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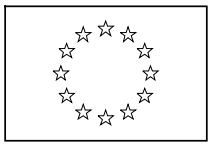

COMMISSION OF THE EUROPEAN COMMUNITIES

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**COMMUNICATION FROM THE COMMISSION
TO THE COUNCIL AND THE EUROPEAN PARLIAMENT**

Innovation in a knowledge-driven economy

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1. INTRODUCTION

The objective of this Communication is to set the broad policy lines for enhancing innovation in the Union.

The importance of innovation was highlighted by the March 2000 European Council in Lisbon. As a response to the challenges of globalisation and the new knowledge-driven economy, the European Council called for a challenging programme for building knowledge infrastructures, enhancing innovation and economic reform, and modernising social welfare and education systems. This is encapsulated in the strategic goal set at Lisbon for the next decade: the Union to become the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion.

Innovation must permeate our economy and be embraced by society for the Lisbon goal to be achieved. Innovation is essential for European enterprises to be competitive, and is therefore a major component of enterprise policy, as well as one of the main objectives of research policy.

The Lisbon European Council endorsed the objectives in the European Commission's Communication "Towards a European Research Area"[1] to enhance the efficiency and innovative impact of Europe's research effort, and called for concrete steps towards their implementation. Enterprise and research policies are mutually enriching, notably where technology-based innovation is concerned[2].

This present Communication reviews progress made in the Union to stimulate innovation by enterprises, explores what the new priorities should be, and defines broad policy lines for the next four years.

1.1. Innovation is a key factor in enterprise policy

The Conclusions of the Lisbon European Council draw attention to two requirements:

– extract the maximum innovative benefit from the national and Union-level research effort,

– create a friendly environment for starting up and developing innovative businesses.

These priorities reflect, firstly, technological innovation's importance as the generator of new products, services and processes, and the specific obstacles to this kind of innovation, and, secondly, the need for innovation (whether technology-based or not) to percolate from the "first movers" to invigorate the entire economic and social fabric.

Primarily it is up to European enterprises to pick up the challenge of innovation, to show their creativity, and use it to conquer new markets. The Commission has recently published a

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1 COM(2000) 6.

2 The European Commission's 1995 Green Paper on Innovation stated that "innovation is the renewal and enlargement of the range of products and services and the associated markets; the establishment of new methods of production, supply and distribution; the introduction of changes in management, work organization, and the working conditions and skills of the workforce" (Bulletin of the European Union, Supplement 5/95).

Communication[3] setting out the requirements if all enterprises, whatever their size, legal form, sector or location, are to have the potential to grow and develop so as to contribute to the overall goal.

To survive in the new competitive environment, no enterprise can afford to stand still. All have to be open to new ideas, new ways of working, new tools and equipment, and be able to absorb and benefit from them. A policy to enhance innovation must be present in a modern enterprise policy as one of its main components. This means buttressing enterprise policy by measures specifically directed at encouraging the emergence and growth of "first mover" firms, and the flow of innovation from them into the enterprise sector as a whole.

This process thus requires additional conditions that are specifically conducive to the creation and growth of highly innovative ventures (often based on advanced technologies), to the circulation of new ideas and technologies, and to an environment in which enterprises are able to absorb them and profit from them.

Ensuring the existence of these conditions is the aim of innovation policy, the subject of this Communication.

1.2 Need for the Communication

The European Commission drew attention to Europe's "innovation deficit" in the 1995 Green Paper on Innovation[4]. The subsequent First Action Plan for Innovation in Europe[5] (1996) indicated lines of action for implementation by the Member States and the Commission.

Since then, the trend towards globalisation and the knowledge-driven economy, exemplified by the rise of the Internet, has accelerated. As recognised by the Lisbon European Council, it is more critical than ever for European enterprises to have a mastery of innovation so as to succeed in an increasingly competitive environment.

Significant progress has been made since the 1996 Action Plan, and is summarised in Chapter 2 of this Communication. A rich variety of innovation-fostering policies and measures has been introduced by Member States at both national and regional levels. The Commission has acted by adjusting its programmes in line with the Action Plan's objectives, and by taking innovation into account in the Community-level rules for doing business, in particular the rules for competition, intellectual property rights, and the internal market.

In spite of these efforts, the overall innovation performance of the Union has not improved relative to our main competitors.

The Lisbon European Council called for the introduction of a European innovation scoreboard. This Communication presents the first outline of the scoreboard (see Annex), based on the statistics that are currently available. This is the first time an exercise of this type has been undertaken at Union level. From the outline, and other data[6], it appears that although the innovation performance of several Member States is already on a level with – or even better than – Europe's most successful competitors, most Member States must further increase their efforts.

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3 Challenges for enterprise policy in the knowledge-driven economy, COM(2000) 256 final.
4 COM(95) 688 final.
5 COM(96) 589 final.
6 See Commission staff working paper, SEC (2000) 1564

An "innovation divide", separating regions according to whether or not they are able to benefit from and thrive in the new economy, is an emerging danger. To combat this, there is considerable scope for raising innovation performance by learning from "good practices". Among enterprises, there are also clear gaps between those able to adapt and those finding it difficult to overcome resistance to change and structural obstacles to innovation.

There continues to be a lack of cohesion in the sense of wide differences in the performance of Member States and regions. The full benefit of the internal market will not be realised in this situation of persistent fragmentation of the European innovation system (exemplified by the relative weakness in technological alliances between European firms). It is therefore necessary to renew the message of the First Action Plan for Innovation in Europe: innovation in the Union is being held back, and Member State and Union-level efforts must be combined to remedy the situation if the Lisbon goal is to be achieved. This is the objective of this Communication.

1.3 Content of the Communication

Five priority objectives are proposed for public action in order to encourage an effective pan-European innovation system:

- **Coherence of innovation policies**
- **A regulatory framework conducive to innovation**
- **Encourage the creation and growth of innovative enterprises**
- **Improve key interfaces in the innovation system**
- **A society open to innovation**

Chapter 2 reviews trends in European innovation policy and Chapter 3 examines the present innovation performances in the Union. The five objectives are presented in Chapter 4, stating what should be done to progress towards the objectives and the target dates. Chapter 5 summarises the main lines of action.

2. TRENDS IN EUROPEAN INNOVATION POLICY

Many policies and measures to foster innovation have been introduced, at both Member State and European level, since the 1996 Innovation Action Plan. The Commission is collecting and analysing information on innovation policies in the Union through the "Trend chart on innovation in Europe" project launched in 1999. From this analysis, the first of its kind in the area of innovation policy, various trends can be discerned and are summarised in this chapter[7], together with developments at EU-level.

Progress is evidently being made, although in most cases it is too early to draw reliable conclusions.

2.1 Progress since the 1996 Innovation Action Plan

The Action Plan was firmly based on the "systemic" view, in which innovation is seen as arising from complex interactions between many individuals, organisations and environmental factors, rather than as a linear trajectory from new knowledge to new product. Support for this view has deepened in recent years.

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[7] More details are provided in SEC (2000) 1564

Innovation was reinforced as a fundamental objective in the Fifth RTD (Research and Technological Development) Framework Programme[8], adopted in 1998. Innovation cells have been established in all its thematic programmes to ensure exploitation and transfer of technologies. Evaluation criteria as well as the rules applying to exploitation and dissemination of the research results have been adapted with the same aim. Each research project includes a "Technology Implementation Plan" which allows the use made of the results to be followed up and their social and economic impact to be assessed.

The Fifth RTD Framework Programme includes a "horizontal" programme for "Promotion of innovation and encouragement of participation by SMEs", which undertakes a range of stimulation and policy-development measures, as well as specific measures benefiting SMEs.

The experience gained from the thematic and horizontal programmes as regards research and innovation will feed into debate on the Commission's proposals for progress towards a European Research Area, and into design of future EU actions in the field of research, including Framework Programmes.

The promotion of research and innovation capacities in an integrated manner has been incorporated as a priority in all fields of intervention of the Structural Funds.

The 1999 reorganisation of the Commission saw innovation policy allocated to the new Enterprise DG, together with responsibility for implementation of the "promotion of innovation" horizontal programme of the Fifth RTD Framework Programme. This positioning, together with the inclusion of innovation as an objective of research policy, makes a bridge between research, industry and entrepreneurship, while recognising that the most difficult obstacles encountered by innovators are usually of a non-technical nature.

Innovation policy plays a vital role in the Community's commitment to strengthen economic performance through structural policy and structural reform. The Broad Economic Policy Guidelines 2000 recommend the pursuit of policy measures to foster the development of a knowledge-driven economy in Europe, notably through the provision of adequate framework conditions, increasing the involvement of the private sector, promoting R&D partnerships and high-tech start-ups, and improving the functioning of risk capital markets.

A broad strategy is therefore required, with firm links to other Commission initiatives having a bearing on innovation, notably enterprise, R&D and regional policies as well as other initiatives in implementation of the Lisbon strategy. For example, the Business Environment Simplification Task Force (BEST – see section 2.4) led to the identification of good practice and has evolved into the "BEST Procedure", described in the Commission's recent Communication on enterprise policy. The European Charter for Small Enterprises, welcomed by the Feira European Council in June 2000, sets out the principles and lines of action in order to have the best possible environment for small business and entrepreneurship. On-going reviews of Community financial instruments and new regulatory initiatives also have a bearing on innovation, as do many elements of the Commission's recent *e*Learning initiative for education and training in a knowledge society and of the European Employment Strategy.

2.2 All Member States have innovation policies

Innovation policy has become a new horizontal policy linking traditional areas such as economic, industrial and research policies. All Member States have invested considerable

[8] Decision no. 182/1999/EC of 22.12.1998.

effort in developing new structures and tools for innovation policy. Three main aspects can be discerned:

– new administrative structures, based on the "system" nature of innovation,

– building awareness of the needs of innovation, and promoting a more intense dialogue between science, industry and the general public,

– developing a strategic vision, and innovation foresight.

The 1999 French Law on Innovation and Research, for example, comprises a bundle of integrated measures to encourage the transfer of technologies from public research into the economy, and the founding of innovative enterprises.

Many countries have created "innovation councils" or extended the role of their traditional "science councils" towards innovation. Countries with a successful innovation record consider the long-standing existence of such high-level coordination structures to be crucial, so as to overcome fruitless struggling and "territorial thinking" among ministries. Some countries have initiated major re-definitions of ministerial competencies or even created ministries whose innovation fostering objectives are clear from their title.

Innovation policy trends in Member States

For some time now, Member States have been pursuing initiatives for:

– Stimulating research carried out by companies,
– Improving innovation financing,
– Promoting technology absorption and innovation management by SMEs.

More recently, additional priorities have emerged:

– Intensifying the cooperation between research, universities and companies,
– Promoting "clustering" and other forms of cooperation among enterprises and other organisations involved in the innovation process,
– Encouraging the start-up of technology-based companies.

There is increasing interest in three further themes:

– Simplifying the administrative procedures faced by innovative enterprises,
– Use of taxation and other indirect methods to encourage innovation and research,
– Developing a strategic vision of innovation and research, and raising the awareness of the wider public.

Finally, several general trends may be discerned:

– System approach to innovation policy,
– Increasing the complementarity of national and regional policies,
– New forms of public/private partnerships,
– New roles for public policy as a facilitator of innovation,
– Tackling globalisation.

2.3 Reform of the patent system is progressing

The drawbacks of the current European patent system are well known. The Commission published a Green Paper on the Community patent[9] in 1997. The follow-up Communication[10] adopted in 1999 included a proposal for a regulation on the Community patent. This would guarantee greater legal certainty and coherence of the jurisprudence, and have significant benefits in terms of costs and simplification of the procedures. The Lisbon European Council asked for the Community patent to be available by the end of 2001, and the Commission adopted the proposal for a Regulation on the Community patent on 5 July 2000.

The importance of intellectual property issues is being brought to the attention of researchers and entrepreneurs. The Commission has established information and assistance services, especially targeted at participants in EU-funded research. Close cooperation between the Commission and the European Patent Office (EPO) led to launch of the esp@cenet information service on patents by the EPO.

2.4 The administrative and regulatory environment is still too complex

The complexity of administrative and regulatory procedures continues to be a serious obstacle to the creation of new businesses and to entrepreneurship. It also affects their capacity to innovate: over-regulation, for example in approval procedures for new products, raises development costs and increases time to market.

At the request of the Amsterdam European Council in June 1997, the Commission set up a group of independent experts (the BEST Task Force[11]) charged with drawing up concrete proposals in this area. On the basis of their recommendations, the Commission submitted to the Industry Council of November 1998 a series of proposals for simplifying administrative procedures coming under its own responsibility or that of Member States. Progress will be measured by regular reports.

2.5 Investment in innovation is being encouraged

The last three years have seen a marked improvement in the conditions for innovation financing through risk capital in the Union. Recent statistics[12] confirm a trend which bodes well: compared to 1998, total funds raised by the European private equity industry in 1999 increased by 25 % from € 20.3 billion to € 25.4 billion, with total investment up 74 % from € 14.5 billion to € 25.1 billion. Technology investments took € 6.8 billion of that (up 70 %), of which € 5.2 billion as venture capital[13]. Still, this good performance has to be contrasted with the fact that in 1999 the United States invested over three times the amount invested in technology venture capital in Europe, and that the corresponding growth rate over the previous year in the United States was 108 %.

Most Member States are increasingly promoting private innovation financing, mainly directed at the early stages of the innovation process. Several initiatives are implemented under the RTD Framework Programme. In particular, the I-TEC pilot project, in collaboration with the European Investment Fund (EIF), fosters venture capital investment in technology sectors and

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9 COM(97) 314 final.
10 COM(99) 42 final.
11 The Business Environment Simplification Task Force.
12 European Venture Capital Association, and "Money for Growth: The European Technology Investment Report 1999" (PricewaterhouseCoopers).
13 Seed, start-up/other early stage, and expansion stage investment.

in the start-up phases of innovative enterprises; a help-desk (LIFT) has been set up to assist in the search for finance for exploitation of the results of EU-funded research; and actions to promote interfacing between would-be entrepreneurs, SMEs and investors are implemented by EU research programmes[14]. The lessons learned from these actions are disseminated by networking investors, and by providing training and tools.

Following the Amsterdam European Council, which called for a programme of financial assistance for innovative SMEs, a series of measures was adopted in May 1998 by the Commission, and the European Investment Bank (EIB) launched its "Amsterdam Special Action Plan", as well as the "European Technology Facility", in co-operation with the EIF[15].

Strengthening these actions, in June 2000 the EIB launched its "Innovation 2000 Initiative", whilst reinforcing its links with the EIF. Cooperation links will ensure complementarity and synergy between the Framework Programme and the EIB initiative.

2.6 Promoting research that feeds into innovation

R&D by private businesses is an important indicator of national innovation capacity, and Member States apply various approaches to improve their performance. Countries where business R&D is weak tend to adopt general programmes and tax incentives, while countries with relatively strong business R&D often implement measures that apply to certain types of companies (such as start-ups, SMEs, or fast-growing or highly research-intensive firms), to specific sectors and "key technologies", or to specific objectives (such as increased employment of researchers). For example, employers in the Netherlands, who are responsible for deducting income tax and social security payments from their employees' gross salaries, may reduce the amount they pay to the authorities in the case of R&D staff, thereby alleviating the wage burden of R&D.

Cohesion countries invest considerable amounts towards overcoming their structural weaknesses in business R&D. Large multi-year umbrella programmes under the Structural Funds still play an important role, but the programme approach is increasingly complemented by fiscal measures to stimulate business investment in R&D. These are well established or being introduced in several Member States.

Because much of the EU research effort is performed in research institutes and the higher education sector, it is important to pursue and strengthen their interaction with industry. This should include promotion of technology transfer to industry and spin-offs from public research organisations, in order to enhance the innovation impact of their research.

2.7 Technology absorption by enterprises is enhanced

Enhancing technology transfer to SMEs and their capacity to absorb technology is a traditional pillar of innovation policy. A demand-led approach, the transfer of "tacit" innovation know-how, and physical proximity to the source of the technology are seen as critical factors for success. Methods used include science parks, regional technology centres, liaison offices in academic and research organisations, and demonstration projects. The

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[14] For example, the Biotechnology and Finance Forum, set up jointly by the "Life Sciences" thematic research programme and the European Association of Securities Dealers.

[15] See "Growth and Employment Initiative Measures on financial assistance for innovative and job creating Small-and Medium-Sized Enterprises (SMEs)", COM(2000) 266 final.

Swedish TUFF[16] scheme, for example, enables SMEs to band together to have the strength to become a customer of public R&D technology providers.

Policy-makers are increasingly rejecting the dichotomy between upstream "stimulation of R&D" and downstream "technology absorption". Under the "system" view, the underlying barriers to innovation arise from differences of a mainly cultural or managerial nature between the performers of research in the public sector and those who take up the results in the private sector. The increased emphasis on the private sector in its double role of technology user and "translator" of market needs into research problems has led to the emergence of a new policy goal of "improving the research/industry interface". In the Teaching Company Scheme in the United Kingdom, for example, highly qualified recent graduates work in a company for two years on a project central to the company's needs, under the joint supervision of academics and company staff. SMEs make up 90 % of the company participants.

2.8 Technology valleys are created

In several countries, mobility schemes are being reshaped and R&D subsidy schemes redesigned to intensify collaboration between the various actors: research centres, universities, groups of enterprises and individual companies.

Two trends can be distinguished: technology-specific "competence networks" that geographically are nation-wide, and region-based "technology valley" concepts, spurred by the success of Silicon Valley. Shifting from single company support to supporting groupings or "clusters" is a general trend in most Member States.

In Belgium, the Flemish government currently supports 11 clusters, defined as networks of cooperating enterprises which may also collaborate with research organisations. At the end of 1998, the government announced it would act as a catalyser for the creation of technology valleys, which would be clusters comprising knowledge-intensive, high-tech enterprises and including a leading research institute and at least one high-tech firm with a successful product on the international market. In comparison with other clusters, technology valleys are more oriented towards advanced technologies, and will often include more enterprises in the start-up or growth phase.

2.9 Technology-based start-ups are a growing priority

In 1997 the Commission initiated consultations on how to provide would-be entrepreneurs with the best possible environment for founding innovative businesses and benefiting fully from the European market. The process led to the First European Forum for Innovative Enterprises, which took place in Vienna in November 1998.

Based on the Forum's conclusions, in 1999 the Commission launched a pilot action with a budget of € 15 million to encourage mechanisms supporting the start-up and development of innovative enterprises. The major objective is to identify and network areas of excellence providing the best environments for the launch and growth of start-up and spin-off companies. The selected areas will form a "European innovation showcase", with a substantial impact and knock-on effect for all regions, encouraging them to implement similar initiatives adapted to their local environment.

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[16] TUFF: Teknikutbyte För Företag.

3. INNOVATION PERFORMANCES IN THE UNION

This Communication contains the first outline of a European innovation scoreboard (Annex). Together with additional statistical information[17], this provides the elements for an assessment of the innovation performance of the Union and its Member States.

The overall result is not optimistic. Most Member States must increase efforts at all levels to get rid of obstacles and rigidities and change attitudes which prevent full advantage being taken of the opportunities and challenges of the knowledge-driven economy.

3.1 Insufficient capacity to launch new products and services

Progress towards completion of the internal market, and the sound monetary and fiscal policies required by economic and monetary union and the launch of the euro, are improving the climate for enterprise in general. There is the potential for enterprises to take advantage of the favourable macro-economic outlook and use the single internal market as a springboard to world markets.

Nevertheless, there are still relatively few enterprises in the Union who are building on innovative products, services and processes to grow into major commercial forces on the world stage. This indicates that some critical factors for innovation are not yet sufficiently developed.

On average 51 % of EU firms in the manufacturing sector and 40 % in the service sector, when asked, consider themselves as innovative. Yet products new to the market make up only 7 % of the turnover of European manufacturing companies. These figures show that although awareness of the importance of innovation is widespread among enterprises, the contribution of innovation to the competitiveness of European industry remains fragile, reflected in insufficient capacity to launch new products and services on world markets, and to react rapidly to changes in demand.

Moving from traditional to more sustainable industrial production systems is an important challenge for European industry, which should be encouraged to adopt research and innovation strategies integrating competitiveness with sustainability objectives[18].

3.2 Globalisation and innovation

Globalisation has raised the stakes for European firms and for the Union as a whole. The EU's technology balance is negative, while the corresponding figures for the United States and Japan are increasingly positive. For companies everywhere, both the rewards for successful innovation and the penalties for failing to innovate are larger and swifter than they have ever been. EU companies are capable of reaping rich rewards, as success in the field of mobile telephony has shown. But in too many sectors and regions innovation bottlenecks remain, encouraging frustrated European scientists, entrepreneurs and investors to try their luck elsewhere – most commonly in the United States.

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17 Presented in SEC (2000) 1564

18 The EU research programme on "Competitive and Sustainable Growth" is precisely aimed at encouraging such innovation strategies.

3.3 Not enough graduates and students with relevant qualifications

Innovation and enterprise require that education and advanced training systems in Member States are capable of delivering the right skills and attitudes to their students. The number of schoolchildren studying innovation-linked subjects (science, for example) are too low. In science subjects generally, EU pupils seem to do less well in standardised tests than pupils in the USA or Japan. In higher education too, the numbers of science and technology students are lower than in the USA or Japan. Further development of the links with business are required in higher education, together with a positive attitude towards innovation in the learning process as a whole. Equally important for the future will be provision of lifelong learning opportunities, especially in view of the ageing of the labour force and the increasing pace of innovation and change.

3.4 Innovation will benefit from strengthened research in the Union

A good flow of ideas with commercial potential emerging from research is a key contributor to innovation. The EU's gross expenditure on R&D as a percentage of gross domestic product in 1997 was low in comparison with the USA and Japan. What is particularly serious for innovation is that the differences are largely due to a much reduced industrial research effort in the EU: R&D by business in the Union is only 60 % of the level in the United States.

The relative weakness of private R&D in Europe also largely explains why the EU has fewer researchers in the labour force (5.0 per 1 000) than either the United States (7.4) or Japan (9.6). The number of researchers in firms is only 2.4 per 1 000 (labour force) in the EU compared with 5.9 in the United States and 6.3 in Japan[19]. Although these figures hide considerable variation across countries, regions, firms and sectors, there is no doubt that private research and employment of researchers by firms should be strongly stimulated.

The Commission Communication "Towards a European Research Area" proposes ways to improve coordination and networking to maximise output from the currently fragmented national R&D systems and unleash Europe's R&D potential.

3.5 Technology diffusion to be improved

Although technology diffusion and absorption by SMEs have, for some time now, been a priority of national innovation policies, there is still room for significant improvement. Cooperation between firms and universities or research institutes is still not very well developed in most Member States. On average, only 13 % of firms cooperate with bodies forming the European R&D and innovation infrastructure.

Available statistics suggest that when (mostly large) European firms and institutions make technology links outside their own national borders, they still prefer to do so with counterparts in the United States, rather than in other European countries. The number of strategic technological agreements between US and European companies grew during the early 1990s, while the number of such alliances between European firms fell.

The internal flows of European technology need further encouragement, in ways ensuring that SMEs may also benefit.

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[19] EU data for 1997, United States data for 1993, Japan data for 1998.

3.6 The innovative capacity of traditional industries needs to be reinforced

One of the features of the modern knowledge economy is the increased breadth of the knowledge base in all industrial sectors. Today, a low R&D industry may well be a major user of knowledge generated elsewhere. In the developed economies, traditional industry will be able to compete only by becoming more knowledge intensive. Knowledge intensification in traditional sectors seems as likely to generate employment and wealth as the emergence of entirely new industries.

In many industries conventionally regarded as low-tech, many firms are "buying-in" innovation in the form of plant and equipment. New technology does not reach them directly from the academic knowledge base or from in-house research, but percolates through suppliers and advisory services.

The knowledge society opens the opportunity for all sectors and firms to be bearers of innovation. The most obvious example is the inclusion of computer electronics (and software) in an increasing variety of products. From this viewpoint, the gap between the United States, Japan and the European Union concerning incorporation of information and communication technologies in products ("ICT intensity") remains a preoccupation.

3.7 The growing importance of the service sector

Insufficient attention has been given to innovation in the service sector, in spite of this sector's potential for significant growth in employment and output.

It is composed of a rather heterogeneous collection of industries. There are significant differences in attitudes towards innovation between, for example, ICT (information and communication technology) services and more traditional sectors such as transport or trade. As enabling technologies, ICTs are far more important than any other modern technology throughout the service sector, and their diffusion is essential in improving the sector's innovative capacity.

Service industries (apart from ICT-related services) spend less than manufacturing industries on R&D. Human capital replaces R&D as the main input of innovation. Education and training, along with the diffusion of new technologies, are therefore the main components of an innovation policy in the service sector. Efforts should be made to remedy skills shortages and to implement training schemes to help the less well qualified workers.

3.8 Innovation and environmental protection

The challenge to decouple economic growth from the accentuation of environmental problems opens opportunities for innovation. Sensitivity to the natural environment is leading to a growing demand for new products and services which improve efficiency in the use of resources, aid environmental protection, and reduce impact on the climate. As well as helping to secure sustainable development, innovation contributes to the lasting business and job prospects emerging in this area.

The conditions under which innovations are created and disseminated are thus shaped by the increasing attention paid to our environment, and the increasing intervention of public authorities in this specific field to complement general innovation policies.

4. FIVE OBJECTIVES

Although a richness of experience is being built up in Member States, its impact is not yet sufficient. Efforts by Member States and at Union level to offer an environment supportive of innovation should be intensified.

Awareness of the importance of innovation policy, and its "horizontal" nature, have often been late in developing in Member States. The unsuitability of the linear model of innovation has meant that isolated measures have not proved successful, and that broader strategies are required in order to reduce the innovation deficit. In particular, the relevance of the regulatory, administrative and financial environment to innovation has often been underestimated.

Today, awareness is more general and good practices are beginning to be identified, but resistance is still encountered to the changes needed to arrive at a more innovation-enhancing environment, often based on cultural or institutional factors. The five objectives presented in this Communication contribute to strengthening Member States' capacity to overcome these obstacles, so as to lead to the dynamic conditions, and hence growth and quality jobs, that innovation can bring.

The general climate for innovation in Member States is conditioned by national and regional innovation policies (Objective 1), by the regulatory framework (Objective 2), and by the degree of openness of society to innovation (Objective 5). To these general conditions, which alone are not sufficient to generate innovation, should be added two more targeted objectives: to focus on the creation and growth of innovative enterprises which, in the context of the knowledge-driven economy, have a decisive importance (Objective 3), and to build on the systemic model of innovation by optimising the workings of key interfaces between actors in the innovation process (Objective 4).

The main features of these objectives are:

Objective 1: Coherence of innovation policies. The Union should capitalise on measures and schemes at regional and national levels through coordination for the benchmarking of national policies and for spreading good practice. A regularly updated European innovation scoreboard will draw attention to progress towards the goal of improving innovation performance.

Objective 2: A regulatory framework conducive to innovation. Regulation is necessary, but over-regulation hinders the development of enterprises, innovative enterprises in particular. There is increasing awareness of the benefits of lowering the costs of doing business and reducing red tape.

Objective 3: Encourage the creation and growth of innovative enterprises. Europe needs an improved environment for high technology start-ups and for starting up and developing innovative businesses in general. Such firms invigorate the economy by being the "first movers" who introduce new ideas, and from their number will emerge the expanding businesses of the future. But the obstacles to their creation and growth continue to be more severe in Europe than in Europe's competitors.

Objective 4: Improving key interfaces in the innovation system. Every business sector, whether in manufacturing or in services, in traditional or "new economy" sectors, should aim to benefit from innovation. For this to happen, enterprises need access to knowledge, skills, financial backing, sources of advice, and market information. While not losing sight of the

"system" view of innovation, the operation of some of the interfaces between enterprises and other innovation players needs to be improved by action targeted at these interfaces. The Lisbon conclusions specifically draw attention to the interfaces between companies and financial markets, R&D and training institutions, advisory services and technological markets. Objective 4 focuses on the effective operation of these interfaces so that innovation may permeate the entire economic and social fabric.

Objective 5: A society open to innovation. Innovation is a human activity. Each citizen is a potential creator, implementer and user of innovation. The preceding objectives will not be fully achieved without an open attitude to innovation, based on an awareness of the nature of the opportunities, and the risks. This can only be brought about by a free dialogue between research, enterprise, government, interest groups and the general public.

The five objectives reflect current priorities for enhancing innovation in Europe, and are in line with the consensus on broad policy orientations arrived at by the Lisbon European Council.

OBJECTIVE 1 COHERENCE OF INNOVATION POLICIES

European diversity can be an advantage, if the handicap of the fragmentation of the European innovation system is overcome.

The Lisbon European Council called for the development of a new open method of coordination for benchmarking national policies, including introduction of a European innovation scoreboard. The process of establishing the innovation scoreboard should in this sense be consistent with the exercise of benchmarking research policies, e.g. the indicators and data used should be consistent with each other. This open method is a means of spreading best practice and achieving greater convergence to the main EU goals. It is designed to help Member States to develop their own policies, and involves:

– Fixing guidelines for the Union combined with specific timetables for achieving the goals which they set in the short, medium and long terms,

– Establishing, where appropriate, quantitative and qualitative indicators and benchmarks against the best in the world and tailored to the needs of different Member States and sectors as a means of comparing best practice,

– Translating these European guidelines into national and regional policies by setting specific targets and adopting measures, taking into account national and regional differences,

– Periodic monitoring, evaluation and peer review organised as a mutual learning process.

Actions by Member States	To be reviewed in:
National and regional innovation policies should take account of **"best practices"** and adapt them to their specific environment	2002
Ensure that **coordination mechanisms** are in place between national and regional levels, and between different departments responsible for matters relevant to innovation, so as to guarantee a coherent approach to innovation policy	2001
Implement **periodic target-setting, monitoring, evaluation and peer review** of regional and national programmes for enhancing innovation and of the bodies which implement them	2001

At the Union level, the Commission should act as a catalyst and contribute to enhancing the activities of Member States. The targets are to:

– Examine and benchmark innovation policies and performances of Member States, and compare them with their main competitors: the United States and Japan,

– Establish the European innovation scoreboard (see the first exercise to produce such a scoreboard, using currently available statistics, in the Annex),

– Publish a periodic report on Europe's innovation performance, including updating of the scoreboard,

using methods such as:

– Development of a framework for dialogue on innovation policies in the Union, and their coordination,

– Work to improve the availability of statistics relating to innovation,

– Organisation of "peer reviews" on topics of common interest, as a contribution to evaluation of innovation-fostering measures and identification of "best practices",

– Analysis and follow-up of important developments elsewhere in the world, and studies on specific themes linked to innovation.

To undertake this work, the Commission intends to extend the scope of the analysis and benchmarking initiated in the Fifth RTD Framework Programme, by reinforcing the provision to this end and by placing the European innovation scoreboard within the overall framework of enterprise policy.

Actions by the European Commission	Timing
Implement a **framework for dialogue, coordination and benchmarking of Member State innovation policies and performances**	Early 2001
Establish the **European innovation scoreboard**, as a component of the analysis and benchmarking activities of enterprise policy	Early 2001

OBJECTIVE 2 A REGULATORY FRAMEWORK CONDUCIVE TO INNOVATION

Regulations are useful, but over-regulation is counterproductive for enterprises, innovative enterprises in particular. The regulatory and administrative obstacles to innovation remain too great, and further efforts are required to lower the costs of doing business and to remove unnecessary red tape. This was also stated in the conclusions of the Lisbon European Council, which refer to the need for a regulatory climate conducive to innovation.

To establish such a climate, public action in this area should combine moderation with ambition and efficacity:

– Moderation, because the pace of technological, economic and social change encourages new approaches, based on consensus-building and self-regulation by enterprises which must cooperate in working out norms and regulations respecting consumer and environmental interests,

– Ambition, because the overall regulatory framework must always be the responsibility of the legislator (e-commerce legislation is a good example of the division of roles between enterprises, administrations and the legislative power),

– Efficacity, because legislation should have just the desired result, with negative side-effects, such as distortion of competition, reduced to a minimum. To this end, the necessary administrative structures should be put in place to ensure that the needs of innovation are taken into account in evaluating the trade-offs in devising legislation.

Whatever is good for enterprise policy is generally good for innovation, and vice versa. This applies in particular to legislative and administrative measures designed to facilitate, and perhaps even encourage (via fiscal measures), risk-taking and the creation of enterprises. There are however several topics under this heading which have an especially strong influence on innovation. These are:

– Intellectual and industrial property rights: this refers to the forthcoming availability of the Community patent and also, more generally, to legal developments in IPR (intellectual property rights) relating to new technologies (information technologies, biotechnologies, etc),

– Obstacles, in the form of rules and statutes, to the diffusion and exploitation of research results obtained with the support of public funding (including obstacles in the form of the terms of employment of researchers in the public service),

– Unnecessary regulation (“over-regulation”) which slows down the introduction of new products and services on the market,

– Measures to incite innovation such as direct or indirect State aids in accordance with Articles 87 and 88 of the Treaty (fiscal measures, for example),

– Adaptation of traditional methods for reporting and documenting companies’ intangible assets.

In these areas, Member States and the Commission should work together to create a legal and regulatory climate more conducive to innovation, while taking other objectives, such as the global reduction of State aid, into consideration.

In addition to the simplification and harmonisation of their legislative and administrative rules, Member States should particularly concentrate on fiscality, on the modalities for dissemination of knowledge and on the statutes of researchers in the public service, in order to remove obstacles to knowledge diffusion, its exploitation and the creation of knowledge-based enterprises.

Actions by Member States	Timing
Adapt the rules for the diffusion of research results from publicly-funded research (licensing, access to foreground knowledge, etc), to encourage exploitation and transfer of results so as to foster innovation	Ongoing
Put in place **fiscal measures**, in accordance with Articles 87 and 88 of the Treaty, to encourage private investment in research and innovation and employment of researchers by the private sector	To be reviewed in 2002

At Union level, the Commission will examine what aspects of the legal and regulatory environment falling within its competences may be improved to enhance innovation, focusing on, for example:

– Rules providing researchers and enterprises with effective means for the protection and exploitation of research results,

– Norms, standards and assessment methods for products as tools to promote innovation,

– European accounting standards,

and will undertake studies to examine "good practices" emerging from Member State actions, particularly those concerning fiscal measures to encourage investment in research and innovation, including stock options, and access to the results of publicly-funded research.

Actions by the European Commission	Timing
Identify and promote the use of good practices and, where appropriate, formulate **rules for adapting existing regulatory environments to make them more favourable for innovation** (in the above-mentioned areas, for example)	End 2001
Contribute to **regular reporting on progress in improving the legal and regulatory framework**, and on the remaining obstacles, at European and Member State levels, from the point of view of facilitating innovation	First report: mid 2002

OBJECTIVE 3 ENCOURAGE THE CREATION AND GROWTH OF INNOVATIVE ENTERPRISES

Many familiar business names were innovative start-ups not so long ago. The creation and growth of innovative enterprises, defined as technology-based firms, active in the most promising markets, should be encouraged. From among their number will emerge the successful businesses of tomorrow, providing high quality jobs and acting as vectors of innovation into traditional sectors.

The Lisbon European Council called for a better environment for high technology start-ups, and for starting up and developing innovative enterprises generally.

Such an environment includes access to new technologies, know-how, venture capital and seed funds, mentoring schemes and support structures such as incubators and hatcheries, as well as a spirit of enterprise. This is the thinking behind the "technology valley" concept which is receiving increasing support in Europe. Member States should continue to pursue efforts to create a legal, fiscal and financial environment favourable to the creation and development of start-ups.

The interface between companies and financial markets requires attention since financial constraints, including lack of appropriate sources of finance, continue to figure among the most cited obstacles to innovation. Availability of seed and early-stage venture capital has been a major concern in the development of high growth, technologically innovative, enterprises. Although business angels and local seed capital funds may be helpful in the establishment of an enterprise, their financial capacity is insufficient to provide for rapid growth. In spite of recent progress, the Union continues to lag the United States, not only in the number of venture capital operators active in the market, but also in the proportion of overall investment dedicated to early-stage financing and to technology investment.

The management of high-tech start-ups requires a broad range of skills, as well as special skills in business support services offering help. Entrepreneurship should become a discipline taught in universities and other institutes of higher education. Role models should be available, to encourage young people to consider setting up a business as one of the options in looking for a job. Member States should encourage education, training and support schemes in entrepreneurship and innovation management, according to their structures for education and training.

Actions by Member States	**Timing**
Pursue efforts to create **a legal, fiscal and financial environment favourable to the creation and development of start-ups**	Ongoing
Foster, at regional level, the **creation or reinforcement of adequate support services and structures such as incubators, etc.**	Ongoing
Set up **education and training schemes in entrepreneurship and innovation management**, where these do not exist, in higher-education establishments and business schools, and disseminate good practice in this area	To be reviewed mid 2001

At the Union level, Member State activities will benefit from networking initiatives, from the addition of a European dimension to regional business support services, by development of instruments such as a European electronic directory of innovative start-ups (as already usefully exists in the United States), and by dissemination of good practices.

The Commission can also apply measures to facilitate access by start-ups to public tendering procedures and to Community programmes such as the research Framework Programme as well as to other schemes such as the "Innovation 2000 Initiative" of the EIB. Young enterprises may be reluctant to compete because of the disproportionate cost to the enterprise of the preparation of tenders and proposals.

Actions by the European Commission	Timing
Encourage networking activities such as the network of regions of excellence for the creation of enterprises, the networks for training and support services (incubators, seed funds, etc.); development of a **European electronic directory of innovative start-ups**	2001
Reinforce support services with a European dimension, such as the LIFT help-desk on innovation financing (web portal, online tool box) and investment fora to facilitate interfacing between researchers, enterprises and investors; **contribute to the development of methods for evaluating enterprises' intangible resources**, in particular to value portfolios of IPR	2002
Facilitate access by start-ups to public tendering, to Community programmes (and their results) and to the "Innovation 2000 Initiative" of the European Investment Bank (EIB)	2001

OBJECTIVE 4 IMPROVE KEY INTERFACES IN THE INNOVATION SYSTEM

Innovative activity is not a matter just for research, high-tech industry and individual entrepreneurship. Every business sector, in manufacturing and in services, is concerned by innovation, including the traditional industries. E-commerce is a prime example of an innovative development affecting all sectors. For these firms, innovation is not directly founded on research, but on new management methods, new business models built on information and communication technologies, investment in new equipment and new skills, and networking. Thus, as the understanding of innovation has become broader, developing into a key element of economic development policy, so has the importance of the regional dimension in innovation policy. Many actions are most effectively conceived at a regional level, since it is at this level that the needs of enterprises and the environment in which they operate can best be assessed.

Innovation policy must therefore act to encourage innovation to permeate the economic and social fabric: traditional as well as new industries, small firms as well as large, in all regions. Innovation in the Union must become an inclusive phenomenon.

The Lisbon Conclusions identify a need for specific action to encourage the key interfaces in innovation networks: interfaces between companies and financial markets, R&D and training institutions, advisory services and technological markets. Their effectiveness contributes to a better assimilation of knowledge and diffusion of innovation throughout the Union.

In accordance with the "system" view of innovation, the interfaces cannot be treated in isolation from each other. Advisory services, for example, should be able to direct enterprises to sources of finance and to R&D resources. Since it is at the regional level that support for innovation is most effectively delivered, Member States should integrate a coherent approach for the strengthening of these interfaces in their regional innovation strategies.

It is not only high-tech start-ups that benefit from a more effective **interface with R&D and training institutions**. Enterprises in traditional sectors, SMEs in particular, can make profitable use of technology transfer and the introduction of new management techniques.

Traditional approaches to the production and use of knowledge should be adapted to the systemic vision of the innovation process. To this end, new relationships should be

established between public research facilities, universities and enterprises. In addition to their traditional roles in education and research, universities should develop a third mission: promoting the diffusion of knowledge and technologies, especially towards their local business environment. Large public research organisations and programmes should be encouraged to benchmark their activities in technology transfer and partnerships with enterprises, including those run at Community level.

As shortages of skills and qualified staff emerge as a major obstacle to innovation, Member States should give more attention to lifelong learning to facilitate the assimilation of new technologies[20]. Training institutions have an important role in remedying weaknesses, for example by providing ICT training for employees in the service sector.

There should be more coherent career structures for researchers throughout their working lives. In particular, the geographic and intersectoral (universities, public laboratories, industry) mobility of researchers should be encouraged through explicit pathways.

Regional structures must be capable of encouraging innovation and providing support to innovators and would-be innovators, through the **interface with advisory services and technological markets.** The strengthening and professionalisation of business support structures, as well as the dissemination of information on technological markets (economic intelligence), must be encouraged. There must also be effective linkages between regions, in order to learn from one another's experience, to provide their "client" enterprises with access to the European dimension as a step in enterprise growth, and generally to reduce the "innovation divide".

Building on experience already gained in this field, notably through the Structural Funds and the RITTS/RIS[21] actions, regional and local authorities should include and strengthen innovation-enhancing measures in their development strategies so as to organise, at their own level, the right environment for a strong regional innovation capacity.

Actions by Member States	**To be reviewed in:**
Stimulate and co-ordinate **regional initiatives and regional actors** to devise and implement integrated research and innovation programmes at regional level	2002
Facilitate the implementation of **lifelong learning** programmes to improve the general assimilation of new technologies and remedy shortages of skills	2002
Encourage **universities to give particular attention,** in addition to the traditional missions of education and research, **to promotion of the diffusion of knowledge and technologies**	2002
Encourage **large public research facilities** to benchmark their activities in technology transfer and partnerships with enterprises	2001

At the Union level, a more cohesive approach is required and networking activities should continue to be encouraged to promote transnational technology partnerships,

[20] In order to contribute to the development of lifelong learning opportunities, the Commission has just adopted the *e*Learning initiative which in turn seeks to support innovative learning techniques.

[21] Regional Innovation and Technology Transfer Strategies/Regional Innovation Strategies.

professionalisation of innovation support structures and the diffusion of "good practices". This is particularly the case as concerns technology transfer from European universities and public research centres, which in general have been less open to relationships with business than their counterparts in the United States. For this reason it is proposed to assist European universities to set up a network or association to promote knowledge diffusion and best practices in technology transfer.

Innovation without research also deserves specific attention, as an important source of technical advance. It is proposed to encourage the testing of methodologies for assisting enterprises to assimilate knowledge, add a European dimension as a step toward global markets and upgrade their innovation management methods.

Actions by the European Commission	Timing
Assist **European universities and public research centres** to set up a **network/association** to promote knowledge diffusion and best practices in technology transfer	2001
Measures to encourage **diffusion of "good practice" and transnational co-operation among regions regarding research and innovation policies**	2001
Support EU-level initiatives, such as **networking** and **pilot experiments**, **to facilitate transnational technology partnerships**, as well as the diffusion of non-technological innovation, in particular for SMEs	2001

OBJECTIVE 5 A SOCIETY OPEN TO INNOVATION

Society has often been reticent about innovation. The advantages, and disadvantages, of innovation are not always distributed equitably, especially when an innovation is first introduced. It may take time for the benefits of change and innovation to be appreciated. The media are important as a source of information on progress in research and innovation: they also draw attention to the balance of advantage and disadvantage.

We need to make both the opportunities and risks of new technologies as transparent as possible in a broad dialogue with science, business and the general public, taking account of the potential economic and social costs of "non-innovation" (for example, in the area of technological innovations to reduce pollution and enhance eco-efficiency). That is the only way to boost public confidence in innovation.

The new generation must be taught how to thrive in a world becoming increasingly complex and subject to change. The challenge is for each Member State to face, notably through their education systems. Efforts must be made to ensure that the disadvantaged in society are not excluded.

Enterprises must play their part in ensuring that the knowledge and skills of their staff are regularly updated. The importance of the working life means that particular attention should be given to innovation at the workplace and how it is introduced. Enterprises also have a major role to play in establishing confidence through consensus, self-regulation and quality standards.

The aim must be a well-informed European society, capable of mature debate on innovative developments, and not handicapped in discussing innovation, or in applying innovative developments, by a weak understanding of science, technology and change.

It is noticeable that countries with a strongly consensual approach, supporting quality debate on innovation issues, also produce strong figures for innovation-related indicators.

Member State administrations, through their public procurement, are major consumers of goods and service: by appropriate purchasing policies they can be a force that stimulates the demand for innovation.

Actions by Member States	**To be reviewed in:**
Encourage comprehensive **"stakeholder" debates on innovation** involving scientists, industry, consumers and public authorities	2002
Stimulate public demand for innovation by **dynamic purchasing policies in public administrations**	2003

At the Union level, linkages can usefully be made between Member States' measures to improve the provision of information to the public, to foster public debate, and to take account of the public's views. These would be in the interest of broadening the horizons of national activities, facilitating a European "consensus", and ultimately arriving at a specifically European vision of science and innovation. To this end, technology foresight exercises, along the line defined in the Communication on the European Research Area, can be used to discuss and share views of how the opportunities and impacts of science and innovation influence the future of Europe. Specific events will also be held and, to measure attitudes to innovation in the EU, an "innobarometer" section will be added to the "Eurobarometer" public opinion surveys.

5. SUMMARY

Innovation and research policies can contribute significantly to improving the business environment for innovation. Combined efforts at European, national and regional level should be intensified.

It is however mainly at national or regional level that public action to enhance innovation should take place. The recommendations contained in this Communication addressed to Member States are listed in the following table:

Main recommendations to Member States

1. National and regional innovation policies should take account of **"best practices"** in other Member States and adapt them to their specific environment.
2. Ensure that **coordination mechanisms** are in place between national and regional levels, and between different departments responsible for matters relevant to innovation, so as to guarantee a coherent approach to innovation policy.
3. Implement **periodic target-setting, monitoring, evaluation and peer review** of regional and national programmes for enhancing innovation and of the bodies which implement them.
4. **Adapt the rules for the diffusion of research results from publicly-funded research**, to encourage exploitation and transfer of results, and encourage **large public research facilities** to benchmark their activities in technology transfer and partnerships with enterprises.
5. Pursue efforts to create, in accordance with the State aid rules, **a legal, fiscal and financial environment favourable to the creation and development of start-ups**.
6. Foster, at regional level, the **creation or reinforcement of adequate support services and structures such as incubators, etc**; stimulate and co-ordinate **regional initiatives and regional actors** to devise and implement integrated innovation programmes at regional level.
7. Set up **education and training schemes in entrepreneurship and innovation management** in higher-education establishments and business schools; encourage **universities to give particular attention**, in addition to the traditional missions of education and research, **to promotion of the diffusion of knowledge and technologies**.
8. **Promote investment in research and employment of researchers by enterprises** through fiscal incentives in accordance with Articles 87 and 88 of the Treaty, and facilitate the implementation of **lifelong learning** programmes to improve the general assimilation of new technologies and remedy shortages of skills.
9. Encourage comprehensive **"stakeholder" debates on innovation** involving scientists, industry, consumers and public authorities.
10. Stimulate public demand for innovation by **dynamic purchasing policies in public administrations**.

Main activities to be implemented by the Commission

The Commission will act as a catalyst to enhance Member State measures and policies, by benchmarking innovation performance and policies, contributing to improving the regulatory environment, and promoting networking and dissemination of good practice at European level.

The promotion of innovation will be embodied in the overall framework of enterprise policy while continuing to be one of the main overall objectives to be systematically pursued in the RTD framework programmes, contributing to the competitiveness of European enterprises.

The main activities of the Commission will be:

1. To promote dialogue, coordination and benchmarking of Member State innovation policies and performance, and on the European innovation scoreboard (see Objective 1: Coherence of innovation policies).

2. To continue studies on topics relevant to innovation. These will notably focus on the regulatory environment, in order to contribute to its adaptation to render it more

favourable to innovation and to regular reporting on progress in improving this environment (see Objective 2: A regulatory framework conducive to innovation).

3. To continue and extend activities to encourage support for networking and advisory services with a European dimension, such as the help-desk on innovation financing (LIFT), activities to facilitate interfacing at European level between researchers, industry and investors, the existing network of regions of excellence for the creation of enterprises, new networks of European universities and public research centres to promote knowledge diffusion and best practices in technology transfer, and development of a European electronic directory of innovative start-ups (see Objective 3: Encourage the creation and growth of innovative enterprises, and Objective 4: Improve key interfaces in the innovation system).

4. To contribute to the development of methods for evaluating the intangible resources of young innovative enterprises, and measures to facilitate their access to Community programmes and results, as well as to the "Innovation 2000 Initiative" of the EIB (see Objective 3: Encourage the creation and growth of innovative enterprises).

5. To continue and reinforce transnational cooperation among regions regarding innovation policies, exchange of good practices and pilot experiments to facilitate transnational technology partnerships as well as diffusion of non-technological aspects of innovation, particularly for SMEs (see Objective 4: Improve key interfaces in the innovation system).

ANNEX: European innovation scoreboard

The "European Innovation Scoreboard" compiles a set of indicators which together give an assessment of Europe's innovation performance. It is one component of a much broader benchmarking exercise of the Enterprise Directorate-General covering European enterprise policy and competitiveness as a whole. This Annex presents the results of a first exercise to produce the European innovation scoreboard, using the statistics that are currently available.

The innovation scoreboard allows relative strengths and weaknesses of the innovation performances of the Member States to be assessed and, for a limited number of indicators for which the relevant statistical data is available, to compare the performances of the European Union with those of the United States and Japan.

The scoreboard is designed to capture the main drivers of a knowledge-based economy plus several measures of innovation outputs. The indicators are grouped into four categories:

- Human resources
- Creation of new knowledge
- Transmission and application of knowledge
- Innovation finance, output and markets

The indicators of the scoreboard are derived from official statistics (e.g. Eurostat, OECD). Reliable private statistics are used when official sources are not available.

The scoreboard includes both 'traditional' indicators based on R&D and patent statistics and indicators derived from recent surveys. An important data source is the "Community Innovation Survey" (CIS). This survey was developed between 1991 and 1993 by the European Commission in co-operation with the OECD. It is implemented by all Member States in a harmonised way and has become the innovation statistics instrument of the Community and a model for non-Member States such as Canada and Australia. At present, the survey is carried out only every four years which explains the fact that the available data dates back to 1996.

A cross-country comparison of the innovation indicators can help identify national strengths, and areas of weaknesses that are amenable to public and private intervention. However, it is important to keep in mind that innovation is a complex activity that is driven by a wide range of factors. An innovation scoreboard can only provide a broad outline of the strengths and weaknesses of national innovation capabilities.

Causal relationships between policies and improvements in the performance of the national innovation system will, in most cases, remain speculative. The scoreboard is therefore complemented by a series of "peer reviews" looking at the identification of more qualitative benchmarks and the exchange of good practices in innovation policy.

The current draft version of the scoreboard is shown in Table 1.

Table 1: European Innovation Scoreboard (indicators, sources and years)

N°	Short description of indicator	Source	Year
1.	**Human resources**		
1.1	Share of S&T graduates among all post-secondary graduates	EUROSTAT, Education statistics	1997
1.2	Percent of workforce with a tertiary education	OECD	1996
1.3	Percent of total employment in medium-high and hi-tech[22] manufacturing	EUROSTAT, R&D statistics, based on Labour Force Survey data	1998
1.4	Percent of total employment in high-tech[22] services	EUROSTAT, R&D statistics, based on Labour Force Survey data	1998
2.	**Knowledge creation**		
2.1	Government R&D funding as % of GDP (GOVERD + HERD)	EUROSTAT, R&D statistics, OECD	1998[23]
2.2	Business expenditures on R&D as a percentage of GDP (BERD)	EUROSTAT, R&D statistics, OECD	1998[23]
2.3	Number of patent applications in high tech classes per million population	EUROSTAT, R&D statistics, based on EPO data	1998
3.	**Transmission and application of knowledge**		
3.1	Percent of manufacturing SMEs that innovate in-house	EUROSTAT, Community Innovation Survey	1996
3.2	Percent of manufacturing SMEs involved in co-operative innovation	EUROSTAT, Community Innovation Survey	1996
3.3	Total innovation expenditures in the manufacturing sector as a percent of total turnover	EUROSTAT, Community Innovation Survey	1996
4.	**Innovation finance, output and markets**		
4.1	Venture capital investment in technology[24] firms as a percent of GDP	European Technology Investment Report 1999, based on EVCA data	1999
4.2	Capitalisation of new (new, parallel, secondary) markets as a percent of GDP	International Federation of Stock Exchanges	1999
4.3	Sales share of products new to the market in the manufacturing sector	EUROSTAT, Community Innovation Survey	1996
4.4	Internet users per 100 inhabitants	EUROSTAT, based on International Telecommunication Union data	1999
4.5	Share of ICT markets as a percent of GDP	European Information Technology Observatory	1997
4.6	Change in share of total OECD production in hi-tech sectors (1992-96)	OECD	1996

22 *The medium-high and high technology sectors include chemicals NACE (24), office equipment (NACE 30), electrical equipment (NACE 31), telecom equipment (NACE 32), precision instruments (NACE 33), automobiles (NACE 34), and aerospace and other transport (NACE 35). The total workforce includes all manufacturing and service sectors.*

23 *The data is for 1998 for Denmark, Germany, France, Italy, Finland, UK, US, and Japan and for 1997 for all other countries, with the exception of Austria, for which the most recent data is for 1993*

24 *The technology sectors include: communication hardware, communication carriers, internet, computer hardware, software, services, and semi-conductors; other electronics ; medical ; and biotechnology.*

Human resources

The scale and quality of human resources are major determinants of both innovation (creation of new knowledge) and diffusion (spread of knowledge throughout the economy). For the former, a critical factor is the available pool of scientists and engineers which is included within indicator 1.2.

For diffusion, and subsequently for productivity, what matters is the skill-level of the workforce involved in operating new equipment, including office software and Advanced Manufacturing Technology (AMTs) in production. These intermediate technical skills are often obtained through post-secondary diploma courses. They are partly captured in indicator 1.1, but relevant skills obtained through secondary education and via on-the-job training are not covered by the available indicators. The result is that the scoreboard provides good coverage of the human resource requirements related to innovation but is weaker on those related to diffusion.

Indicators 1.3 and 1.4 are not, strictly speaking, indicators of human resources for innovation, but are rather the effect of innovation on employment. They are also indicators of the structure of the economy.

Creation of new knowledge

The three indicators for the creation of knowledge measure inventive activity, which is the source of all of the benefits of innovation. All three are based on traditional innovation statistics. Other methods of innovation creation, such as the adaptation of new equipment to a firm's production and service systems, are indirectly covered under the transmission and application of knowledge.

Transmission and application of new knowledge

Formal inventive activity, covered under knowledge creation, is only one aspect of innovation. Firms also innovate by adopting innovations developed by other firms or institutions and adapting them to their own needs. Furthermore, firms can obtain ideas and technical information from external sources that they then use to develop innovations in-house or in cooperation with others. This section includes three indicators, all derived from the second Community Innovation Survey (CIS-2), that measure different aspects of the transmission of knowledge.

Two of the indicators are limited to small and medium-sized enterprises (SMEs) with between 20 and 249 employees. There are two reasons for this limitation. First, SMEs play a vital role in innovation, both as intermediaries between the public research infrastructure and large firms, as in biotechnology, and as developers of new ideas. The CIS provides several measures of the percentage of innovative SMEs that is not based on formal R&D (where large firms do better). Second, almost all large firms are involved in the innovative activities captured by these three indicators. This means that the results will be dominated by SMEs anyway, since SMEs make up the largest fraction of manufacturing firms in all EU countries.

All of the CIS-2 indicators suffer from differences in response rates by country, varying from less than 30 % in Germany to 85 % in France, a problem typical to surveys. The main problem with low response rates is that the firms that choose to respond could be less or more innovative, on average, than the non-respondents. These and other lessons will be taken into

account for the next CIS round. At present, there is no viable alternative to using the CIS which remains Europe's most important source of innovation data.

Innovation finance, output and markets

This group includes six indicators that cover a range of issues: the supply of venture capital, (two indicators), sales of innovations, internet use, ICT investment, and economic activity in advanced sectors.

The data sources for these indicators include both data collected by private firms and public data. Little is known about the reliability or quality of the former. Nevertheless, several indicators are based on this data because of a lack of equivalent public data for several indicators of high policy interest, such as the supply of venture capital.

Summary of results

Table 2 summarises the innovation indicators for each country. Overall, the picture confirms the existence of disparities in innovation performance in Europe. Certain countries, in particularly some of the smaller ones, score quite high and sometimes even better than the US. The country with the highest score is Sweden, with above average figures for 12 of the 16 indicators, followed by Finland (8), Denmark and Germany (both 7)

The most innovative of the larger economies is Germany, which is particularly strong in knowledge creation. Italy and Spain are less innovative in this group, with France and the UK exhibiting a mixed picture of a few strengths and a few weaknesses.

The fact that the smaller economies such as Ireland, the Netherlands, Finland and Sweden appear to be the most innovative could be misleading. Small economies often have an industrial distribution which is concentrated in a few sectors, while larger economies are more diverse, spanning all sectors from low to high technology. This can shift the scores towards the mean for many innovation indicators in large economies, while small economies can exhibit either a high or low innovative capacity, depending on the sectors that dominate the economy. This is apparent in the high innovative capacity of Sweden, Finland and Ireland and the low innovative capacity of Greece and Portugal. Of course, this shift towards high or low technology sectors is not accidental, but can reflect both public and private institutions seeking out areas of comparative advantage and high profitability.

Finland's SMEs have a below average performance on the majority of SME indicators. This suggests that Finland's innovative strengths lie within large firms, which could be of concern for the future. Conversely, Denmark' SMEs have an average or above average innovative capability, although this could partly be due to the industrial structure of Denmark, which has few large firms.

The US exhibit above average scores for most innovation indicators. Its score for the percentage share of high-tech production is borderline, at a 1 % increase.

Table 2: Summary of innovation indicators by country

No	Indicator	EU	B	DK	D	EL	E	F	IRL	I	L	NL	A	P	FIN	S	UK	US	JP
1.1	S&T graduate share	37	*26*	32	**48**	38	32	31	39	32		30	33	*28*	**58**	**47**	37		
1.2	% workforce with tertiary grade	13	11	15	13	12	13	*10*	11	*8*	11	**23**	*6*	*7*	12	13	13	**26**	
1.3	% employment in high-tech manufacturing	7,7	7,2	6,8	**11,0**	*2,4*	*5,5*	7,0	7,4	7,5	*1,6*	*4,8*	6,5	*3,5*	7,2	8,6	7,8		
1.4	% employment in high-tech services	3,0	3,5	**4,2**	2,6	*1,5*	*1,9*	**3,6**	2,4	2,6	2,5	3,3	2,5	*1,4*	**4,6**	**4,4**	**3,7**		
2.1	Government expenditure on R&D / GDP	0,70	*0,42*	0,72	0,82	*0,22*	*0,36*	**0,90**	*0,32*	*0,53*		0,83	0,72	*0,44*	**0,90**	**0,97**	0,58	0,78	0,59
2.2	Business expenditure on R&D / GDP	1,20	1,31	1,26	**1,53**	*0,13*	*0,49*	1,38	1,03	*0,55*		1,11	*0,83*	*0,14*	**2,06**	**2,77**	1,21	**2,04**	**2,18**
2.3	High-tech patents / population	14,9	12,5	**19,3**	**23,9**	*0,3*	*1,7*	16,3	*0,9*	*4,2*	*1,9*	**26,8**	*9,1*	*0,0*	**69,6**	**41,7**	15,0	**19,7**	*9,4*
3.1	% SMEs innovating in-house	44,0	*29,4*	**59,0**	**58,7**			36,0	**62,2**	44,4	*24,5*	51,0	**59,1**	*21,8*	*27,4*	44,8	35,8		
3.2	% SMEs innovation co-operation	11,2	*8,9*	**37,4**	**14,7**		*4,6*	12,0	**23,2**	*4,7*	9,6	**14,6**	12,9	*4,5*	**19,9**	**27,5**	**15,7**		
3.3	% innovation expenditure / total sales	3,7	*2,1*	**4,8**	4,1		*1,8*	3,9	3,3	*2,6*		3,8	3,5	*1,7*	4,3	**7,0**	3,2		
4.1	% venture capital / GDP	0,06	**0,16**	*0,02*	0,06	*0,01*	*0,02*	0,07	**0,08**	*0,02*		**0,11**	*0,01*	*0,01*	*0,05*	**0,15**	**0,10**		
4.2	% new market capitalisation /GDP	3,4	*0,1*		3,7	**17,5**		**4,7**	0,4	*1,1*		*0,3*	*0,5*	*0,2*	*2,3*	**31,2**	*1,5*	**57,3**	
4.3	% sales of new-to-market products	6,5	*2,6*	*5,1*	*3,8*		**9,5**	**7,9**	**8,4**	**13,5**		6,6	5,6	7,2	7,3	6,9	6,7		
4.4	Internet users per 100 inhabitants	14,9	13,7	**28,2**	**19,4**	*7,1*	*7,2*	*9,7*	*11,8*	*8,7*	17,4	**19,0**	*10,5*	*7,0*	**32,3**	**41,4**	**21,0**	**39,8**	14,5
4.5	% ICT markets / GDP	5,0	5,1	5,5	4,5	4,4	*3,9*	5,0	5,7	4,1		5,9	4,3	4,9	5,3	**6,5**	**6,4**	**7,6**	4,4
4.6	% change, high-tech share (1992-96)			**9**	*-19*	*-36*	**4**	*-15*		*-12*		*-7*			**150**	**86**	*-9*	**1**	*-7*

Note: Results that are more than 20 % above or below the EU average are highlighted in **bold** or *italics* respectively. For indicator 4.6, countries are ranked on the basis of showing an increase or a decrease in their share.