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A FRAMEWORK FOR COMMUNITY RTD ACTIONS

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1. The basis for Community action in the field of R & D is Title VI of the Third Part of the EEC Treaty as introduced by the Single European Act, with its key instrument the multiannual Framework Programme (Article 130 I).

2. Article 4 of the 1987 Council Decision on the Framework Programme for 1987 - 1991 [1] provides for a mid-term review to allow for modifications in the light of changing circumstances and new requirements.

3. At its meeting on 14th March 1989, the Council of Research Ministers was in general agreement that a substantial revision to the current Framework Programme would now be timely. The Commission intends, therefore, to present proposals for such a revision.

4. These proposals should reflect a consensus on the guiding principles and key orientations for future action. The aim of the present document is to provide a basis for discussion of these issues.

5. The paper takes into account both the discussion at the 14th March (Research) Council meeting as well as the results of the wide-ranging consultations launched at the end of 1988 on the Commission's First Report on the State of Science and Technology in Europe (COM/88/647 final) [2]. The Commission's reflections have also been aided and enriched by the work of the Energy, Research and Technology Committee of the European Parliament and in particular by the report of its President, Michel Poniatowski, on the competitive challenge facing Europe [3].

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[1] OJ L 302/4, 24.10.87

[2] The Commission will be issuing separately a working document comprising the comments on the First Report.

[3] "Europe's Response to the Modern Technological Challenge", Third Report, Feb. 1989 - PE 127.487.B.

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THE CHALLENGES OF 1992

6. Research and development is an investment bridging the present and the future. In the debate on general policy orientations for Community RTD the focus must be on the challenges of 1992 and beyond in a changing international and scientific environment.

Increasing competitive pressures

7. The Community represents the largest potential market in the industrialised world in terms of population (323 million inhabitants in 1987 compared with 244 in the USA and 122 in Japan). Its total GDP (4,200 billion ECU in 1988) is close to that of the USA (4,300) and well above that of Japan (2,600). The same holds true for industrial production, where the Community is second only in size to that of the USA. The Community's share in world trade is around 1.2 times that of the USA and twice that of Japan.

8. The completion of the Single Market will make it possible to exploit the benefits from integration of this vast but hitherto fragmented market. The availability of the large home market and the integration of financial and savings markets will be a spur to competition. The Cecchini report has demonstrated that 1992 will make it easier to realise economies of scale and to mobilize within industry the "critical mass" in R & D. Moreover, competitive pressures will force the pace of innovation. Investment in R & D by industry should be spurred on by the supply side shock to the European economy.

9. At the same time, however, there will be growing competition from our major trading partners - the USA and Japan - and from the faster-growing NICS. The paradox is that some of our own industries, still hide-bound by national perspectives, may be less prepared for 1992 than our partners, who are already contemplating the opportunities offered by the creation of a large European market.

10. Competition in the coming years will be particularly strong in the high-technology industries, on which the future prosperity of Europe depends. The Cecchini report highlighted continuing weaknesses in Europe's trade performance in many of these industries.

11. The viability of Europe's information technology and communications industries will be increasingly important in the 1990s with the opening of new markets through the introduction of a wide range of new products and services, including HDTV and Integrated Broadband Networks. Competition from Japan and the USA will be very strong on these fronts. According to the recent assessment by MITI, 21% of Japanese GDP in 2000 will be derived from information and communications technologies. Japan currently dominates the world market for domestic electronics with 60% of production, a field where Europe has a persistent trade deficit of about 8 billion ECU per year; while the USA maintains its long-standing strength in data-processing.

12. Traditional manufacturing industry too will face continuing challenges. Some sectors (textiles, automobiles) have invested heavily in new technologies. Others (eg. machine tools) have had a more patchy performance. Even the most successful face the prospect of increasing international competition. A strong European manufacturing industry depends heavily on wider diffusion and application of new technologies and on advances in technologies of broad application, including materials and biotechnology.

    Major efforts will be needed also to harness new technologies to improve productivity and prospects in the agro-industrial industries, as well as in agriculture itself, which will continue to play a key role in world trade.

13. The service sector will continue to increase in importance as a source of wealth and employment. The growth in service sector activities is increasingly dependent on the results of specific R & D. Europe faces a particular challenge in the software field.

14. Both the Japanese and the Americans are investing more of their resources in R & D than Europe (around 2.8% of GDP in both Japan and the USA in 1986 compared with only 2% in the Community), and the Community effort is strongly concentrated since just four countries together account for 88 % of Community R & D. Both our main trading partners are making major efforts to improve their competitive positions through science and technology.

15. The Japanese are seeking to develop a wide-ranging mastery of the life sciences and an expertise in basic research as a means of opening up new technological options for themselves in the longer-term and enabling them to stay one step ahead.

16. In the USA, at the same time, major efforts are being made to reverse the erosion of industrial competitiveness by the Japanese. The Bush Administration's proposals for the 1990 Federal Budget give particular

emphasis to support for R & D as a means of advancing competitiveness and encouraging economic growth. Federal funding of R & D will be up by 7% next year and basic research commitments by 6%. This is alongside continuing efforts to improve the industrial spin-off from military programmes; encouragement of cooperation between the Federal government, universities and industry; and the establishment of industrial consortia (including SEMATECH in the field of semi-conductors) to pool industrial R & D resources.

17. The fact that both Japan and the USA are single national States can make more rapid and flexible decision-making possible on questions relating to R & D than in the Community framework, where many decision-making processes are often more complicated.

18. While our major trading partners are adjusting themselves to a changing international environment, competition from other countries is also on the increase. Korea, in particular, which already has a major foothold in consumer electronics, is planning a substantial growth in R & D spending and qualified R & D personnel. Other major players will have an increasingly significant impact over the coming years. China is making particular efforts to improve its S/T capability. The Soviet Union could become a much more important international actor.

Improving the Quality of Life

19. Alongside the pressures of competitiveness will come increasing demands for improvements in the quality of life of Europe's citizens, through a cleaner and safer environment, better health-care, education and training, more efficient and safer production and transport systems, more wholesome food products.

The objectives of improved competitiveness and better quality of life are increasingly interlinked, in three main ways.

Firstly, by improving competitiveness the Community will create the wealth which makes it possible to provide the health care, access to better systems of education and training, and an improved environment, which Europe's citizens are seeking.

Secondly, however, achieving competitiveness in the modern world itself demands increasingly well-educated citizens (to use and to benefit from the new technologies); more efficient health-care systems (to ensure that the costs of better health provision can be mastered and do not place unacceptable constraints on economic performance); and cleaner and safer technologies and the products derived from them (which will be increasingly required to penetrate and capture new markets).

Thirdly, new technologies themselves offer an essential means of meeting the twin objectives of competitiveness and improved quality of life. They provide ways of reducing or avoiding environmental damage and injury: increasingly, prevention is seen to be economically cheaper than cure. They open up new possibilities to improve the quality of life (to add life to years) as well as to extend the span of life. They can improve education and training systems and, in particular, distance training, through new and cheaper means of communication.

A Changing Scientific Environment

20. Community R & D policy also has to face up to major changes in S & T itself.

21. The new **pervasive technologies** (information and communication technologies above all, but increasingly biotechnology and materials technologies) are seeping deeply and broadly into the economic and social fabric of all industrial countries, both improving productivity and creating new products, processes and services. Some observers go so far as to speak, as a result, of new economic and social paradigm.

22. The speed and cost of advances in these technologies are high and rising. This is particularly true in the case of information technology. The time-scale between two generations of semi-conductor devices (from 4 megabyte memories to 16 megabyte memories) has fallen from 4 to 3 years, while the associated investment in R & D has doubled in cost.

23. At the same time, scientific and technological advance depend much more than hitherto on the **coordination and integration of skills and expertise.** Medical research, for example, increasingly requires access to large-scale data-storage and processing facilities and sophisticated instrumentation to support biochemical, physiological and pathological expertise. In environmental research chemists, physicists and biologists must work together and in conjunction with experts in mathematical modelling and in remote sensing and space technologies. An integrated or "systems" approach to the development and use of technologies is similarly necessary in the field of industrial R & D: in the aerospace industry, for example, electronics, materials, optical technologies and hydrodynamics have to be engineered together into new design and operating systems.

24. Not only are the barriers between traditional scientific and technological disciplines being broken down. In many areas the relationship between science and technology itself is also altering. Less and less can

technologies develop without advances in the associated scientific disciplines, while scientific research itself calls increasingly on the fruits of technology. In many fields there is a growing interaction and proximity between more basic and applied R & D. In the field of high-temperature superconductors, for example, basic research is being undertaken with a view to future applications right from the beginning. In some areas of biotechnology substantial progress in applications will not be possible without breakthroughs in understanding basic biology.

25. A further issue that will have far-reaching implications for S/T policy in the 1990s is the growing need for closer contact and interaction between the "consumers" of technologies and the "producers" of technologies (the scientific and industrial communities). Accelerating scientific and technological changes provide new opportunities to enhance the quality of life and to widen personal freedoms, creating new and better ways of serving consumers and solving societal problems. But S & T can also create new sources of concern - from a growing awareness of environmental impacts, to worries about the privacy of personal information, ethical concern about the possibilities opened up by biotechnology and concern about the impact of new technologies on employment and safety.

If the benefits of S & T advance are to be fully realised it will become more and more necessary to ensure that producers are able to respond rapidly and effectively to consumer requirements and concerns, while consumers are better informed of the potential implications of new developments.

26. The increasing complexity and accelerating rate of change in S & T has major implications for financial resources which have to be depreciated over ever shorter periods of time and directed at an ever-growing number of problems. Chemistry provides a vivid example. New compounds are doubling in number every 6 -7 years compared with a doubling every 40 years in the 1940s. Progress depends on increasingly sophisticated and costly instruments and analytical aids (lasers, spectroscopic instruments, the electron microscope, synchrotron light etc., as well as information technologies).

27. The new trends also generate growing requirements for investments in human capital. Increasing numbers of skilled personnel must be available to carry out research; to manage it, and to exploit its results. This means a growing need for continuously trained research scientists and engineers; better integration of research into company management; and the development of a skilled and adaptable work-force. International competition for human resources is likely to grow. In the USA a potential shortfall of 500,000 scientists and engineers in 2010 has been predicted as a result of demographic trends and the pattern of university enrolment. There is already a significant shortage in the Community in some fields: the number of scientists and engineers (around 500,000) is well below that of the USA (825,000), and little above that of Japan (400,000) (where the numbers are increasing rapidly).

FROM ANALYSIS TO ACTION

28. These new trends have been discussed at length in the consultations on the First Report on the State of Science and Technology in Europe. S & T policies, both at Community level and within the Member States, must all take them into account.

29. We examine below (paras 45-64) the main orientations for action at Community level in this new context. But we consider briefly first the more general principles that should guide such action in the 1990s.

THREE GUIDING PRINCIPLES

The Institutional Basis: the Single European Act

30. A new common policy has been founded with the Single European Act. Community R & D policy, which was previously without a specific institutional base, is now on the same level as other Community policies and can be pursued in a more systematic and stable manner.

31. The Single European Act sets complementary objectives, giving emphasis to improving both industrial competitiveness and the underlying scientific and technological base. Article 130 F of the EEC Treaty states that the aim of the Community shall be to strengthen the scientific and technological basis of European industry and to encourage it to become more competitive at the international level.

32. The SEA outlines the precise mechanisms which enable this mandate to be pursued: the multiannual Framework Programme and the specific programmes as the centre-piece of Community-level action and, alongside this, supplementary programmes involving the participation of some Member States (Article 130 L); participation in R & D programmes undertaken by several Member States (Article 130 M); the coordination of national R & D policies by the Member States, in liaison with the Commission (Article 130 H); and cooperation with third countries or international organisations (Article 130 N). Article 130 O provides for the establishment of joint undertakings or other structures necessary for the efficient execution of Community programmes.

33. Article 130F, third paragraph, of the Single European Act underlines the importance of the links between the common effort in research and technological development, on the one hand, and the establishment of the internal market and the implementation of common policies, particularly as regards competition and trade, on the other.

A Method of Action: Subsidiarity

34. The question of when and why action at Community level is to be preferred to national actions and vice-versa must be addressed. In other words, how to apply the principle of "subsidiarity".

The approach is straightforward. What can be done better by the private sector should not be done by national or regional authorities; what can be done better at the national level should not be done at Community level, provided of course that Community law, including the provisions relating to competition policy, is fully respected. But the Community should take action when the objectives can be attained more effectively at Community level than at the level of the individual Member States.

35. The strengthening of the European R & D effort in the 1990s does not at all imply a greater centralisation of planning and support. Individual regional and national actions will fully retain their importance; and a number of different mechanisms for coordination and support will continue to evolve. The diversity of national expertise and specialisation in Europe is one of the Community's assets. But not only are there national benefits from giving a European dimension to nationally planned and managed R & D efforts. In many cases it will be much more cost-efficient to pursue a specific R & D objective in the Community framework, rather than to develop separate and competing sub-critical national efforts. There are also areas where R & D is needed specifically in support of other Community policies (for example, standards and environment in particular). In these areas Community level R & D will be a more natural and appropriate frame of reference than either national or bilateral efforts.

36. A broad consensus on criteria for Community action would enable the principle of subsidiarity to be put into practice effectively on a case-by-case basis.

37. Criteria in deciding on Community level action include: the strategic importance for the European economy and society of the areas chosen; the risk that national or bilateral efforts will be sub-critical in size and impact, notably in small countries and in less developed regions; the links to other Community policies (1992, competition, environment, etc.); the prospect that a large number of Member States will benefit from the results and spin-off of the actions; the likely catalytic impact on other actions (both public and private) throughout the Community; and their

contribution to strengthening the European scientific community.

Community level actions provide a basis for building bridges between different concepts and experiences in R & D, enriching the results for all parties concerned. They enable a European perspective to be adopted, thus reducing the potential conflict between vested interests. Some Community level actions (eg. environment) also offer the natural basis for an effective contribution to wider international efforts.

A Political Commitment: Cohesion

38. It is in the common interest of all Member States that the disparities between the various regions of the Community and the backwardness of the less-favoured regions (LFRs) should be progressively reduced (Article 130A introduced by the Single European Act into the EEC Treaty). The continuation of such disparities would reduce the opportunities offered by the single European market.

39. The technology gap between the less-favoured regions and the economically more advanced areas is greater even than the economic gap. Without substantial improvements in the science and technology fabric in the LFRs it will be impossible to reduce the disparities in economic performance and prospects.

40. The principle applying to Community actions in the science and technology field, notably in the choice of specific projects, is and must remain that of excellence. Excellence, however, cannot be achieved unless LFRs have the opportunity to improve their science and technology infrastructures; to enjoy special efforts in education and training; and to benefit from collaboration with more developed areas.

41. The Community's structural funds have an important role to play in meeting infrastructural needs; in supporting innovative activities in industry; and in technical assistance and evaluation. A special effort by the structural funds is expected during the next five years in the training and employment of young research workers and technical personnel, especially in the less developed regions.

42. Success cannot depend on the structural funds alone. The Community's own actions in the field of RTD have a special contribution to make, especially in providing opportunities for collaboration.

43. The Community's own research programmes have already encouraged links between researchers in the less-favoured regions and their colleagues elsewhere, facilitating a "trickling down" of best practice and

experience. These links, like every action in the RTD field, by their nature have a structural impact on the regions concerned. Action to disseminate the results of Community R & D projects and programmes (and specifically the VALUE programme) also has spin-offs in promoting economic and social cohesion.

44. The contribution of Community RTD actions to the process of economic and social cohesion should be reinforced in the coming years by action on a number of fronts.

Firstly, by ensuring that **all** Member States can take part in each Community R & D programme, including those programmes that are industry-oriented.

Secondly, by strengthening Community actions in the field of technology transfer and transfer of knowledge.

Thirdly, the choice of subject for Community R & D itself must take due account of the need to balance the interests of all the Member States.

Fourthly, a particular attention must be paid to training and to ensuring that all European researchers have equal access to the major scientific installations in the Community. In the latter field the JRC has an important contribution to make.

GENERAL ORIENTATIONS

45. The new context described above requires a redefinition of the main principles of Community action in order to guide the revision of the Framework Programme. Member States are invited to examine and debate the following six general orientations.

To Take Full Account of the Whole Range of Precompetitive Activities

46. The process of technological advance involves a continuum of R & D action from basic scientific research to demonstration of the applications of new technologies, and includes interaction and iteration between the different parts of this process.

47. Community RTD actions possess a pre-competitive nature. They cannot avoid, however, taking into account the evolving nature of R & D. The scope of actions needs to be extended to cover also activities which now appear necessary for the development and exploitation of emerging technologies. In specific cases, properly justified by reference to the Community interest, it would be appropriate, without leaving the remit of

precompetitive actions, to put the accent on the demonstration of the technical and economical feasibility of emerging technologies through pilot applications.

At the same time, Community actions must reflect the increasing interaction between basic and applied research: a solid foundation in basic research is essential to successful application of technologies.

48. The level of financial support for R & D should reflect how close an R & D programme is to commercial exploitation. The principle of degressivity needs to be applied, with a lower level of support, whether from national or Community resources, being given to near-market R & D. Such a principle is already applied in the operation of the Community's competition policy.

Greater Selectivity in the Choice of Research Themes

49. It is beyond Europe's means to tackle all areas of R & D in depth. It would be ineffective to spread Europe's resources thinly over a wide area. It is, therefore, imperative that Europe is selective in the choice of areas for significant R & D collaboration and support in the 1990s. Major efforts need to be concentrated on a small number of key areas, while a lower level of effort is maintained across a comprehensive range of subjects to keep abreast of developments.

50. A number of new technologies can be identified as "enabling technologies". The most obvious examples are the information, telecommunications, audio-visual, materials and bio-engineering technologies. The application of these technologies can have a major impact on the viability and profitability of many activities. R & D in these technologies can have a substantial knock-on effect and, because applications are all-pervasive, they can be an instrument for strengthening the economic and social cohesion of Europe. Priority needs to be given to Community R & D in these areas of technology development and application.

51. The concentration of Community efforts on a smaller number of key areas includes also a more integrated "systems" approach to major technological challenges. The development of integrated programmes with multi-disciplinary contributions to a strategic goal can help to ensure that actions remain appropriately focused while allowing some flexibility to re-allocate resources in the light of changing circumstances. Artificial institutional barriers between disciplines, that currently present a serious handicap in European R & D, may then be more easily overcome.

Improved Integration of National Activities and European Programmes

52. Europe spends relatively less on R & D than its major trading partners. There is also a dispersion and duplication of efforts amongst different institutional mechanisms for collaboration.

53. The Single European Act, in article 130H, makes provision for Member States, in liaison with the Commission, to co-ordinate their policies and programmes carried out at national level. Such R & D co-ordination needs a more systematic joint consideration of the Community's strategic requirements by Member States. Such joint assessments need to be reflected more strongly in the definition of national R & D efforts and in the early identification of priority areas for multi-lateral and Community collaboration.

54. The Single Act, through articles 130L and 130M also opens the possibility of creating collaborative arrangements of varying geometries. These possibilities must be exploited to optimise the allocation of the total resources available for European RTD and, in particular, to increase the involvement of the Community in EUREKA projects which can further the Community RTD strategy. The dispensations of the Single Act should also be used to improve the interface between the Framework Programme and COST. Likewise, it is necessary to increase flexibility in the use of different mechanisms and harmonise the mechanisms themselves such that R & D support can pass from one mechanism to another as technologies move towards commercial exploitation.

A more Systematic Approach to Pre-normative Research

55. The Single European Act has given the Community firmer basis for development of new common policies. Some of these, such as environment policy, which is the subject of Article VII of the treaty, impose important legal and regulatory obligations on the Community. The Community is called on to establish standards, to define regulations, to introduce upper and lower limits. Public expectations are high in this area, above all in health-care, in risk control, in environmental protection, in the area of the security and confidentiality data in information and communication systems. Industry experiences a parallel need for predictability and confidence.

56. The reinforcement of the standardisation and regulatory power of the Community makes it necessary to establish, in an anticipatory way, firm scientific and technological bases for action. Pre-normative R & D, to establish a solid common basis, must be carried out at Community level with the industrial sectors involved.

57. The benefits engendered by Community actions in pre-normative research are of two types. The improvements in knowledge and know-how first allow industry to create new tools to respond to the challenges of today: cleaner cars, substitutes for CFCs, nuclear safety, genetically-modified organisms, etc. Secondly, the Community will have a solid foundation on which to establish standards and realistic legislation, essential for the unity of the European market, the future competitiveness of the economy and a response to the demands of Europe's citizens.

58. In the framework of the greater responsibilities given to the Community, it will become essential that it develops a real expertise that is neutral and independent of the economic actors directly involved. The JRCs must find, in this need, one of their principal justifications. The Joint Research Centres must become the instrument of Community research providing the direct link with common policies.

Supporting the Research Community

59. The quality of the European scientific community is high, but Europe has relatively fewer scientists and researchers than our major trading partners. It is also ageing and the rate of renewal is only about 1% per year. There are already skill shortages in key areas. Very significant improvements in the effectiveness of the European scientific research community could be gained from a strengthening of the European infrastructures and networks for training, co-operation and exchanges of information. This would also help to reduce the "brain-drain" affecting certain Member States.

60. The mobility of research staff is also poor. Two-thirds of research workers have never studied in other European countries. Actions to promote the mobility and retraining of researchers can be a stimulus to development, a mechanism for cross-fertilisation and a mechanism for strengthening the European scientific community. One can then evisage, within or connected to the Framework Programme, putting in place a specific action devoted to the mobility of young post-doctoral researchers.

61. The increasing cost of major new scientific and research installations, and the pace of technological change, makes it increasingly important to share the cost of such installations between Member States. The development of major scientific installations in Europe, with improved access to them for the European scientific community, will help to make Europe a more attractive place for scientists to work and could strengthen the sense of community amongst key research groups in Europe.

Increasing Management Efficiency

62. The reinforcement of Community RTD policy and the expansion of the means by which it is implemented should not bring unjustified growth in the level of Community Programme Management. New management methods must be put in place, based on a close association between the performers and the users of research, to lead programmes.

63. A certain decentralisation is thus envisaged. This will act by entrusting as much of the operational management as is possible to distributed structures consisting of the research participants (for example, GEIE). In parallel, the services of the Commission should provide the monitoring and real-time control of the progress of projects.

64. No one formula will always be appropriate: a range of mechanisms will need to be explored in the future, bearing in mind the Community's political, budgetary and institutional responsibilities.

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