engineers			Share of patents applied for				Relative efficiency	
	Share of GDP	Million USD	Share of total for the triad	Proportion of population	1 000	Share of total for the triad	In the United States (%)		In Europe (%)		Of researchers and engineers	Of R&D
	(%) (1)	(%) (2)	(%) (3)	(%) (4)	(5)	(%) (6)	(7)	(8)	(9)	(10)	(11)=(8)/(6)	(12)=(8)/(3)
EEC	2.0	78 968	29.6	1.7	546	27.5	19.2	24.1	45.7	50.0	0.88	0.82
USA	2.9	137 816	51.6	3.7	823	46.6	39.7	50.0	26.0	28.4	1.07	0.97
Japan	2.9	60 987	19.0	4.2	513	26.9	20.6	26.9	19.7	21.6	1.00	1.36
Total for the triad												
OECD		267 761	100.0	2.9	1 982	100.0	79.5	1.00	91.4	100.0	1	1
World		206 575			2 182		100.0		100.0			
		285 116										

Source: OST *Science et technologie. Indicateurs 1991-92*, September 1991. Columns (1) to (3) and (5): Table 4.1, p. 132; column (4): taken from *European Economy* No 42, p. 235; column (7): Table 4.8, p. 135; column (9): Table 4.9, p. 136.

Table 4 — *Emerging technologies*

Europe	<i>Vis-à-vis</i> the USA	<i>Vis-à-vis</i> Japan
Ahead	Digital imaging technology Flexible computer-integrated manufacturing	Flexible computer-integrated manufacturing Software engineering technology
Level	Advanced semiconductors High-density data storage Sensor technology Superconductors Advanced materials Software engineering technology	Artificial intelligence Digital imaging technology Sensor technology Superconductors Biotechnology Medical equipment
Behind	Artificial intelligence High-performance computers Optoelectronics Biotechnology Medical equipment	Advanced semiconductors High-performance computers High-density data storage Optoelectronics Advanced materials

Source: US Department of Commerce.

Table 5 — *Development and production of materials*

Areas	Position <i>vis-à-vis</i> competitors	Industrial prospects
<i>Advanced structural materials</i>		
Advanced metallic alloys	+	=
High-performance polymers	-	+
Metallic-matrix composites	=	=
Polymer-matrix composites	-	+
Engineering ceramics	-	+
Ceramic-matrix composites	-	+
<i>Advanced functional materials</i>		
Display materials	-	+
Electronic ceramics	-	+
Magnetic materials	+	=
Optical materials	-	+
Superconductors	-	+
<i>Advanced treatment of materials</i>		
Manufacturing with final surface treatment	-/=	+
Process design	-/=	+
Process control	-/=	+
<i>Pharmaceuticals and biotechnology</i>		
Chemistry-based products	=	-
Biotechnology-based products		
Vaccines	=	+
Antibiotics	=	+
Therapeutic proteins	-	+
Cell therapy	-	+
Gene therapy	-	+
Molecular biology of cultivated plants	+/=	+

Note: Position *vis-à-vis* competitors:

+ Technology more advanced in Europe than elsewhere. Europe's presence on the market ensured thanks to products using this more advanced technology. Does not necessarily imply a large share of the market.

= Level.

- Opposite of '+'.
Industrial prospects:

+ Industrial applications and penetration of these technologies in the ascendancy compared with competing technologies.

= Stable technology with well-established industrial applications.

- Opposite of '+'.
Source: Commission.

Table 6 — *Manufacturing, information and communications technologies*

Areas	Position <i>vis-à-vis</i> competitors	Industrial prospects
Semiconductors		
Standard IC products	—	+
Application-specific ICs	+ / =	+
Microprocessors		
CISC	—	=
RISC	—	+
Computer-aided design (CAD)	—	=
Personal computers	—	=
Workstations	—	+
Minicomputers and mainframes	—	—
High-performance computers	—	+
High-speed networks	—	+
Mass storage — magnetic	—	=
Mass storage — optical	=	+
Liquid-crystal displays	—	+
Cathode-ray tubes	+ / =	—
Printers	—	=
Operating systems	—	=
Packages	—	+
Software and systems engineering	+	+
Application systems	+ / =	+
Computer-integrated manufacturing (CIM)		
Robotics	+ / =	+
Flexible computer-integrated manufacturing	+	+
Computer-aided engineering	—	+
Man/machine interfaces	= / —	=
Virtual presence	—	+
Communications		
High-speed data transmission	+	+
Mobile communications	—	+
Services engineering	—	+
Micromachines/microsystems	+ / =	+
Superconductivity	+ / =	=
Neural systems	= / —	=
Telematic systems		
Interoperability	—	+
Telematic technologies	=	+

NB: Symbols used: see Table 5.
Source: Commission.

Table 7 — *Financial perspective**(million ECU, 1992 prices)*

	1992	1993	1994	1995	1996	1997
<i>Commitment appropriations</i>						
1. Common agricultural policy	35 348	35 340	37 480	38 150	38 840	39 600
2. Structural operations	18 559	21 270	22 740	24 930	27 120	29 300
Structural Funds	17 965	19 770	20 990	22 930	24 870	26 800
Cohesion Fund		1 500	1 750	2 000	2 250	2 500
(IMPs/Pedip)	594					
3. Internal policies ¹	3 991	4 500	5 035	5 610	6 230	6 900
4. External action	3 645	4 070	4 540	5 060	5 650	6 300
5. Administrative expenditure	4 049	3 310	3 465	3 720	3 850	4 000
Staff and administration						
Commission	1 696	1 760	1 825	1 890	1 960	2 035
Other institutions ²	895	930	960	1 000	1 040	1 070
Pensions (all institutions)	249	290	325	380	400	445
Buildings	287	330	355	450	450	450
(repayments)	922					
6. Reserves	1 000	1 500	1 600	1 200	1 300	1 400
Monetary reserve	1 000	1 000	1 000	500	500	500
Exceptional expenditure		500	600	700	800	900
Total	66 592	69 990	74 860	78 670	82 990	87 500
<i>Payment appropriations required</i>	63 241	67 005	71 650	75 110	79 060	83 200
<i>Payment appropriations (% GNP)</i>	1.15	1.19	1.24	1.27	1.30	1.34
<i>Margin for revision (% GNP)</i>	0.05	0.03	0.03	0.03	0.03	0.03
<i>Own resources (% GNP)</i>	1.20	1.22	1.27	1.30	1.33	1.37
¹ Indicative amounts for R&TD policy:	2 448	2 730	3 040	3 380	3 770	4 200
² Subject to confirmation by the institutions concerned.						

Implementation of the third framework programme of Community R&TD activities (1990-94) State of advance of specific programmes as at 31 March 1992

Introduction

1. The third framework programme of Community R&TD activities was adopted on 23 April 1990 for the 1990-94 period.¹ The Council Decision provides for a review of the state of realization of the framework programme during the third year of its execution, i.e. in 1992.

2. The third framework programme is implemented through 15 specific programmes organized around six main action lines. As well as the 15 decisions covering these, decisions are foreseen for a centralized action of dissemination and valorization on the one hand, and for the activities of the Joint Research Centre on the other.

The decisions on the specific programmes

3. Despite the speed with which the Commission presented its proposals, the decision-making procedure for the 15 new specific programmes was the object of some delay because of interinstitutional difficulties, but it should be completed in the first half of 1992 (see Table 1).

4. Up to now, 14 specific programmes have already been decided. A first group of programmes was adopted before summer 1991 (information technologies, communications technologies, telematic systems of general interest, marine sciences and technologies, life sciences and technologies for developing countries) and a second group in the second half of 1992 (industrial and materials technologies, agricultural and agro-industrial research, biomedical and health research, non-nuclear energies, nuclear fission safety, controlled thermonuclear fusion).

Two programmes were adopted in March 1992: human capital and mobility as well as biotechnology. In February 1992 a common position was reached on the centralized action for the dissemination and valorization of the results of Community R&TD, while the 1992-94 programme of JRC activities has so

far been the object of a common position for the EEC activities and a common orientation for the Euratom part. They should be adopted together with the measurement and testing programme in April 1992.

State of progress of the specific programmes

5. Given the staggering over time of the decisions, the 15 specific programmes are not at the same stage in terms of execution procedures (see Tables 2 and 3).

6. For the six programmes adopted before summer 1992, the situation is as follows.

The programmes on information technologies, communications technologies and telematic systems of general interest have, after the acceptance of the workplans by their respective Management Committees, launched three main calls during summer 1991 covering the whole of the priority areas, and the bulk of the execution procedures were completed in March 1992.

The programmes on the environment, marine sciences and technologies, and life sciences and technologies for developing countries also launched their calls for tenders in 1991 but either the deadline has not yet arrived (environment) or the final selection of proposals is not complete (marine sciences and technologies, life sciences and technologies for developing countries).

7. For the six specific programmes adopted in the second half of 1992, the implementation procedures (calls for proposals, selection, negotiation and signature of contracts) are not complete. The deadline for the call for proposals for the programme on agricultural and agro-industrial research was 31 January 1992 and negotiation procedures are under way for the contracts.

¹ Council Decision 90/221/Euratom, EEC.

For the non-nuclear energy and the nuclear fission safety programmes, the calls for proposals are fully complete (non-nuclear energy: 14 February 1992) or in part (nuclear fission safety: deadlines 14 February 1992 and 10 July 1992).

The deadline for the call for proposals on industrial and materials technologies has been set for 3 April 1992 while, for the biomedical and health research programme, the call for expressions of interest ended on 31 January 1992.

8. Finally, still remaining to be launched and completed are the implementation procedures for the two

programmes which have just been adopted (human capital and mobility, biotechnology) and for the programme on measurement and testing which is still to be adopted.

9. If this timetable is respected and if the implementation procedures develop within the deadlines foreseen, around 44% of the amounts deemed necessary for the third framework programme will have been committed by the end of this year (see Table 4).

Table 1 — Specific programmes under the third framework programme 1990-94 (ECU 5 700 million)
(at 30 March 1992)

		1990	1991	1992	1993	1994	Reference document
<i>I — Enabling technologies</i>							
1. Information and communications technologies							
Information technologies	SCA-CONC				338.48		L 218-91
Communications technologies	SCA-CONC				484.11		L 192-91
Development of telematic systems of general interest	SCA-CONC				376.20		L 192-91
2. Industrial and materials technologies							
Industrial and materials technologies	SCA-CONC				663.30		L 269-91
	JRC			xxxxxxx	77.22	xxxxxxx ¹	
Measurement and testing	SCA-CONC			xxxxxxx	47.52	xxxxxxx ¹	
	JRC			xxxxxxx	91.08	xxxxxxx ¹	
<i>II — Management of natural resources</i>							
3. Environment							
Environment	SCA-CONC				261.40		L 192-91
	JRC			xxxxxxx	148.50	xxxxxxx ¹	
Marine sciences and technologies	SCA-CONC				102.96		L 192-91
4. Life sciences and technologies							
Biotechnology	SCA-CONC				162.36		
Agricultural and agro-industrial research	SCA-CONC				329.67		L 265-91
Biomedical and health research	SCA-CONC				131.67		L 267-91
Life sciences and technologies for developing countries	SCA-CONC				109.89		L 196-91
5. Energy							
Non-nuclear energies	SCA-CONC				155.43		L 257-91
Nuclear fission safety	SCA-CONC				35.64		L 336-91
	JRC			xxxxxxx	161.37	xxxxxxx ¹	
Controlled nuclear fusion	SCA				411.84		L 375-91
	JRC			xxxxxxx	41.58	xxxxxxx ¹	
<i>III — Optimization of intellectual resources</i>							
6. Human capital and mobility							
Human capital and mobility	JRC				488.07		
				xxxxxxx	24.75	xxxxxxx ¹	
Dissemination and exploitation of results				xxxxxxxxxxxxx	57	xxxxxxx ¹	
<p><i>NB.:</i> The figures given in the columns above indicate the amount allocated to the activity in million ECU. CONC: concerted action (including COST). SCA: shared cost action. JRC: Joint Research Centre action.</p>							
						¹	Council common position/orientation.
						—	Programme adopted by the Council.
						xxxx	Programme proposed by the Commission.

Table 2

Name of specific programme	Commission proposal	Council Decision	Call for proposals		End of evaluation
			Call	Close	
Information technologies	23. 5. 1990	8. 7. 1991	27. 7. 1991	5. 10. 1991	February 1992
Communications technologies	23. 5. 1990	7. 6. 1991	12. 6. 1991	16. 9. 1991	March 1992
Telematic systems	23. 5. 1990	7. 6. 1991	15. 6. 1991	16. 9. 1991	February 1992
Industrial and materials technologies	28. 5. 1990	9. 9. 1991	24. 12. 1991	6. 3. 1992 3. 4. 1992	3. 4. 1992
Measurement and testing	28. 5. 1990		1. 7. 1992 ²		
Environment	28. 5. 1990	7. 6. 1991	16. 7. 1991	31. 10. 1991 30. 11. 1991 31. 1. 1992 31. 3. 1992	completed completed completed 1
Marine sciences and technologies	28. 5. 1990	7. 6. 1991	28. 6. 1991	15. 11. 1991 14. 2. 1992	10. 4. 1992 ²
Biotechnology	28. 5. 1990	26. 3. 1992	1. 7. 1992 ²		
Agricultural and agro-industrial research	28. 5. 1990	9. 9. 1991	10. 10. 1991	31. 1. 1992	29. 4. 1992 ²
Biomedical and health research	28. 5. 1990	9. 9. 1991	25. 10. 1991	31. 1. 1992	1
Life sciences and technologies for developing countries	28. 5. 1990	7. 6. 1991	18. 7. 1991	16. 9. 1991 16. 12. 1991	1
Non-nuclear energies	28. 5. 1990	9. 9. 1991	13. 9. 1991	14. 2. 1992	27. 3. 1992
Nuclear fission safety	14. 9. 1990	28. 11. 1991	13. 12. 1991	14. 2. 1992 10. 7. 1992	1
Thermonuclear fusion	25. 9. 1990	19. 12. 1991	special procedure.		
Human capital and mobility	28. 5. 1990	16. 3. 1991			
Dissemination and exploitation of knowledge	25. 1. 1991				
Joint Research Centre	22. 7. 1991		—	—	—

¹ In progress.² Estimate.

Table 3

	Number of proposals received	Total cost (million ECU)	EC contribution requested (million ECU)	Number of proposals selected	Funds available
Information technologies	1 259	7 921	4 255	317	875
Communications technologies	213 ¹	2 622 ²	1 454	95	443
Telematic systems	722	3 135 ²	1 742	162	316.5
Industrial and materials technologies					
Measurement and testing					
Environment	585*	718*	531*	49*	88
Marine sciences and technologies	221*	559*	338*	32*	89
Biotechnology					
Agricultural and agro-industrial research	762*	1 698*	1 008*		80*
Biomedical and health research	1 898*				42
Life sciences and technologies for developing countries	896*	600*	556.4*	62*	24*
Non-nuclear energies	678	983.7	552.8	126	155
Nuclear fission safety	634*	95*	80*		24
Thermonuclear fusion	Special procedure				
Human capital and mobility					

* Estimated at 30. 3. 1992.

¹ Excluding the working proposals on the security of information systems on the closing dates 16. 9. 1991 and 10. 2. 1992.

² Total 'eligible costs'.

Table 4 — *Schedule of commitment appropriations in the preliminary draft budget for 1993*

(1 000 ECU)

Heading	1991	1992	1993	1994	Total	Amounts deemed necessary
Information technologies		547 860	484 500	306 120	1 338 480	1 338 480
Communications technologies	142 669	143 802	107 625	90 010	484 106	484 110
Telematic systems	89 416	168 584	78 800	39 400	376 200	376 200
Industrial and materials technologies	2 571	299 898	204 988	155 430	662 887	663 300
Measurement and testing		15 526	21 594	10 400	47 520	47 520
Environment	33 344	114 627	72 836	40 550	261 357	261 360
Marine sciences and technologies	11 783	33 686	40 660	16 830	102 959	102 960
Biotechnology		51 851	76 849	33 660	162 360	162 360
Agricultural and agro-industrial research		141 531	100 899	87 240	329 670	329 670
Biomedical and health research	264	47 236	61 400	22 770	131 670	131 670
Life sciences and technologies for developing countries	16 307	46 871	26 938	19 770	109 886	109 890
Non-nuclear energies	48	137 242	10 413	7 727	155 430	155 430
Nuclear fission safety		24 740	7 900	3 000	35 640	35 640
Thermonuclear fusion		111 238	200 992	99 610	411 840	411 840
Human capital and mobility		114 679	261 521	111 870	488 070	488 070
Exploitation of knowledge		25 000	15 000	17 000	57 000	57 000
Total	296 402	2 024 371	1 772 915	1 061 387	5 155 075	5 155 500
Joint Research Centre		178 802	179 285	186 413	544 500	544 500
Total	296 402	2 203 173	1 952 200	1 247 800	5 699 575	5 700 000
Third framework programme						

Notes

- The figures in the 1991 column correspond to outturn as at the closing of accounts for the 1991 financial year.
- The figures in the 1992 column comprise:
 - amending budget No 1 for 1992;
 - carry-overs from 1991 to 1992.
- The 1993 column contains the commitments proposed in the preliminary draft budget for 1993.
- The total commitments for 1991 and 1992 amount to ECU 2 499 575. The Council Decision provided for ECU 2 500 million. Since the ECU 425 000 difference cannot be carried over, the total commitments for the third framework programme will be that much less than the ECU 5 700 million provided for in the amounts deemed necessary.

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After analysing the situation in Europe in the field of research and technological development, examining the possibilities opened up by the Maastricht Treaty and assessing what the Community has achieved so far, this communication indicates how the Community's strategy in this area should be developed in the years ahead by redirecting activities, and by focusing on technological priorities reflecting industry's needs.