ESPON Project 2.1.2: The Territorial Impact of EU Research and Development Policy

Third Interim Report to the ESPON Coordination Unit

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1.1. *Executive Summary with main preliminary results, including policy recommendations*

This is the Third Interim Report by ESPON Project 2.1.2 examining the Territorial Impact of EU Research and Development Policy. The main reporting requirements for the project are as follows:

- Diagnosis of R&D sector in an enlarged Europe
    - R&D policy at Community and national level
    - Existing territorial imbalances and regional disparities in R&D capacity and innovation
    - Provisional results of spatial effects at EU level and in member states in terms of the economic relocation and other spatial criteria

- Definition of appropriate indicators, typologies and instruments to detect regions and territories most negatively and positively affected by identified trends, with special reference to accessibility, polycentric development, environment, urban areas, structurally weak areas

- Presentation of hypothesis on the territorial effects of relevant measures of the investigated policy field

- Conclusions and recommendations on the improvement of sector policies and instruments considering territorial governance

- Conclusions and recommendations on the institutional aspects of the spatial co-ordination of EU and national sector policies

These are tackled in Part 2 of this report. Part 1 focuses on a short presentation of key concepts, lists of maps and indicators and the application of the Crete Guidance paper.

Approach

The methodology for the study is based upon the analysis of the following key datasets:

R&D Indicators

- R&D expenditures as a percentage of regional GDP (in millions of national currencies, in millions of euro, and as a percentage of gross domestic product) for the whole economy, for the business enterprise sector (BES), government sector (GOV), higher education sector (HES), and private non-profit sector (PNP);

- R&D personnel as a percentage of the labour force (in full time equivalents, head counts, and as a percentage of the labour force) for the whole economy, for the business enterprise sector (BES), government sector (GOV), higher education sector (HES), and private non-profit sector (PNP);
- Patent Applications and High Tech Patent Applications to the European Patent Office (total number of applications, number of applications per million people in population, and number of applications per million people in the labour force) for the whole economy
- Employees with Tertiary level education working in a Science and Technology Occupation (HRSTC).

Indicators of "Innovative Capacity"

- Employment in High Technology and Medium High Technology Manufacturing as a percentage of total employment;
- Employment in High Technology Services as a percentage of total employment;
- Percentage of the Working Age Population (aged 24-65) having successfully completed some form of tertiary education.

Indicators of R&D Infrastructure

- Science Parks that are members of the International Association of Science Parks (ISAP).
- Business Innovation Centres
- Most Actively Publishing Universities and Public Research Institutes in the EU 15

Policy input indicators

- Framework Programme participation by region
- Field of Intervention code data by Structural Fund programme

The indicators have been selected on the basis of their relevance to the topic of study, covering both regional R&D capacity and regional innovation capacity. This has enabled an assessment of the strengths, weaknesses and disparities in these fields across the European territory. The initial selection of the chosen indicators was based upon a knowledge of available robust datasets and evidence from other work as to indicators that could be applied to these fields.

Identified strengths and weaknesses

Overall, the indicators portray a picture of a European territory that exhibits a strong degree of variation between regions, including disparities in performance within countries.

When viewed on a European scale, the regional figures for R&D intensity show a marked concentration of European R&D in a relatively small number of core regions, at the expense of Less-Favoured Regions and more peripheral areas. A number of regions in the candidate countries perform very well against this indicator. Map 6.1 shows R&D intensity across the EU-27 against the EU average, based on current data availability. The strong performance of Sweden, Finland and parts of the UK, Netherlands, Germany, France and Austria is clearly visible. The concentration of R&D expenditure is yet more evident when one examines Business expenditure on R&D, demonstrating the reliance of a number of high expenditure regions on public funding for R&D activities.

In the EU-15, the levels of R&D employment as a percentage of the labour force largely mirror the pattern of R&D expenditure, with the many of the highest regional concentrations of total R&D personnel located in the Northern part of the European territory. The average level of total R&D employment in the EU-15 in 1999 was 1.36% of the labour force, although analysis highlights a number of core regions with research employment rates considerably above this.

On the basis of available data 9 of the top 25 regions in terms of total R&D employment were located in Germany (the top three again include Oberbayern, Braunschweig, and Stuttgart with 3.72%, 3.41% and 3.04% of the labour force respectively[1]), three in Sweden and two in Finland. This said, core R&D regions, in terms of research personnel, are also evident in many other countries, in particular Slovakia (where Bratislavsky gains the highest overall score of any region), Hungary, the Czech Republic, Austria, France and Bulgaria; comparable total R&D employment figures are not available at regional level in the UK.

The pattern of HRSTC, as a percentage of total employment in EU-15 regions illustrates a slightly different picture to that portrayed simply by R&D based indicators. Two countries come out as clear leaders: Sweden (6 out of the top 25 regions, including Stockholm with the highest overall figure) and Belgium (7 out of the top 25 regions). This is largely explained by the fact that both these countries have high levels of the working age population with tertiary education and important concentrations of high technology sectors (both countries perform particularly well in terms of total employment in High Technology Services).

Other leading regions in the EU-15 include core or capital regions in Finland (Uusimaa, Manner-Suomi), the UK (Inner London), Germany (Berlin), France (Ile de France) and the Netherlands (Utrecht). The lowest scoring regions against this indicator are found in Portugal, Greece, Italy and Austria. Italy and Austria also record comparatively low levels of tertiary level education, even in core economic areas. This may reflect differences in the exact classification of the educational qualifications used and demonstrates one of the problems associated with international comparisons involving educational attainment levels.

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[1] Figures for 1997, the most recent year for which data is available

The average level of employment in High and Medium High Technology manufacturing sectors in the EU-15 in 2001 was 7.57%, compared with a figure of 6.63% across the candidate countries. The highest proportions of employment in these sectors in the EU-15 are found in Germany, where the top seven regions are all located. The region with the highest proportion of the labour force engaged in high technology manufacturing sectors is Stuttgart with 21.08%. Other top performing regions include Franche Comté, Piemonte and Comunidad Foral de Navarra.

The bottom 50 regions include a high proportion of regions from cohesion areas of Southern Europe, along with a number of regions from core economic areas of the continent such as Outer London (1.96%), Utrecht (2.14%) and Noord Holland (2.56%). The figures for these latter regions reflect the proportionately dominant role of the service sector in these areas.

The highest rates in the candidate countries are found in the Czech Republic, Hungary and Slovenia, all of which have levels of medium high and high tech manufacturing above the EU-15 average. Cyprus, the three Baltic States and Romania all have rates of employment in these sectors well below the EU-15 and candidate country average.

In 2001, 3.61% of the EU-15 labour force was employed in High Technology Services. The highest levels of employment in these dynamic sectors of the economy are found in North Western Europe, in London and the South East in the UK, in Stockholm, Helsinki, Utrecht and the Paris region. Berkshire, Buckinghamshire and Oxfordshire, all in the UK, registered the highest figure at 4.65% of the labour force.

In the candidate countries, 2.34% of the labour force in 2001 was employed in high tech services. The highest proportion was found in Estonia (3.38%), with similarly high levels in the Czech Republic, Hungary, Malta and Slovakia (3.22%, 3.24%, 3.06% and 3.03% respectively). Romania, Cyprus and Latvia had the lowest rates of employment in these sectors (1.43%, 1.83% and 2.01%).

Tertiary education is generally considered to act as a reasonable proxy for the capacity of a region to adopt new innovations as the adoption of innovations in many areas, particularly in the service sectors, depends on a wide range of skills, which may not be captured by an overly narrow focus on scientific subject areas.

The aggregate proportion of the working age population with tertiary education in the EU-15 for this year was 21.2%. The regions with the highest levels of highly qualified people in current members of the Union are concentrated in the Nordic Countries and parts of Germany, the Netherlands and the UK. The lowest levels are found in Northern Portugal, parts of Italy and Greece. There are very large disparities between the tertiary education levels in the candidate countries. While the overall proportion of the candidate country population of working age with tertiary education was 13% in 2001, Bulgaria, Cyprus, Estonia and Latvia all have rates above the EU-15 average (with rates of 21.3%, 26.8%, 29.4% and 45% respectively).

One factor that can assist in the development of a strong and innovative economy is the strength of supporting infrastructure. At a European level the strength of the local university base, presence of recognised science parks and Business Innovation Centres can all play a role. Analysis of the location of this infrastructure across Europe demonstrates some strong patterns.

4% of EU regions account for 40% of the leading research universities and institutes; 46% of recognised Science Parks and 25% of Business Innovation Centres. In contrast, 76% of regions contain none of these. All EU-15 Member States contain at least one region in this leading group, although the institutional mix varies. In general, the leading regions have a very strong university base, or a balance between Science Parks, Business Innovation Centres and Universities.

Developing a regional typology for R&D and innovation capacity

On the basis of the above indicators a regional typology has been developed that identifies regions according to similar characteristics in their capacity to undertake R&D and innovation. The method adopted to establish the typology is based upon combining the indicators for R&D capacity and innovation capacity and assigning Z scores for the 3 indicators in each. High, medium and low scores are based upon the European average.

- R&D Scores – average of the Z scores for 3 indicators (regions only included if at least 2 of the 3 available) – classified high, medium, low (top, middle and bottom third of scores)
- Innovation Scores– average of the Z scores for 3 indicators (regions only included if at least 2 of the 3 available) - classified high, medium, low (top, middle and bottom third of scores)

The resulting typology is as follows:

Type	***Description***
Type 1	High R&D capacity and high innovation capacity
Type 2	High R&D capacity but low or medium innovation capacity
Type 3	Low or medium R&D capacity but high innovation capacity
Type 4	Medium R&D capacity and medium innovation capacity
Type 5	Low R&D capacity and low innovation capacity

Essentially, Types 2 and 3 are special cases in the context of regions that perform well either as producers of R&D or as users of R&D that is produced elsewhere. They reflect the potential reality of the EU as an area of transnational and transregional knowledge flows but may also suggest asymmetries in the regional innovation systems in these places. Types 4 and 5 should not necessarily be seen as the ‘worst cases’. As has been identified in the earlier conceptual work for this study, not all regions will find a high R&D capacity a desirable objective.

The typology has been applied to all EU 15 Member States. It has proved impossible to apply to the regions of the Accession States and Candidate Countries owing to weak levels of information on innovation data. Instead we have included these Countries in the typology at a national level. The breakdown of the typology across 160 territories is set out in Table 1 below.

Table 1

Type	*Number of territories*	*%*
Type 1	33	21
Type 2	18	11
Type 3	16	10
Type 4	47	29
Type 5	46	29

For 12 Member States data is available at a regional level. This demonstrates that some States display sharp differences in performance, whilst for others the picture is more homogenous (Table 2). Overall, most Type 1 regions are located in the northern part of the EU but the pattern for Type 5 regions, whilst skewed towards southern EU Member States, does also illustrate the disparities that exist in some Member States.

Table 2

	Type 1	*Type 2*	*Type 3*	*Type 4*	*Type 5*
Austria	1	-	-	2	6
Germany	12	4	8	13	-
Spain	2	-	1	5	9
Finland	4	1	-	-	-
France	4	3	-	9	5
Greece	-	-	-	2	4
Italy	-	1	1	4	13
Netherlands	2	5	1	1	3
Portugal	-	-	-	-	3
Sweden	3	1	-	1	-
UK	4	-	3	5	-

Although there exists a strong relationship between levels of GDP and the regional typology this does not extend to a significant relationship with rates of growth, either in terms of innovation capacity within the region or levels of R&D capacity. There appears to be some evidence that the least well-endowed regions are 'catching' up in terms of R&D capacity, whilst the picture in terms of innovation capacity is less clear.

EU R&D policy

The European Union's role in the field of R&D is set out in Article 163 (ex 130f) of the Treaty establishing the European Community [2] and in subsequent articles up to Article

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[2] Article 163: *1. The Community shall have the objective of strengthening the scientific and technological bases of Community industry and encouraging it to become more competitive at international level, while promoting all the research activities deemed necessary by virtue of other Chapters of this Treaty.*

173. In relation to the policies used to achieve the objectives set out in the Treaty, a useful distinction can be made between *sectoral* interventions, on one hand, and *territorial* interventions on the other[3].

- *Sectoral interventions* are directly addressed at the R&D sector, through the provision of direct support to R&D projects and researchers. In the EU context, the main instrument of direct sectoral support for R&D is the RTD Framework Programme. This is coordinated by DG Research and designed to promote cooperation in the field of R&D and the dissemination of research results and stimulate the training and mobility of researchers in the Community[4].
- The EU's *territorial interventions* in the field of R&D are addressed to specific geographical areas, through cohesion policies and specifically the Structural Funds. Coordinated by DG Regional Policy, these interventions have generally focused on indirect support for R&D, such as the creation of networks for innovation, and worked alongside national and regional activities.

The immediate objectives of EU R&D actions are broadly targeted towards the following types of activity:

- Promoting International R&D collaboration
- Establishing networks of SMEs
- Creating mechanisms to stimulate and support innovation
- Increasing EU wide human capital
- Building up knowledge infrastructure in less favoured regions and links to more advanced regions

In addition to the Framework Programmes and the R&D-related actions funded under the mainstream Structural Funds, Innovative Actions, funded under Article 10 and now Article 2 of the European Regional Development Fund (ERDF) have also been used to promote technological innovation at a regional level. During the 1994-1999 funding period, these took the form of Regional Innovation Strategies (RIS) and Regional Technology Transfer (RTT) actions. Under the current programming period (2000-2006), the first of three strands of Innovative Action aims to support regional competitiveness on the basis of innovation. A new Pilot Action 'Regions of Knowledge' has also just been launched by DG Research by request of the European Parliament.

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2. *For this purpose the Community shall, throughout the Community, encourage undertakings, including small and medium-sized undertakings, research centres and universities in their research and technological development activities of high quality; it shall support their efforts to cooperate with one another, aiming, notably, at enabling undertakings to exploit the internal market potential to the full, in particular through the opening-up of national public contracts, the definition of common standards and the removal of legal and fiscal obstacles to that co-operation.*
3. *All Community activities under this Treaty in the area of research and technological development, including demonstration projects, shall be decided on and implemented in accordance with the provisions of this Title*.

[3] This distinction is made in *Study on the Construction of a Balanced and Polycentric Development Model for the European Periphery: Research and Development and Innovation*.

[4] Objectives set out in Article 164 of the Treaty

All these different aspects of Community policy in the field of R&D now operate in the context of a strategic goal, on the part of the EU, to create a European Research Area (ERA). The concept of the European Research Area (ERA) was established in the Commission communication *Towards a European Research Area*, published in January 2000, in advance of the Lisbon Summit of March that year. The basic idea underpinning the ERA is that the issues and challenges of the future cannot be met without much greater integration of Europe's research efforts and capacities.

The territorial effects of the RTD Framework Programmes

Regions with high levels of participation in the Framework Programmes can be identified in most of the Member States of the EU. However, participation is weighted towards the more advanced regions. Participation in the Framework Programmes is highest in Type 1 regions. This pattern has remained stable between Framework Programme 4 and Framework Programme 5. In both periods 67% of Type 1 regions featured in the top quartile of regions by number of projects funded through the Framework Programme. Type 2 regions also register strong levels of participation, possibly reflecting their higher capacity for R&D activity. Between Framework Programme 4 and Framework Programme 5 there is some, albeit marginal, evidence of increasing levels of participation by some Type 5 regions, whilst participation levels by Type 3 regions have fallen back.

Participation in the Framework Programmes is also significantly related to levels of GDP. Regions in the lowest quartile of regions based on the level of GDP per capita tend to have the lowest levels of participation in the Framework Programmes. Those regions in the highest quartile have the highest levels of participation. Whilst the picture between Framework Programme 4 and Framework Programme 5 remains broadly similar there are signs that participation levels by less favoured regions are increasing. However, not withstanding this, the highest levels of participation remain the preserve of those regions with the highest levels of GDP per capita.

The Framework programmes are supportive of actions in Objective 1 regions but participation is skewed more strongly to non-objective 1 regions. The average number of participants in FP5 in an Objective 1 region is some 63% of the EU average. This is slightly below the average level of GDP for an Objective 1 region (70%) suggesting that FP participation is disproportionately greater in non-objective 1 regions. Notwithstanding this, participation is relatively high in a number of Objective 1 regions, particularly in Ireland, Portugal and some regions of Greece. Objective 1 regions account for some 22% of the EU population. Objective 1 regions are thus also underrepresented in comparison to their share of population, although a mixed picture is visible with some regions in Ireland, Greece and Portugal demonstrating higher participation levels. Overall, participation levels weighted for population appear to be slightly lower than those weighted for GDP.

The territorial effects of Structural Fund actions in the field of RTD

In total some 10.6bn euros are intended to be spent on R&D activity in the 2000-2006 programming period. This represents 8.5% of expenditure in relevant programmes or 5.1% of all Structural Fund expenditure (208.5bn euros); a slight decrease on the 5.6% reported for the 1994-1999 period. Around three-quarters (74%) of expenditure is contributed by the ERDF and a quarter (25%) from the ESF.

The distribution of activity between Objective 1 and 2 varies with a stronger emphasis in Objective 1 regions on actions supporting innovation and technology transfers, establishment of networks and partnerships between businesses and/or research institutes. In contrast, a higher proportion of funds is focused on supporting the development of RTDI infrastructure in Objective 2 areas. This is contrary to previous estimates of the mix of activities between Objective 1 and 2 regions. Of course, absolute values of support in Objective 1 regions are higher across all categories.

Structural Fund actions in support of R&D are heavily focused on the Objective 1 regions of the EU. This reflects the overall focus of the Structural Funds as a whole with planned R&D expenditure in Objective 1 regions representing a similar proportion of overall activity as the balance of Structural Fund expenditure as a whole (76% of R&D spend is planned in Objective 1 regions versus 77% of overall Structural Fund expenditure). Given that Objective 1 regions have a GDP of some 70% of the EU average and a population of just 22% of the EU average this does suggest that EU policy in this direction is supportive of territorial cohesion.

By value, the largest expenditure on R&D actions supported by the Structural Funds are planned in Spain, closely followed by Italy and then Germany. As a proportion of total Structural Fund expenditure Luxembourg and Finland plan the greatest support for R&D activity, closely followed by Italy. The lowest levels are planned in the Netherlands and Greece. Naturally, many Structural Fund programmes are focused on areas where R&D activities are not necessarily appropriate and this may lead to an understatement of the support planned. Examining the proportion of funds dedicated to R&D actions in only those programmes which feature these FOI codes provides a slightly different picture. In many countries there appears to be a concentration of activity in a limited number of programmes, with RTD actions approaching (and exceeding) a quarter of all Structural Fund activities in a number of cases.

Whilst most regional programmes contain some allocation for actions in support of R&D the proportionate value of this can range from a high of 30% to a low of 0.5%. Ireland, Portugal and Spain have all allocated significant resources to the promotion of R&D in areas for support under Objective 1 of the Structural Funds through central programmes. In these cases significantly less resources are available through the regional programmes themselves. Further work is required to relate these regional variations back to the regional typology.

Table 3

Country	FOI Total Structural Fund	Total Structural Fund Amount	FOI Total Structural Fund	Total national structural Funds	FOI% of overall total
Belgium	159,613,980	1,417,720,466	11.26%	2,083,000,000	7.66%
Denmark	26,416,106	189,000,000	13.98%	828,000,000	3.19%
Germany	1,991,713,813	20,889,458,296	9.53%	29,764,000,000	6.69%
Greece	418,154,903	10,052,473,693	4.16%	25,000,000,000	1.67%
Spain	2,695,002,743	30,429,550,000	8.86%	56,205,000,000	4.79%
France	591,808,719	10,176,578,667	5.82%	15,666,000,000	3.78%
Ireland	246,486,322	854,140,923	28.86%	3,482,000,000	7.08%
Italy	2,508,423,859	20,331,480,092	12.34%	29,656,000,000	8.46%
Luxembourg	9,020,000	41,000,000	22.00%	91,000,000	9.91%
Netherlands	24,663,342	969,860,000	2.54%	3,286,000,000	0.75%
Austria	141,379,152	974,000,000	14.52%	1,831,000,000	7.72%
Portugal	683,765,542	13,897,246,000	4.92%	19,700,000,000	3.47%
Finland	202,868,900	1,450,440,000	13.99%	2,090,000,000	9.71%
Sweden	132,634,077	986,000,000	13.45%	2,186,000,000	6.07%
United Kingdom	642,201,111	14,379,982,600	4.47%	16,596,000,000	3.87%
Total	***10,474,152,569***	***127,038,930,737***	***8.24%***	***208,464,000,000***	***5.02%***

Source: adapted from DG Regional Policy records

Conclusions and recommendations

Clear disparities exist between regions across the European territory in terms of their capacity to undertake R&D and innovation. These disparities exist both within States and between States, with a close correlation to levels of GDP per capita. The direction of this relationship is not evident though. The concentrated distribution of high-level R&D infrastructure across the European territory is symbolic of these disparities, although demonstrating the strength of certain capital city regions rather than a 'core' of activity within Europe.

In terms of gross expenditure on R&D the central position of a limited number of areas is clearly evident. This concentration of activity is even greater when the distribution of private sector expenditure on R&D is considered. The reliance of many regions on publicly funded R&D may be seen as a potential weakness, but it also provides a lever through which to encourage a more effective regional innovation system.

A nascent polycentric structure can be identified in the European territories, although this is not evenly balanced. The Accession and Candidate Countries, Spain, Portugal, Greece and Italy are noticeable in their limited areas of European strength in this sector. It is not clear whether this polycentric pattern is a force for positive development or not. European policies have not, so far, explicitly identified this as a pattern to be developed.

Participation in the Framework Programmes is strongly linked to regional R&D capacity. This pattern has not changed significantly between the 4th and 5th Framework Programmes, although there are some, modest, signs of increasing rates of participation amongst those regions with the weakest capacity for R&D and innovation. The Typology of regions developed for this study demonstrates a strong correlation between participation and strength of regional R&D capacity.

However, a number of less favoured regions do demonstrate relatively stronger levels of participation in the Framework Programme than might be expected based upon their existing population or GDP base. This does suggest that the Framework Programmes are having a small positive influence on cohesion objectives. Capital city regions are strongly represented in this area, a position that is, perhaps, reinforced by their strong base of R&D infrastructure.

Overall, the benefit of participation in the Framework Programmes tends to be gathered by the institutions involved. Networking and knowledge creation are regarded as significant gains but are often limited to the partners involved. Knowledge development within regions is present, but only in the best cases. Intra-regional capacity building is thus considered to be limited. In this respect the involvement of regions with weaker R&D capacities may not be accruing the regional benefits that could be achieved through participation in international knowledge networks.

The Structural Funds are focused on supporting the development of less favoured regions. Structural Fund support broadly follows this pattern, with higher levels of support allocated to Objective 1 eligible areas, than those eligible for Objective 2. Proportionately, a greater amount of Structural Fund support is focused on R&D activities in Objective 2 programmes than in Objectove 1 programmes. Overall, the policy approach is thus broadly supportive of cohesion objectives.

The balance of activity targeted on R&D actions varies strongly between eligible regions in some Member States. It is not possible to tell whether this is justified or not. Further work is planned to assess the fit between Structural Fund support and the regional typology developed.

The Structural Funds are more strongly supportive of technology transfer and other knowledge building activities than other forms of R&D intervention. This is a positive reflection on the focus of the Funds. Support for R&D infrastructure remains important, with, proportionately, a stronger focus in Objective 2 programmes, a counter-intuitive finding.

The development of R&D infrastructure is most effective when it is well embedded into a strongly functioning regional and national innovation system. Support for the development of this institutional capacity is limited following the end of the RIS/RITTS initiatives. The Innovative Actions programme continues to support actions in this field although its scope is much wider. The recent launch of a Regions of Knowledge pilot action by DG research may make an important contribution in this field but further support for such activities through the Structural Funds, or other policy initiatives, would be merited.

The distinctions between the Framework Programmes and the Structural Funds offer an important opportunity to balance the twin European objectives of promoting efficiency and equity in the field of R&D capacity. There need not be a trade-off between these two activities and efforts need to be directed towards securing closer synergies between the two within eligible regions. There are some positive examples of efforts made towards supporting the intra-regional transfer of knowledge and capacity generated through participation in the Framework Programmes. It would be valuable if Structural Fund actions could support such actions further. In part this reinforces the need to give more attention to strengthening regional innovation systems in practice.

The move from a simple focus on support for R&D towards one that acknowledges the role of innovation and the complex relationships between the two is gradually being reflected in many European policy approaches in this field. Whilst the two are intrinsically inter-related there is no evidence that they have to occur in the same region. The Framework Programmes offer the epitomy of this. This is one reason we have developed the regional typology to take this into consideration. The typology retains a strong focus on R&D actions and there is the possibility that it is biased towards regions with larger R&D intensive firms. Given that this is a feature of R&D activity across Europe this is not seen to be problematic.

In summary EU R&D policy is broadly appropriate in its overall focus. The Structural Funds and the Framework Programmes are both making a positive contribution to improving the capacity of regions to engage in R&D and innovation. There is a recognition that support for frontier research is not appropriate in all regions and efforts are targeted towards supporting the development of absorptive capacity. At present this capacity is not well distributed across the European territory and efforts by the Structural Funds are broadly positive in this respect. Participation in the Framework Programmes is also assisting in avoiding regional lock-in, although whether the potential they offer is being maximized is a moot point. It should, of course, be recognised that support for R&D may not be an appropriate strategy for all regions in Europe and this study is unable to assess whether the focus attached to R&D targeted actions at a regional scale is appropriate or not.

Whilst the overall focus of EU R&D policies does seem to be broadly appropriate the fact remains that R&D capacity is unevenly balanced. It is also true that the potential intra-regional benefits of participating in the Framework Programmes seems to be undervalued. The importance of promoting effective regional innovation systems has been acknowledged by the Commission through current and past pilot actions and it would appear that this remains a key connection in the bid to improve the overall competitiveness of the European economy. It is at the regional level that connections between supply and demand-side measures can best be made and support to institutional structures to achieve this is to be encouraged. Such actions, coupled with those currently supported are likely to promote increases in regional R&D and innovative capacity, without these then the value of the good work being promoted is unlikely to be maximized. Our key recommendation lies in developing substantive actions which will support the development of well-functioning regional innovation systems, with the objective of increasing the flow of knowledge generated through international networks throughout a region.

In the coming weeks we intend to explore the potential of the regional typology developed further, in order to assess whether it might signal different types of actions as appropriate in different types of region. This may offer the potential for developing a more targeted approach than is currently adopted.

1.2. List of indicators developed/provided to the ESPON Data base

R&D Indicators

- R&D expenditures as a percentage of regional GDP (in millions of national currencies, in millions of euro, and as a percentage of gross domestic product) for the whole economy;
- R&D personnel as a percentage of the labour force (in full time equivalents, head counts, and as a percentage of the labour force) for the whole economy;
- Patent Applications and High Tech Patent Applications to the European Patent Office (total number of applications, number of applications per million people in population, and number of applications per million people in the labour force) for the whole economy
- Employees with Tertiary level education working in a Science and Technology Occupation (HRSTC).

Indicators of "Innovative Capacity"

- Employment in High Technology and Medium High Technology Manufacturing as a percentage of total employment;
- Employment in High Technology Services as a percentage of total employment;
- Percentage of the Working Age Population (aged 24-65) having successfully completed some form of tertiary education.

Indicators of R&D Infrastructure

- Science Parks that are members of the International Association of Science Parks (ISAP). Data was obtained from the membership list on the ISPA website: http://www.iaspworld.org/
- Business Innovation Centres: locations obtained from the European Commission Services
- Most Actively Publishing Universities and Public Research Institutes in the EU 15

EU Policy Indicators

- Project Participations in the EU R&D Framework Programmes
- Field of Intervention data for planned Structural Fund expenditure in the field of RTD

1.3. List of maps and tables in the Interim Report

Tables

Maps

Map 6.5: The proportion of working age population with tertiary education in the EU-27
Map 6.6 High level R&D infrastructure across Europe
Map 8.1 5th Framework Programme Participation by million population

1.4. Application of common platform and Crete Guidance paper

As part of a range of indicators, TPG 2.1.2 has delivered the core indicators indicated in the Crete Guidance Paper at the level of NUTS 2, where available. This is reported more fully in Part 2. The core indicators requested are:

- R&D personnel
- R&D expenditure
- Patents

Regional typologies are to be developed by the ESPON network related to specific themes. These typologies are intended to describe in a bottom up ("inductive") approach certain types of regions which are strong or weak, affected or not affected, attractive or less-attractive with reference to specific ESPON topics (like, e.g., hazard regions, R&D attractive regions, sparsely populated and depopulating regions, peripheral regions etc.). These inductive typologies are intended to be the result of analyses done by the different TPGs on their specific field of research. We report on a proposed typology for R&D and innovation in Part 2.

The measurement and analysis of policy goals and concepts is a crucial component of the Crete Guidance paper. In Part 2 we report on measuring the regional distribution of EU R&D policy, through Framework programme participation and levels of support for R&D activities supported through the Structural Funds. We then assess the extent to which this contributes to the goal of a more balanced development across Europe, with particular reference to less favoured regions.

1.5. Integration of points raised in CU response on IR from March 2003

The following comments and questions were raised regarding the Second Interim Report. We respond to each bullet point as requested.

Analysis

- The report provides background statistics, which are entirely based on Commission sources. All of these are well known, and have been presented in various Commission reports. No analysis of the data is provided, beyond a description of differing levels of a given indicator across regions.

The broad indicators reported in the Second Interim Report remain. These are the focus for the typology developed and also represent the indicators that are accepted as indicators of R&D capacity and innovation capacity. Analysis of this background data is included in Section 6.

- The theory/discussion section provides a framework for the study, however little linkage to the data collection is made.

The links to the data collection have now been made more explicit and are set out in Section 3.

Typology

- The distinction between knowledge-using and knowledge-producing regions will be based upon whether a region has high R&D expenditure or personnel. This distinction is not convincing, as the two would intuitively be expected to go hand in hand.

The typology has been refined further and is not based solely upon whether a region has high R&D expenditure or personnel. The initial typology was not intended to be based upon this distinction but additional explanation is now offered to overcome any ambiguities. The typology is set out in Section 7.

Methodology

- This has to be refined, especially more detailed concerning the territorial effects (chapter 4 and 5). It remains rather vague what would be the concrete work in the coming months, up to the Third Interim Report.

Further detail was provided on this in subsequent correspondence with the Co-ordination Unit. A full description of the methodology is set out in Section 3.

Data, indicators

- Data problems appear to be large, as might have been expected, and as was noted in comments on the First Interim Report. This issue is not addressed in a fully satisfactory manner. The study is restricted to using data from Eurostat, which have practically no value added, since they are well known and available. This suggests that data collection will consist entirely of data request to Eurostat. Data for accession and neighbouring countries is largely missing.

EUROSTAT data remains the principle source of data for the study. This has been augmented by requests to national statistical offices and analysis of data provided by DG Regional Policy and Framework Programme data. Data on Accession Countries has been included as per the reported timetable. Some data problems do remain and are reported on separately. A full description is set out in Section 3. The principle added value of the report lies in reporting the territorial distribution of EU R&D policy interventions.

- The use of national and regional level data to supplement Eurostat data is dismissed (despite the Data Navigator available for each country within ESPON) with no explanation as to which steps were taken to investigate additional sources, what problems there were with these, or which sources were considered , or which sources were considered as potential additions to EU level data.

It is unfair to suggest that the use of national and regional data has simply been 'dismissed'. The intent all along has been to develop a robust, consistent and coherent analysis in order to develop the requested European level analysis and typology of regions. This requires the use of comparable data sets. Significant efforts have been expended to ensure that this is the case. The full details are set out in Section 3.

The main focus with regard to collecting the data for Project 2.1.2 has been on collecting (harmonised) data from EUROSTAT. The two main reasons for doing so are assumed data availability and assumed data reliability. With assumed data availability, we mean that, to the best of our knowledge, if relevant RTD data or indicators are collected by national statistical offices within the (enlarged) EU, these data are transferred to and collected by EUROSTAT. Data collected by national statistical offices which are not collected by EUROSTAT will either only be collected by a limited number of European countries, and as such will make them less useful for comparative analyses, or are too different in definition or methodology to transform them into comparative harmonised data. The latter corresponds to our concept of assumed data reliability, with reliability referring to a common use of definitions and methodology. Our initial assumptions have been proved broadly correct following contacts with national statistical offices.

Given the limited resources for collecting data and given the need for harmonised data for both applying the formal model and for elaborating the case studies, it is thus most efficient to rely on existing data sources already collected by EUROSTAT. TPG 2.1.2 cannot act as a second EUROSTAT collecting data across the European territory that is not already collected by EUROSTAT. The technical expertise to transform national micro data into harmonised European data is not within the expertise of Project 2.1.2.

- There is no apparent awareness of OECD data, which address R&D by sector (national level), where some simple additional information could be found.

Please see response above. OECD data is useful but does only apply at a national level. Whilst this provides interesting additional information on the R&D intensity of different sectors (which may offer an explanation of differentials in regional R&D performance) it was not felt to add significantly to the regional typology developed or the assessment of strengths and weaknesses of different regions, owing to difficulties in allocating this information to regions.

- Checking the availability (p. 13) and perspectives on accession country data seems to need a closer contact with the relevant Eurostat people.

Close contact has been maintained with EUROSTAT staff throughout this study.

Case studies

- The number is still the same (12), although it was underlined in the comments on the First interim Report that the number should be increased, also in view of data gaps on European level.

The number of case studies has been increased to reflect the emphasis placed on this matter.

- The choice of the 12 case studies does not seem to be well balanced over the European territory, but rather linked to the project partner's countries, and does not include any accession country. The case studies should take mainly into account the few available data at NUTS III level.

The balance of the case studies has been adapted to cover a wider range of Member States. The focus of the case studies has been maintained on seeking to identify more clearly Framework Programme participation and Structural Fund activities in support of R&D at a regional scale. Attention has been paid to NUTS 3 data but this is not the primary focus.

Mapping

- Map format (p. 65): the maps should follow the standardised ESPON map layout

- Map production and output:

  - Map output in PowerPoint format is not appropriate.

  - Thematic maps (even if produced in an alternative GIS software environment) have to be exported and delivered in industry standard vector formats (i.e. Adobe Illustrator or Illustrator EPS)

Maps have been produced in the appropriate formats.

1.6. Networking undertaken towards other TPG.

There has been limited networking with other TPGs outside of the Lead Partner and Crete meetings. This reflects the nature of this study. It is envisaged that stronger links might be developed in the coming months as the initial analysis is further refined. There has been strong networking with other relevant projects in this field, including the European Innovation Survey (and Scoreboard) and work led by Cambridge Econometrics for DG

Regional Policy examining the factors of regional competitiveness. This has focused on discussions relating to regional typologies to ensure a consistency in approach.

Part Two

2. *INTRODUCTION*

This report is the third interim report for ESPON Project 2.1.2 : The Territorial Impact of European Union R&D Policy. ECOTEC Research and Consulting Ltd is the lead Partner for this ESPON Project. The project is aimed at supporting policy development by providing new knowledge, concepts and indicators on territorial trends and policy impacts related to an enlarged European Union. In this respect, the project uses the EU 27 as the territorial unit of analysis and as far as possible includes Norway and Switzerland, where relevant.

The ESPON studies are intended to inform:

- Those factors relevant for a more polycentric European territory.
- The development of territorial indicators and typologies, capable of identifying and measuring development trends as well as monitoring the political aim of a better balanced and polycentric EU territory;
- The development of tools supporting diagnosis of principal structural difficulties, as well as potentialities. This should include disparities within cities and regenerating deprived urban areas;
- The investigation of territorial impacts of sectoral and structural policies, such as the Structural Funds;
- The development of integrated tools in support of a balanced and polycentric territorial development.

The general objectives set out for Project 2.1.2 are:

1. To develop methods for territorial impact assessment of sectoral policies
2. To develop territorial indicators, typologies and concepts, establish a database and map-making facilities and sustain the project by empirical, statistical and/or data analysis.
3. To analyse territorial trends, potentials and problems deriving from the policy, at different scales, and in different parts of the European territory.
4. To show the influence of the policies on spatial development at relevant scales
5. To show the inter-play between EU and sub-EU spatial policies and best examples for integration
6. To recommend further policy developments in support of territorial cohesion and a polycentric and better balanced EU territory
7. To find appropriate instruments to improve the spatial co-ordination of EU sector policies and the ESDP
8. To consider the provisions made and to provide input for the achievement of the horizontal projects under priority 3.

In addition, the study is expected to:

- Identify and gather existing territorial indicators to measure and display the state, trends and impacts of R&D policy and propose new indicators where necessary.

- Operationalise the policy options of the ESDP relevant for a territorial impact analysis of R&D policy, and development of a methodology for impact analysis at a EU scale.
- Conceptualise and elaborate a territorial impact analysis for R&D policy with special consideration of the following points:
  - How far R&D policy addresses emerging border and integration problems, taking into account the variety of regions and enlargement. Does EU R&D policy provide adequate accessibility in the regions of Europe?
  - What spatial effects are expected in terms of current and future R&D policy?
  - How far does EU R&D policy support the concentration of development corridors and polycentric development and what other spatial effects are emerging?
  - How far does EU R&D policy affect the spatial diffusion of innovation and knowledge in Europe?
- Consider what kind of resources are available at EU level to conduct R&D policy and whether the necessary co-ordination take place with national policy;
- Consider what the territorial conditions that allow regions to take best advantage R&D policy are, in terms of innovation and economic development;
- Consider how R&D policy at EU and Member State level should be designed and co-ordinated to promote an equal access to knowledge infrastructures for all European territories;
- Consider how the Structural Funds and R&D policy could develop a more coherent and effective approach in promoting R&D capacities and territorial cohesion.

This report builds upon the first and second Interim Reports, produced in October 2002 and April 2003, and takes into account comments made by the European Commission, the ESPON Co-ordination Unit and discussions at the ESPON meetings in Luxembourg, Crete and Brussels. It also takes into consideration discussions between this project and the ESPON projects 2.2.1 and 1.1.1.

Some elements of the following analysis have been previously provided to DG Regional Policy, at their request, for consideration in the preparation of the 3rd Cohesion Report. We would like to thank Mikel Landabasso, Gabrielle Hernandez, Ulrike Hiebl, Patrick Salez and Hugo Poelman of DG Regional Policy for their many constructive inputs to the present report. The report has also benefited from the helpful and positive comments of Dimitri Corpakis and Keith Sequira of DG Research and Peter Mehlbye of the Co-ordination Unit. These are reflected in the shape of the report presented.

3. METHODOLOGY

3.1. Background

The approaches, methodologies, typologies, concepts, indicators, data availability and mapping were set out in the first Interim Report. Following comments on this report by DG Regional Policy and DG Research, some amendments have been made to refine the approach further and to take into account more clearly some specific interests of the European Commission, as set out in the Terms of Reference. The conceptual basis for the study has been based upon an extensive review of existing literature in this field, which, together with the knowledge of the expert team, assisted in identifying key areas for analysis.

The methodology for the study was based upon the following assumptions, partly given by the teams existing knowledge in the area and partly by review of literature in the topic area. This highlighted the following assumptions:

1. The territorial impacts of EU R&D policy will be caused principally through the operation of different financial mechanisms. Consequently a clear assessment of where this activity occurs is highly important, in particular:

- Actions supported through the EU RTD Framework Programmes (FPs) such as FPs 4, 5 and 6.
- Actions supported through the ERDF and ESF. Some actions may be supported through EAGGF but they are not considered here. In particular actions financed through Objective 1, Objective 2 and Innovative Actions.

2. The form that the effect will have will be influenced by the nature of the funding programmes, with an a priori assumption that this will be of the following form.

	ERDF	***ESF***	***FP***
Business research	*Yes*		*Yes*
University research	*Yes*	*Yes*	*Yes*
Research infrastructure	*Yes*		
Regional strategies	*Yes*		

3. That the intended impacts of EU R&D would be to contribute to a strengthening of the regional R&D base leading to:

- Improved levels of R&D leading to increase in economic performance of firms and the region
- Improved quality of R&D leading to higher economic performance of firms and the region
- Increased commercialisation of R&D leading to higher economic performance of firms and the region

- Increased capacity to undertake R&D leading to increase in amount of R&D undertaken leading to higher economic performance of firms and the region

4. That the temporal scale for the study will primarily be backwards looking, building an assessment of what the territorial effects of EU R&D policy have been to date. In this respect we primarily examine the period 1994-2006.

5. That two principal hypotheses are presented for assessment by this study:
- EU Framework Programme participation is weighted towards economically stronger regions with an established R&D capacity.
- EU Structural Fund programmes focus proportionately more resources on developing R&D capacity in those regions where capacity is weakest and economic performance low

3.2. Assessing EU R&D policy

The study is examining EU R&D policy. In this respect, it is examining the territorial impact of actions undertaken though the R&D Framework Programmes and those actions aimed at improving R&D capacity undertaken through the Structural Funds. The initial element of the work programme has thus been to identify the nature of EU R&D policy. This focuses on the RTD Framework Programmes (FP), primarily FP 4 and 5, and the R&D supportive elements of the Structural Funds. Description of approach is included coupled with an analysis of the territorial distribution of these activities. This is based upon the analysis of datasets which, to our knowledge, has not been undertaken before. In the case of the Framework Programme this has involved detailed interrogation of the CORDIS database, and for the Structural Funds the manipulation of records held by DG Regional Policy on the different Fields of Intervention supported by Structural Fund programmes across the EU. The initial terms of reference for the study also made reference to analysis of domestic R&D policy. Following an explicit request from the European Commission in the initial stages of the study this element of the work programme was not continued as a separate activity. The synergies between EU and domestic R&D policies are, however, an area for exploration in the more detailed regional case studies.

3.3. Assessing capacity for R&D and innovation

A critical element of the study is to identify territorial imbalances and regional in R&D capacity and innovation. This has been undertaken through analysis of a number of datasets that are comparable across the European territory. We have undertaken the analysis at the NUTS 2 level both for practical and conceptual reasons, as previously agreed. In addition to basic socio-economic indicators (GDP, unemployment etc), TPG 2.1.2 has focused on collecting the following core indicators relating to the field of R&D and Innovation. The selection of these is related to literature analysis of suitable indicators coupled with common consensus as to acceptable indicators in this field.

R&D Indicators

- R&D expenditures as a percentage of regional GDP (in millions of national currencies, in millions of euro, and as a percentage of gross domestic product) for the whole economy, for the business enterprise sector (BES), government sector (GOV), higher education sector (HES), and private non-profit sector (PNP);
- R&D personnel as a percentage of the labour force (in full time equivalents, head counts, and as a percentage of the labour force) for the whole economy, for the business enterprise sector (BES), government sector (GOV), higher education sector (HES), and private non-profit sector (PNP);
- Patent Applications and High Tech Patent Applications to the European Patent Office (total number of applications, number of applications per million people in population, and number of applications per million people in the labour force) for the whole economy
- Employees with Tertiary level education working in a Science and Technology Occupation (HRSTC).

Indicators of "Innovative Capacity"

- Employment in High Technology and Medium High Technology Manufacturing as a percentage of total employment;
- Employment in High Technology Services as a percentage of total employment;
- Percentage of the Working Age Population (aged 24-65) having successfully completed some form of tertiary education.

Indicators of R&D Infrastructure

- Science Parks that are members of the International Association of Science Parks (ISAP). Data was obtained from the membership list on the ISPA website: http://www.iaspworld.org/
- Business Innovation Centres: locations obtained from the European Commission Services
- Most Actively Publishing Universities and Public Research Institutes in the EU 15

The definitions of the indicators referred to above are as follows:

1 Expenditure on R&D as a percentage of GDP

The basic measure for R&D expenditure is the "intramural expenditures", which are all expenditures for R&D performed within a statistical unit or sector of the economy, whatever the source of funds (Frascati Manual, § 335). R&D expenditure is produced separately for the Business Enterprise Sector (BES), the Higher Education Sector (HES), the Government Sector (GOV) and the Private non-profit sector (PNP).

2 R&D personnel as a percentage of the labour force

R&D personnel data measure the amount of resources going directly into R&D activities. This includes all persons employed directly in R&D plus persons supplying direct services to R&D, such as managers, administrative staff and office staff (Frascati Manual § 279). R&D personnel data is collected in Headcount (total number of persons who are mainly or partially employed on R&D) and Full Time Equivalent (FTE). Not all countries collect R&D personnel by headcount.

3 Employees with Tertiary level education working in a Science and Technology Occupation as a percentage of total employment.

Human resources in science and technology (HRST) are people who fulfil one or other of the following conditions:

- successfully completed education at the third level in an S&T field of study (including natural sciences; engineering and technology; medical sciences; agricultural sciences; social sciences; humanities; other fields, where the first five are "core" fields and the last two "extended")[5]
- not formally qualified as above but employed in a S&T occupation where the above qualifications are normally required

Human Resources in Science and Technology Core (HRSTC) are those people who have a third level education and work in a S&T occupation. Examples include:

- university professor with a PhD in economics;
- computer system designer with a degree in computer science;
- dentist practising in his/her own dental surgery

The Codes are as follows:

- HRSTE: those people who have successfully completed third level education
- HRSTO: those people working in a S&T occupation
- HRSTC: the core HRST (those people who have a third level education and working a S&T occupation).
- HRST = HRSTO + HRSTE - HRSTC

For further information, see OECD and Eurostat (1995), "Manual on the Measurement of Human Resources Devoted to S&T – Canberra Manual", Paris

4 Employment in High Technology and Medium High Technology Manufacturing as a percentage of labour force

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[5] Manual on the Measurement of Human Resources devoted to S&T Canberra Manual, OECD, Paris 1995, p.22 (see http://www.oecd.org/dataoecd/34/0/2096025.pdf)

The medium-high and high technology sectors include chemicals NACE[6] (24), machinery (NACE 29) 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.

5 Employment in High Technology Services as a percentage of labour force

This indicator focuses on three leading edge sectors that produce high technology services: post and telecommunications (NACE 64); information technology including software development (NACE 72); and R&D services (NACE 73). The total workforce includes all manufacturing and service sectors.

6 Population with Tertiary Education

The percentage of the total working age population (25-64 years age classes) with some form of post-secondary education (ISCED 5 and 6).

7 Project Participation in the Framework Programmes

The data for regional participation in the Framework programmes has been obtained from the Projects database maintained by the European Commission's CORDIS service[7]. This database records the details of all partners participating in research activities funded under the Framework Programmes, including the region in which they are located.

The ***total number of project participations in a given Framework Programme in a region*** measures the number of projects with at least one participant in the region concerned. The figure includes all project (contract) types in all sub programmes, including research support actions, such as Accompanying Measures, which do not involve direct involvement in Research and Development activities.

The figure for total number of project participations can be sub-divided into "Prime Contractors" and "Other Contractors":

- ***Prime Contractors*** are those participants responsible for co-ordinating the research (or research-related) activity in question. This group of participants includes individuals who are awarded fellowships of other support grants and are not part of a larger research project network.
- ***Other Contractors*** are secondary contractors, who participate in research (or research-related) projects, but do not have responsibility for co-ordinating the action in question.

[6] Nomenclature statistique des Activités économiques dans la Communauté Européenne" - Statistical classification of economic activities in the European Community
[7] Available online at http://dbs.cordis.lu/search/en/simple/EN_PROJ_simple.html

Data is available at NUTS II level for most regions in the EU-15. In some cases, often where NUTS boundaries have been altered, data is only available at NUTS I level (for example for Wales or Ireland). Data is available at national level for other countries, including Accession and Candidate states, Norway, Iceland and Switzerland.

8 Members of the International Association of Science Parks (ISAP).

Data was obtained from the membership list on the ISPA website:
http://www.iaspworld.org/

9 Most Actively Publishing Universities and Public Research Institutes in the EU 15

Most actively publishing universities and public research insititutions in the EU-15 member states (universities and public research insitutions appearing in the top 20 most actively publishing research institutions in D,E, F, I, NL, S, UK and top 10 most actively publishing institutions in B, DK, FIN, AT, GR, P, IRE). Obtained from *Third European Report on Science and Technology Indicators 2003*, DG Research 2003 pp.310-314. Private Organisations appearing in the original ranking have been excluded.

3.4. Data Availability

The primary source for data used by the project was Eurostat's Regio Database. This database is the most comprehensive and reliable source of regional statistical data in Europe and covers both the EU-15 countries, Accession States and, for some indicators, Norway. Data was first obtained in November 2001 and updates, mostly covering R&D data for the candidate countries, was obtained in July 2002. In general the smallest territorial unit for which R&D data is available is NUTS II. In some cases it is only available at NUTS 1.

In general terms, R&D data (total expenditure and personnel) is available at NUTS II level for most countries in the EU-27 (with variable availability over time), with the exception of the Belgium, Ireland, Malta, Romania, Sweden and the UK[8]. The innovation indicators used are consistently available for the EU-15, but only available at national level in the Candidate Countries. Availability of innovation data is even more problematic for Romania and Malta. The level of data used by the project for the six key indicators for each country of the EU-27 is summarized in the table below. Exceptions to the general rule of NUTS II data are highlighted.

[8] See Methodology for further details, including steps taken to address data gaps.

Table 3.1 Data status for key indicators

Country	R&D Capacity			Innovation Capacity		
	R&D expenditure (All sectors)	R&D personnel (All sectors)	HRSTC	Employment in High & Medium High Tech Manufacturing	Employment in High Tech Services	Working Age Population with Tertiary Education
Austria (AT)	NUTS II	NUTS II	NUTS II	NUTS II	NUTS II	NUTS II
Belgium (BE)	**NUTS 0**	**NUTS 0**	NUTS II	NUTS II	NUTS II	**NUTS 0/I**[9]
Bulgaria (BU)	NUTS II	NUTS II	**NA**	**NUTS 0**	**NUTS 0**	**NUTS 0**
Cyprus (CY)	NUTS II	NUTS II	**NA**	NUTS II	NUTS II	NUTS II
Czech Republic	NUTS II	NUTS II	**NA**	**NUTS 0**	**NUTS 0**	**NUTS 0**
Germany (DE)	NUTS II	NUTS II	NUTS II	NUTS II	NUTS II	NUTS II
Denmark (DK)	NUTS II	NUTS II	**NA**	NUTS II	NUTS II	NUTS II
Estonia (EE)	NUTS II	NUTS II	**NA**	NUTS II	NUTS II	NUTS II
Spain (ES)	NUTS II	NUTS II	NUTS II	NUTS II	NUTS II	NUTS II
Finland (FI)	NUTS II	NUTS II	NUTS II	NUTS II	NUTS II	NUTS II
France (FR)	NUTS II	NUTS II	NUTS II	NUTS II	NUTS II	NUTS II
Greece (GR)	NUTS II	NUTS II	NUTS II	NUTS II	NUTS II	NUTS II
Hungary (HU)	NUTS II	NUTS II	**NA**	**NUTS 0**	**NUTS 0**	**NUTS 0**
Ireland (IE)[10]	**NUTS I**	**NA**	**NUTS I**	NUTS II	NUTS II	**NA**
Italy (I)	NUTS II	NUTS II	NUTS II	NUTS II	NUTS II	NUTS II
Lithuania (LT)	NUTS II	NUTS II	**NA**	NUTS II	NUTS II	NUTS II
Luxembourg	NUTS II	NUTS II	NUTS II	NUTS II	NUTS II	**NA**
Latvia (LV)	NUTS II	NUTS II	**NA**	NUTS II	NUTS II	NUTS II
Malta (MT)	**NA**	**NA**	**NA**	**NA**	**NA**	NUTS II
Netherlands	NUTS II	NUTS II	NUTS II	NUTS II	NUTS II	NUTS II
Poland (PL)	NUTS II	NUTS II	**NA**	**NUTS 0**	**NUTS 0**	**NUTS 0**
Portugal (PT)	NUTS II	NUTS II	NUTS II	NUTS II	NUTS II	NUTS II
Romania (RO)	**NUTS 0**	**NUTS 0**	**NA**	**NA**	**NA**	**NUTS 0**
Sweden (SE)	**NUTS 0/I**	NUTS II	NUTS II	NUTS II	NUTS II	NUTS II
Slovenia (SI)	NUTS II	NUTS II	**NA**	NUTS II	NUTS II	NUTS II
Slovakia (SK)	NUTS II	NUTS II	**NA**	**NUTS 0**	**NUTS 0**	**NUTS 0**
UK	**NUTS I**	**NA**	NUTS II	NUTS II	NUTS II	NUTS II

Where gaps have been detected in the data availability the project team has attempted to fill these, through a variety of mechanisms. The principle measures to taken to address identified data gaps are set out below.

To address data shortages for R&D expenditure and personnel, initially identified in the candidate countries, an initial request was sent for data was sent to the national statistical agencies in 10 countries. In addition the following requests were made:

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[9] Population with Tertiary Education data is only available for the *Brussels-Capital* region..

[10] Until the end 1999, the Republic of Ireland was one NUTS 0,I and II region, at which point it was divided into two NUTS II regions. R&D data is not available for the new NUTS II regions.

- Request to Eurostat through Project 3.1
- Contact with ESPON national contact points in EU-15 and Switzerland
- Direct Contact with National Statistic Offices in the EU-15
- Direct contact with various contacts at Eurostat

The response to the various approaches is summarized below.

Table 3.2: Candidate countries' response to the March 14 data survey

Country	Date of sending the survey	Date of receiving first answer	Answer
Bulgaria	March 14	March 25	Positive reply, but additional data have to be paid for
Czech Republic	March 14	March 21	Positive reply
Estonia	March 14	March 21	Positive reply, willing to provide NUTS3 data
Hungary	March 14		
Lithuania	March 14	March 24	Positive reply, did send updated data
Latvia	March 14	March 20	Positive reply, did send updated data
Poland	March 14		No reply
Romania	March 14		No reply
Slovenia	March 14		No reply
Slovakia	March 14	March 28	Asked for resending the survey, no reply since then

Replies have also been received from all agencies except the German Federal Statistical Office, the UK ONS, the French Statistics Office The replies received either sent data, highlighted websites or indicated why data was not available (in other word confirmed or explained the data gaps in the Eurostat database.

Key points that emerge from this exercise are that:

- Innovation indicators not consistently collected at regional level in any candidate countries (regional level is NUTS III in Baltic States, Slovenia)
- Total R&D expenditure data does not exist at regional level in Belgium (it is the competence of region and community)
- For Austria there is no R&D data since a 1998 survey
- For Sweden no regional R&D expenditure data is available

3.5. Assessing the regional dimension to EU R&D policy

The quantitative data analysis has been supplemented with qualitative evidence of the spatial effects of EU R&D policy drawn from 25 case study regions. Data has been collected for all regions on the nature of EU R&D activities in the region. The overall objective of the regional case studies is to explore the ways in which EU policy initiatives in the field of R&D have a territorial impact at the regional level and beyond. The case study regions, selected to give coverage of a range of EU R&D policy interventions, regional economic performance levels and RTDI intensity, are designed to help us answer the following core questions:

- What are the expected *spatial effects* of current and future European R&D policy?
- How *accessible* are EU R&D policy instruments in different types of region?
- How far do EU R&D policies support *polycentric development*?
- How do the policies affect the *spatial diffusion* of innovation and knowledge?
- How *coherent* are the different strands of EU R&D policy, in terms of territorial impact?
- What are the *territorial conditions* which allow regions to take best advantage of EU R&D policy (economic conditions and structure, regional and national policy context)?

In practical terms, each case study will provide data and analysis allowing us to gain an insight into the following questions:

a. *Which* EU R&D policies directly affect the region, in terms of programme (RTD Framework Programmes, mainstream Structural Funds, RIS, RITTS, RIS+, Innovative Actions) and budget allocation (where possible)?
b. *Who* is affected by these interventions? This includes identifying the direct beneficiaries of policy interventions and those who are affected indirectly, downstream from direct beneficiaries
c. *Where* are these effects felt (i.e. what is the territorial dimension of these effects)?
d. *What* factors or framework conditions, (including territorial location, regional economic performance and policy context), influence the territorial reach of these policies?

Following discussion with the European Commission and comments from the Co-ordination Unit the number of case studies examined as part of the study was increased from 12 to 25. This included broadening the spread of case studies from the initial 5 Member States to 13 Member States and 1 Accession Country. The following areas have been selected as case study regions:

1. Liguria (Italy)
2. Puglia (Italy)
3. Calabria (Italy)
4. Cologne (Germany)
5. Mecklenburg-Pomerania (Germany)
6. Overijssel (the Netherlands)
7. Castilla y León (Spain)
8. Comunidad De Madrid (Spain)
9. Aragón (Spain)
10. West Wales and The Valleys (UK)
11. West Midlands (UK)
12. East Anglia (UK)

13. Auvergne (France)
14. Lorraine (France)
15. Uusimaa (Finland)
16. Stockholm (Sweden)
17. Vienna (Austria)
18. Limburg (Belgium)
19. Lisbon (Portugal)
20. Algarve (Portugal)
21. Ireland
22. Luxembourg
23. Warsaw (Poland)
24. Wielkopolska (Poland)

The criteria on which this selection was based were discussed in the Second Interim Report and reflected comments from the Commission. The case studies were selected on the basis of whether regions benefit or not from the following:

a. Objective 1
b. Objective 2
c. RIS/RITTS or Innovative Action 2000-2006
d. R&D Framework Programmes

Other indicators that were taken into consideration included economic strength and R&D capacity, based on:

- GDP % EU Average - 1999
- BES R&D expenditure % GDP 1999
- GOV R&D expenditure % GDP 1999
- High-tech patents (no. applications per million population) 1999

4. *TOWARDS AN UNDERSTANDING OF THE TERRITORIAL EFFECTS OF R&D POLICY*

The following section presents hypotheses on the territorial effects of R&D Policy. It provides a framework for the later analysis of the territorial effects of EU R&D policy and consideration of different policy options. It has also played a role in considering the nature of the Typology of regions developed later.

4.1. From R&D to Innovation: Learning, Knowledge and Absorptive Capacity

There is universal agreement in the innovation literature that the biggest error one can make in this field is to confuse R&D with innovation. Major advances have been made in recent years, in both the theoretical and statistical literatures, in distinguishing between R&D and innovation - the means and the end so to speak. A large part of the innovation literature aims to analyse the innovative performance of units – be they firms and industries or countries and regions – through proxy indicators such as R&D expenditure, patents, technology balance of payments and trade in high-tech products. While each of these is useful, they all have their limitations and need to be used in conjunction to give a more satisfactory account of innovative performance. R&D expenditure is perhaps the most ubiquitous proxy indicator for innovation, but even this is a partial explanation because learning, knowledge accumulation and innovation involve far more than formal R&D processes. Indeed, according to the Community Innovation Survey, a breakdown of innovation expenditure showed the following proportions: R&D accounted for 41% of total expenditure, trial production, training and tooling up (27%), product design (22%), market analysis (5%), acquisition of patents (3%), with 2% devoted to other activities (EC, 1997).

As three seasoned experts have put it, it is possible that our measure of technological capability – namely formal R&D - is biased to large firms in high R&D industries and countries and fails to reflect efforts by small firms engaged in imitation and industries in which informal learning dominates the innovation process. They conclude by saying that this is an area ‘where further research seems not only fruitful but absolutely necessary’ (Cappelen, Fagerberg and Verspagen, 1999).

The most important international source of guidelines on the definition and measurement of innovation activities is the Oslo Manual (1997), which has formed the methodological basis of a number of innovation surveys, including the Community Innovation Survey (CIS), which was first developed between 1991 and 1993. The main focus of the Oslo Manual is on technological innovation, or more precisely technological product and process innovation. This it defines as technologically new or improved products and processes that have been introduced onto the market (product innovation) or used within a production process (process innovation). However, non-technological innovation (eg organisational or managerial innovation) is not included, even though the Manual admits that technological and organisational may be highly inter-connected. Few innovation surveys have addressed this omission adequately, hence the Manual recommends the development of measures of non-technological innovation, an issue which has been addressed at the regional level in a highly stimulating analysis of evaluation methodologies (Nauwelaers and Reid, 1995), a theme to which we return later.

Addressing the organisational dimension is becoming ever more essential to an understanding of innovation. Models of innovation have become more sophisticated in recent years, moving away from the simplistic 'technology push' and 'market pull' models towards a less linear and more interactive understanding of the innovation process (the pioneering texts here are Burns and Stalker, 1961; Rothwell and Zegveld, 1985 and Kline and Rosenberg, 1986).

It is absolutely vital to understand the implications of this shift from linear to interactive models of innovation because so many regional and RTD policies are predicated on the former rather than the latter, and this helps to explain why so many of these policies have failed, a point we address in more detail below. In linear models innovation is basically conceived as the application of 'upstream' scientific knowledge to the 'downstream' activities of product design, production and marketing. Linear models suffer from three fatal weaknesses:

- They exaggerate the role of basic science
- They invoke an unwarranted hierarchy of knowledge in which 'pure' scientific knowledge is ranked above 'applied' technical and engineering knowledge
- They fail to appreciate the need for continuous interaction and feedback (OECD, 1992; Cooke and Morgan, 1998)

From a policy perspective the key point to establish is that R&D has to be integrated with other complementary assets, particularly in the firm, if it is going to make a difference to innovation and economic development. The celebrated notion of 'cathedrals in the desert' is an excellent metaphor to describe R&D facilities that are not embedded in and connected to wider commercial processes in less favoured regions of Europe.

There is no guarantee that R&D will lead to successful innovation, even though some of the classical scholars thought that the innovation process was becoming routinised as a result of it being managed by 'teams of trained specialists who turn out what is required and make it work in predictable ways' (Schumpeter, 1943). Far from being a predictable process R&D is best conceived as 'a groping, searching, uncertain process', the success of which can only be established ex post (Freeman, 1982). There is no better illustration of this conception than the innovation paradox in today's pharmaceutical industry, one of the most R&D intensive sectors of all. Last year the leading pharma companies invested some $35 billion in R&D but the results have been disappointing because in that year only 24 new drugs were approved in the US, compared with 27 in 2000, 35 in 1999 and 53 in 1996. This declining rate of product innovation has been attributed to the fact that 'large pharmaceutical companies, with several thousand of research scientists and annual budgets in the billions of dollars, have become so large that innovation is stifled' (Dyer, 2002).

The unpredictability of R&D stems from its inherent complexity and from the fact that it involves a high degree of tacitness. In contrast to codified knowledge, which can be standardised and disseminated quite easily, tacit knowledge is person-embodied and context-dependent, hence it requires more face-to-face contact to be exchanged effectively. Crudely speaking, this is how a lot of theoretical literature explains the phenomenon of spatial clustering. One of the key assumptions that the theoretical literature makes when examining the link between knowledge spillovers and spatial clustering is that 'knowledge externalities are more prevalent when new economic knowledge plays a greater role' (Audretsch and Feldman, 1996). The burgeoning literature on learning and innovation seems to point to the following as a rough rule of thumb: the greater the complexity, uncertainty and tacitness of an activity, the more it will require physical as opposed to virtual proximity to be transacted (see Morgan, forthcoming, for a review of the 'death of geography' debate).

One way to summarise the results of a great deal of recent research in the cognate spheres of learning, knowledge transfer and innovation is to say that the most critical aspects 'are *not* dependent upon frontier research, doctoral graduates, gross expenditures and so on, but on spillovers, linkages, networks, inter-dependencies, synergies etc' (de la Mothe and Pacquet, 1998). Developing this robust line of reasoning other experts have argued that the 'technological and market knowledge which underpins innovation is often tacit and idiosyncratic, and therefore learned by doing, using and interacting with customers, suppliers and related industries' (Utterback and Afuah, 2000).

In the evolutionary economic literature which has made the running in innovation studies in recent years, one of the greatest challenges for firms, and indeed for other organisations too, is how to strike a balance between *routines,* which help to steer and regularise organisational practices, and *creativity,* which is the lifeblood of innovation (Dosi et al, 1988). Learning is what helps firms to strike this balance and the capacity to learn depends in no small way on their *absorptive capacity*. In other words a firm's ability to recognise, assimilate and exploit knowledge, both from within and without, is largely a function of the level of prior-related knowledge (Cohen and Levinthal, 1990). To put it another way, to be able profit from the technological expertise of research centres, universities or private R&D labs, local firms have to perform a modicum of R&D themselves and this capability helps to keep them attuned to the commercial possibilities of R&D performed elsewhere.

This critically important concept of absorptive capacity refers to much more than technical skills; rather it underlines the need for a shared cognitive framework within the firm and the ability to transfer knowledge across departmental boundaries. The concept also highlights the significance of organisational learning, which is much more than the sum of individual learning (Nonaka and Takeuchi, 1995)

The concept of absorptive capacity has been employed to explain why regional technology policies often fail. Animated by a linear model of innovation, such policies were traditionally biased towards supply-side infrastructures. In one of the very best reviews of RTD policy in the EU it was argued that the problem now is that 'enterprises often lack the internal motivation and organisational resources to develop entrepreneurial and organisational ('learning') competences', and therefore there is a need for 'a new balance between measures supporting the science and technology infrastructure and measures supporting absorptive capacity, ie the resources available *inside* the enterprise' (Dankbaar et al, 1993).

While R&D may be an important factor behind differences in growth performance among advanced regions, and between advanced and less advanced regions, it does not seem to be a very efficient tool for regions below a certain threshold of development, and this begs new questions about the creation of RTD capabilities in less favoured regions. These findings serve as a warning against R&D euphoria in backward regions that lack the necessary infrastructure and complementary assets to make a success of it because 'creating technological capabilities in backward regions demands much more than R&D' (Cappelen et al, 1999).

Recent research in innovation has stressed the growing significance of intangible assets, a category that includes formal assets like research, software, brands etc (Lev, 2000), as well as informal assets like social capital, which is shorthand for the norms and networks of trust and reciprocity. Unlike physical capital, which wears out with use, social capital wears out with disuse, hence it is enhanced when it is (successfully) used (Ostrom, 2000).

Although social capital is notoriously difficult to define, let alone measure and quantify, it would seem to play an increasingly important role in fostering/frustrating collective action within organisations as well as between them. To the extent that social capital helps organisations to collaborate for mutually beneficial ends, this process tends to spawn and sustain trust. A social facility which is learned, trust tends to be conceived in the development literature as an asset as well as a liability: it is an asset to the extent that it saves time and expedites learning, but it can be a liability if it leads to 'lock-in', where the partners in a network become blind to good practice outside the network (Grabher, 1993; Cooke and Morgan, 1998).

If these informal intangible assets are becoming more important in explaining differential innovation performance, it is imperative that surveys try to capture their effect through new proxy indicators, a point we address later.

4.2. The Role of Institutions: National and Regional Innovation Systems

The recognition of the role of institutions in innovation has entered the mainstream in recent years and it has been predicated upon a number of developments in evolutionary political economy, innovation theory and economic development policy. This section aims to give a flavour of these debates in the context of national innovation systems and the more recent concept of regional innovation systems.

As we saw in section two, an exclusive focus on R&D blinds us to wider innovation processes in terms of where they occur and the actors involved, which may be just as important in terms of competitiveness as Schumpeterian (product based) advances

(Asheim & Cooke, 1999; Cooke, 1998; Nelson & Rosenberg, 1993). This suggests the need for an important reconceptualisation - from the 'knowledge economy', which implies a neatly packaged, tradable asset, to the 'learning economy' which captures the greater complexity of an uncertain and unpredictable world (Lundvall, 1999). Innovation is thus conceived of as an interactive - collective and iterative - process involving actors from diverse sectors and in different functions (Cooke, 1998; Braczyk & Heidenreich, 1998; Cooke & Morgan, 1998). It involves both institutions in terms of organisations, and institutions as norms, rules and behaviour; crucially, institutions may thus be both the medium and the outcome of collective action (Morgan, forthcoming).

The latter further reflects acceptance of the mutual compatibility of collaboration and competitiveness (Cooke, 1998). This is linked to the increased interest and, many would argue salience, of evolutionary economics. Amongst other things, theorists under this umbrella assert the significance of various disequilibria situations such as dynamic uncertainty and bounded rationality. These are held to induce certain kinds of behaviour (collaboration, risk-sharing, interactive learning, spatial agglomeration etc) and result in further path dependencies and positive feedbacks (Cooke & Morgan, 1998). This theory also highlights an inherent tension or dialectical tendency in such configurations - the balance between routines or institutional embeddedness and creativity.

Some economic geographers (e.g. Scott, Storper, Schoenberger) meanwhile have been investigating the 'clustering phenomenon', and the continuing relevance of geography in an era in which technology is allegedly dissolving locational constraints and material needs. The results of such work tie in with conceptions of relational space as place, comprising both physical and more intangible characteristics - including institutions.

The acknowledgement of the role of actors (both collectively and individually conceived) beyond the firm and conventional R&D institutions coincides with conceptions of contemporary, associational, networked governance, as compared to the polar opposition of the market and the state (Grabher, 1993; Morgan, 1997, Morgan & Cooke, 1998).

Lastly, a move to focus on outcomes and processes rather than inputs and outputs in economic development theory and policy is discernible (Oughton et al. 2002). At one level this dictates the desirability of unpacking the black box to reveal the linkages between inputs, processes and outputs, and how these are sustained and broadened/deepened to produce outcomes with greater effect. The language of institutions may thus be seen as a simplification or at least summary of these complexities. More prosaically, this can be seen in a shift from simply attempting to lever in inward investment, to working to add value to such investment though for instance, local supply chain support, aiming to safeguard jobs as well as create new ones, and thence to focusing on endogenous potential (Morgan, 1997). These prefatory remarks lead us to consider two specific institutional forms – national innovation systems and regional innovation systems.

a) National Innovation Systems (NIS)

One way to understand the role of institutions has been through national comparative analysis, based on the acknowledgement of differences in national technological trajectories (Dosi, 1988; Oughton et al, 2002). This reveals considerable variation across several types of institution between countries, which conceivably affect patterns of innovation to the extent that they together may be conceptualised as a system. The following dimensions of a NIS emerge from the literature (Dosi et al, 1988; Lundvall, 1992; Nelson, 1993; Cooke and Morgan, 1998):

- The organisation of R&D - the role of government funding, and large firms. National technological specialisation may reflect this, as may mechanisms of diffusion, giving rise to particular key arenas of interaction

- The ensemble of education and training institutions - providing particular skill configurations within the workforce, influenced to a greater or lesser extent by industry. There may also be significant differences in the way in which these skills are organised within the firm - for example, the extent to which vertical hierarchies as opposed to horizontal relations prevail

- The financial system - the time-scale of investment, price of borrowing, financial regulations, accounting practices, corporate ownership rules and relations with industry

- The network of user-producer relations - the intensity and stability of feedback relations and hence learning. This may also however vary with product type

- Intermediate institutions - both sectoral (such as trade associations) and territorial (such as local chambers) may be key institutions of diffusion

- Social capital - features of social organisation, such as norms, networks and trust, particular configurations of which may prevail on a national basis, which may relate to particular national historical political-economic trajectories

Together these can affect the world view of actors and organisations, their calculation of risk and opportunity, who they seek to interact with, flows and nodes of communication and so on (Morgan forthcoming; Cooke & Morgan, 1998). For instance, the German configuration has until recently been based on amongst other things, a strong system of intermediate vocational qualifications, intimate finance-industry relations based on long term investments, stable and intense user-producer relations marked by trust, voice and loyalty, strong intermediate organisations and wider societal relations more open to collaboration for mutually beneficial ends. This may be contrasted with Anglo-American configurations with their elitist educational system, loose and short-term relations with the financial sector and between users and producers, weaker intermediate organisations and a societal emphasis on individualism (Cooke & Morgan, 1998). The former may be more generally dynamic, with greater potential for interactive innovation; the latter, myopic (Patel and Pavitt, 1994).

However, a number of authors note certain pressures upon the coherence of these systems, in particular associated with the 'deregulatory bias of globalisation' (Cooke & Morgan, 1998). In some earlier work referring to the mid-late 20th Century for instance, Nelson (1993) considers the effect of macroeconomic policy and protectionism on national systems, which would appear to be less relevant now. Those that persist may perhaps be termed institutionalised conventions as opposed to those subject to the vagaries of policy and politics, including shifts to supranational regulation and integration. Key case studies in this respect appear to be transition economies in Eastern Europe and China (Malecki et al. 1999). However, perhaps national institutional robustness is not so easy to define - complex feedbacks seem possible, affecting the will to change or preserve.

Although a major step forward, the NIS literature suffers from a number of limitations: first, it has failed to integrate the macro and micro dimensions of its analysis; second, it tells us little as to how firms actually utilise the NIS infrastructure; third, it says little about the possible emergence of a post-national, European innovation system; and finally, it is remarkably silent about the growth of sub-national, regional innovation systems.

b) Regional Innovation Systems (RIS)

Recent research suggests that national systems do not exclusively determine the fate of firms or aggregates of firms in their country, with wide and persistent inter-regional performance variations, implying that some other institutional forces operate on a more focused regional basis (Morgan, 1997; Braczyk et al, 1998; Cooke et al, 1998; Cooke et al, 2000; Howells, 1999; Oughton et al, 2002). Others argue that although there may be national commonalities, from a bottom-up perspective, regional institutions effectively filter these - affecting their delivery and the response of firms - with a regional focus also enabling a more micro-level analysis of actual beneficial mechanisms (Howells, 1999).

One institutional filtering mechanism may be the policy-action of regional government, including tax incentives, and other forms of budget allocation, to the extent that such governments have power devolved to them. For example, German Länder governments have their own ministries of technology, giving rise to proactive regional development policy, with for instance, the provision of state technology transfer institutions, and various other business support mechanisms (as intermediaries); concurrently, they have funding discretion for the universities which they can use to direct particular specialisms (Howells, 1999). This is some ways corresponds to a territorially focused national innovation system, which conceivably comprises a tighter, more intense network of institutions, with more tangible outcomes, given the specific regional strategic focus. Indeed, Oughton et al, (2002) suggest institutions can operate at both national and regional levels, albeit differently.

At this level however, the critical role of softer institutions is also evident, a factor deducible from failed policy interventions that have merely provided hard institutions - such as public R&D labs - in areas in which they were lacking (e.g. Lowland Scotland -

MacLeod, 1997 cit. in Malecki et al. 1999). From this situation, derives the notion of the importance of institutional connectivity, through networks of people, based on two-way learning processes, lubricated by shared traditions of trust and co-operation, which promote embeddedness (Oughton et al. 2002, Oinas & Malecki, 1999). Institutions are thus both actors, more intangible convergences, and regulatory mechanisms. Such co-ordination permits both knowledge flows and synergies - in particular, the re-combination of knowledge to produce new orders of innovation, and in order to adapt it to enable assimilation (Oughton et al, 2002; Howells, 1999; Braczyk & Heidenreich, 1998). Ashiem & Cooke (1999) summarise this as innovation comprising learning, creativity and tutoring. Etzkowitz & Leydesdorff (1997, 2000 cit. in Oughton et al 2002) propose that a 'triple helix' of government-university-industry relations is critical, the conceptualisation of helix-as-nexus capturing the complexities and mutual-dependencies of the interrelations - a 'nestedness' of institutions. This serves to emphasise that the above configurations of regional governance must also be receptive to learning feedbacks in order to for example, better co-ordinate supply- and demand-side processes (Oughton et al, 2002). Thus the systemic element is revealed as a team-like orientation amongst regional actors (Asheim & Cooke, 1998).

The spatial link is also clarified in this way, given that such softer institutions are usually built up on the basis of face-to-face interactions, which continue to be more likely and frequent, particularly in more informal settings, (complementing formal ones) on a localised basis (Oughton et al, 2002; Howells, 1999; Asheim & Cooke, 1999). Such interactions combine socialisation processes with the evolution of relations and regional vision in a spatial, path-dependent process (Morgan, forthcoming; Howells, 1999; Braczyk & Heidenreich, 1998). The spatial agglomeration of different institutions, including different industrial functions thus becomes important beyond the traditional conceptions of external economies in terms of 'collective economies' which require extra-market, co-ordinated and active involvement of actors, a certain amount of solidarity (Oughton et al, 2002; Lundvall, 1999). The distinctiveness of this territorial assemblage may be further reinforced by national processes pertaining to core-periphery structures, with centralisation and funding based on excellence rather than need, contributing to institutional paucity elsewhere (Morgan forthcoming; Oughton et al, 2002; Howells, 1999).

However, it would also appear that the extent to which territorialisation is essential to innovation systems has gone largely uninterrogated (Morgan, forthcoming). Asheim & Cooke (1998) suggest that the orientation of firms will affect the extent to which a system is territorially integrated as opposed to a regionalised national innovation system. They also suggest that the triple-helix can be stretched across space, that links with for instance, universities outside the region may be important to overcome local limitations. Overall it is unclear which processes and activities associated with institutionalised innovation are constrained to regional spaces (Morgan, forthcoming; Malecki et al. 1999) - for example, whether regional identity is crucial and whether this is compromised by excessive external linkages. From another perspective, Florida (2002) for instance, proposes that key mobile innovation actors are attracted to put down their roots by particular cultural configurations.

Turning the lens back to key innovation institutions themselves however, it can equally be shown that even softer institutions or institutional thickness are not sufficient to drive regional success, and may conversely, act as constraints (Howells, 1999; Cooke & Morgan, 1998). This reflects the dialectic referred to above - the tension between creativity and routinisation, or inertia. Thus it is possible to conceive of shared visions becoming overly normative and closed to alternatives, including the participation of new actors and organisations (Oinas & Malecki, 1999; Braczyk & Heidenreich, 1998). Indeed, it remains unclear as to what extent institutional reproduction is based on particular personalities and interpersonal contact (e.g. the role of mobile individuals) rather than wider cultural socialisation and inter-organisational contact. A dynamic perspective would further suggest the importance of fluidity - changing flows and linkage patterns (Archibugi et al, 1999) implying that institutions must both reproduce and evolve, ebb and flow, involving a certain amount of creative destruction, assimilation of old and new. Cooke and Morgan (1998) propose that institutional learning transcends this dialectic, but this should not elide the fine balancing acts involved, the containment of what could conceivably disintegrate into raw power struggles.

Overall these nuances to regional innovation strategies highlight the importance of more qualitative research looking at more abstract integrative mechanisms, rather than relying on simplistic inventories of institutions (including networks) as indicators of potential (Morgan, forthcoming). Several authors suggest that there are still gaps in the understanding of these processes, particularly how individual firms learn, what is the crucial knowledge that they learn, to what extent roles are substitutable by different organisations, and how all this activity feeds into improved economic performance, as well as crucially, to what extent policy can create particular institutional dimensions, as opposed to just following and supporting them (Morgan, forthcoming; Oughton et al, 2002; Malecki et al 1999). As various authors remind us however, the focus on institutions must not marginalise the role of firms themselves (Morgan, forthcoming; Howells, 1999; Asheim & Cooke, 1999; Nelson & Rosenberg, 1993).

c) Linking NIS and RIS

Having identified institutions of relevance to innovation at both the regional and national levels, it still remains unclear how these levels are linked, particularly the national components and firms themselves (Morgan, forthcoming; Archibugi et al, 1999). It is suggested that there have been two separate realms of analysis - macro and micro - without an explicit consideration of interaction between them - for example, how firms use national systems as we noted above. To some extent theories of governance and multi-level polity are helpful, in suggesting that actors may be part of various circuits of action and interaction, and proposing that learning needs to be extended from the bottom up to the top, both through the institutionalisation of devolution and mutual reflexivity (Cooke et al, 2000; Oughton et al. 2002; Healey, 1997; Morgan, 1997). Indeed, referring back to the issue of which parts of the system need to be localised, some authors have in fact suggested that non-local links are an important dimension to learning and a means of overcoming local limitations (Oinas & Malecki, 1999; Asheim & Cooke, 1999). Perhaps bridging institutions are important fora to access such links, although the role of MNCs could also be clarified (Morgan, forthcoming; Malecki et al, 1999). Howells (1999) conceives of smaller systems being more 'open' to non-local interaction, but it seems somewhat myopic to subsequently ignore potential interaction between any other types of system, especially given the aforementioned 'global' level pressures, and sometimes tangential trends in sectoral systems (Morgan, forthcoming; Nelson & Rosenberg, 1993). There is some tentative suggestion that a concerted action at multiple levels of governance is needed to counteract the powerful forces pertaining to regional inequality. It is conceivable that a bold strategic role for national and supranational governments is waiting should these linkages be clarified, to re-allocate funding to where it can have most impact, and in framing policy so that it takes these diverse institutional interactions (which from a bottom-up perspective vary from place to place) into account rather than taking a limited, simplistic view, aiming to capture, rather than be dependent on them.

Just as the NIS literature has its weaknesses, so too does the RIS literature. First, the vast corpus of writing on RIS tends to assume what actually needs to be explained, that is whether we actually have fully formed regional innovation systems, which imply internal coherence and regionalised patterns of interaction, or whether these are really regional innovation strategies which aim to create a regional innovation system. Second, the RIS literature tends to be an inventory of regional institutions and these tell us little or nothing about the processes of causality (eg whether the mere existence of regional institutions has a benign effect on the innovative capacity of local firms). Third, the success of a limited number of ‘regional systems’ cannot be taken as evidence that the regional level per se is the always the most effective level for the design and delivery of innovation policies (Morgan, forthcoming).

5. *EU R&D POLICY*

5.1. The policy perspective

This part of the report examines the main EU policy instruments in the field of R&D, which form a key focus of the ESPON 2.1.2 study. It draws together and updates material previously presented in the second interim report.

The European Union's role in the field of R&D is set out in Article 163 (ex 130f) of the Treaty establishing the European Community [11] and in subsequent articles up to Article 173. In relation to the policies used to achieve the objectives set out in the Treaty, a useful distinction can be made between *sectoral* interventions, on one hand, and *territorial* interventions on the other[12].

- *Sectoral interventions* are directly addressed at the R&D sector, through the provision of direct support to R&D projects and researchers. In the EU context, the main instrument of direct sectoral support for R&D is the RTD Framework Programme. This is coordinated by DG Research and designed to promote cooperation in the field of R&D and the dissemination of research results and stimulate the training and mobility of researchers in the Community[13].
- The EU's *territorial interventions* in the field of R&D are addressed to specific geographical areas, through cohesion policies and specifically the Structural Funds. Coordinated by DG Regional Policy, these interventions have generally focused on indirect support for R&D, such as the creation of networks for innovation, and worked alongside national and regional activities.

The immediate objectives of EU R&D actions are broadly targeted towards the following types of activity:

- Promoting International R&D collaboration
- Establishing networks of SMEs
- Creating mechanisms to stimulate and support innovation

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[11] Article 163: *1. The Community shall have the objective of strengthening the scientific and technological bases of Community industry and encouraging it to become more competitive at international level, while promoting all the research activities deemed necessary by virtue of other Chapters of this Treaty.*
2. For this purpose the Community shall, throughout the Community, encourage undertakings, including small and medium-sized undertakings, research centres and universities in their research and technological development activities of high quality; it shall support their efforts to cooperate with one another, aiming, notably, at enabling undertakings to exploit the internal market potential to the full, in particular through the opening-up of national public contracts, the definition of common standards and the removal of legal and fiscal obstacles to that co-operation.
3. *All Community activities under this Treaty in the area of research and technological development, including demonstration projects, shall be decided on and implemented in accordance with the provisions of this Title*.

[12] This distinction is made in *Study on the Construction of a Balanced and Polycentric Development Model for the European Periphery: Research and Development and Innovation*.

[13] Objectives set out in Article 164 of the Treaty

- Increasing EU wide human capital
- Building up knowledge infrastructure in less favoured regions and links to more advanced regions

Over the last decade EU support has to some extent helped disadvantaged regions although data confirms the continuing dominance of 'Archipelago Europe'. In the mid 90's almost half the amount of RTD Framework Programmes went to 9 regions, which only account for 28% of the population, an issue we address in more detail later. Cohesion and regional development policies have also tried to counter the tendency towards an EU division into a knowledge centre and a knowledge periphery. However the internal technology/knowledge gap measure in terms of the ratio of gross expenditure of R&D to GDP between the EU 4 (Greece, Spain, Portugal and Ireland and EU15 continues to be high at 43% *(IPTS, 1999)*.

In addition to the Framework Programmes and the R&D-related actions funded under the mainstream Structural Funds, Innovative Actions, funded under Article 10 and now Article 2 of the European Regional Development Fund (ERDF) have also been used to promote technological innovation at a regional level. During the 1994-1999 funding period, these took the form of Regional Innovation Strategies (RIS) and Regional Technology Transfer (RTT) actions. Under the current programming period (2000-2006), the first of three strands of Innovative Action aims to support regional competitiveness on the basis of innovation. These policies are examined in more detail later.

All these different aspects of Community policy in the field of R&D now operate in the context of a strategic goal, on the part of the EU, to create a European Research Area (ERA).

The concept of the European Research Area (ERA) was established in the Commission communication *Towards a European Research Area*, published in January 2000, in advance of the Lisbon Summit of March that year. The basic idea underpinning the ERA is that the issues and challenges of the future cannot be met without much greater integration of Europe's research efforts and capacities. At present European research is fragmented along national lines, with the result that efforts are duplicated and valuable resources wasted.

The ERA project is seen as means to improve coordination and, in the longer term, to achieve greater co-operation between Member States' research strategies and a mutual opening up of programmes. This approach is seen as key, if Europe is to meet the aim, set out in the conclusions of the Lisbon summit, of becoming 'the world's most competitive and dynamic economy by 2010'.

In practical terms, the Sixth Framework Programme (see below) is the Commission's main instrument for achieving the goals of the ERA. In addition, however, it is recognised that the overarching nature of the ERA's objectives implies a greater co-ordination between the different strands of EU policy in the field of R&D[14].

The rest of this section will now go on to examine the different element of EU R&D policy in more depth. The following sections will provide:

- A brief overview of the successive RTD Framework Programmes (FPs) from the Fourth FP (1994-1998) onwards, followed by initial analysis of patterns of participation in the FPs across the European territory;
- An overview of the R&D component of the Structural Funds, including the territorial distribution of these actions and;
- A description of the Innovative Actions conducted under Article 10 of the ERDF (RIS, RIS+) and the subsequent Innovative Actions for the period 2000-2006.

5.2. The RTD Framework Programmes

The RTD Framework Programmes (FPs) are the most important mechanism for EU funding of R&D. As set out in the Treaty (art.166), these multi-annual Programmes fix the objectives and priorities for activities to promote cooperation in the field of R&D, the dissemination of research results and the training and mobility of researchers in the EU. The First Framework Programme (FP1), launched in 1984, ran until 1987 and was succeeded by FP2 (1987-91), FP3 (1990-94), FP4 (1994-1998) and FP5 (1998-2002), until the recent launch of the Sixth Framework Programme (FP6) in November 2002.

Research and training in the field of nuclear energy, which constituted the main focus of Community research funding prior to 1984, is covered by the separate European Atomic Energy Community (EURATOM) Treaty. However, despite this distinct legal basis and slightly different rules regarding participation and dissemination of information, the implementation of these activities is integrated into the overall Framework Programme structure.

Research and training activities in all sectors, funded under the FPs, are implemented through project-based contracts between the European Commission and participants. Until the end of FP5, a substantial proportion of Framework Programme funding went to "shared-cost" research actions. These are research projects put into effect by multinational consortia made up of firms (including Small and Medium-sized Enterprises, SMEs), research centres and universities, eligible to receive 50% of their basic project funding costs from the Commission. The new instruments (contract types) introduced with the launch of FP6 have altered this picture slightly[15], although the co-operative, multinational projects remain the core focus for funding.

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[14] See, for example, *The Regional Dimension of the European Research Area* COM(2001) 549 final, Brussels, 03.10.2001

[15] The main new instruments introduced in FP6 are Networks of Excellence and Integrated Projects. The former are eligible for a maximum of 25% funding, while Integrated Projects can receive between 35% and 100% funding depending on the type of project. Specific Targeted Research and Innovation Projects follow the traditional "shared cost" model and are eligible for 50% funding.

A significant part of FP funding is also allocated for the direct activities of the Joint Research Centre (JRC). The JRC is an integral part of the European Commission, made up of seven research institutes in five separate locations[16], and provides scientific advice and technical expertise to support EU policies. The majority of JRC activities, in both the nuclear and non-nuclear field, are explicitly set out in the FPs (the "direct activities"), although the institution is also able to participate in other competitive FP projects with other partners or engage in external contracts ("indirect" activities).

Framework Programme 4 and Framework Programme 5

The Fourth Framework Programme was launched in 1994, with an overall budget allocation of € 13 100 million. As shown in Table 5.1 below, it was structured into four main activity areas (reflecting the structure set out in the Treaty), of which RTD and demonstration projects in seven thematic areas accounted for the vast majority of funding. The main innovative features of FP4, compared with previous Programmes, were the integration of two new research themes (transport and targeted socio-economic research), the definition of substantive activities concerning internal cooperation and dissemination of results and the introduction of a more tailored approach to stimulating research by SMEs. Activity four, the "stimulation of the training and mobility of researchers" continued to include Marie Curie Fellowships for individual researchers, first introduced under the Second Framework Programme.

Table 5.1: Structure and Budget of FP4

Programme	*Structure*	*Budget*
FP4 (1994-1998)	**ACTIVITY 1**	
	❑ *Information and Communication Technologies*	€ 3 626 million
	❑ *Industrial Technologies*	€ 2 125 million
	❑ *Environment*	€ 1 150 million
	❑ *Life Sciences and Technologies*	€ 1 674 million
	❑ *Energy (including nuclear activities)*	€ 2 403 million
	❑ *Transport*	€ 256 million
	❑ *Targeted socio-economic research*	€ 147 million
	Subtotal	**€ 11 381 million**
	ACTIVITY 2	
	❑ *Cooperation with third countries and international organisations*	€ 575 million
	ACTIVITY 3	€ 352 million
	❑ *Dissemination and exploitation of results*	
	ACTIVITY 4	€ 792 million
	❑ *Stimulation of the training and mobility of researchers*	
	TOTAL	**€ 13 100 million**

[16] In Geel (B), Ispra (I), Karlsruhe (D), Petten (Nl) and Seville (E).

Source: Global Budget FP4

The Fifth Framework Programme introduced a simplified structure based on four "thematic programmes" (Activity 1), addressing defined problems, and three "horizontal programmes", designed to respond to common needs across all research areas. The Structure and budget distribution for FP5 is shown in Table 5.2.

Each Thematic Programme was subdivided into so-called "Key Actions", conceived as clusters of specifically targeted research projects of different sizes, "directed towards a common European challenge or problem"[17]. In all, there were 22 Key Actions under the Thematic Programmes of FP5, complemented by "Research and technological development activities of a generic nature" (in a limited number of areas not covered by the Key Actions) and support for research infrastructures.

Table 5.2: Structure and Budget of FP5

Programme	Structure	Budget
FP5 (1998-2002)	**ACTIVITY 1** ❑ *Quality of life and management of living resources* ❑ *User-friendly Information Society* ❑ *Competitive and Sustainable Growth* ❑ *Energy Environment and Sustainable Development*	€ 10 843 million
	ACTIVITY 2 ❑ *Confirming the international role of Community research*	€ 475 million
	ACTIVITY 3 ❑ *Promotion of Innovation and encouragement of SME participation*	€ 363 million
	ACTIVITY 4 ❑ *Improving human research potential and the socio-economic knowledge base*	€ 1 280 million
	❑ *Joint Research Centre (non nuclear)*	€ 739 million
	EURATOM Programme ❑ *Research, training and JRC activities in the field of nuclear energy*	€ 1 260 million
	TOTAL	**€ 14 960 million**

Source: Global Budget FP5

[17] CORDIS: Introduction to FP5 http://www.cordis.lu/fp5/src/struct.htm

The Current Framework Programme: FP6

The Sixth Framework Programme, launched in November 2002, contains many features in common with previous FPs, but, as noted above, is now conceived as the main tool to further the development of the European Research Area. FP6 has been structured with the main objectives of better integrating research across Europe in seven thematic areas and "structuring" and "strengthening" the ERA. The structure and budget for FP6 are set out in Table 5.3 below.

One of the most significant innovations brought by FP6 is the introduction of two new "instruments", or project types. Firstly, "Networks of excellence" are large-scale projects, designed to strengthen scientific and technological excellence in a particular research field, with the ultimate aim of producing a durable structuring and shaping of the way research is conducted on that topic in Europe. This long-term structuring effect is seen as a means to bolster cooperation and reduce the current fragmentation between different national research programmes.

The second major new instrument is "Integrated Projects". These are multi-partner projects to support objective-driven research, where the primary deliverable is knowledge for new products, processes and services. They are designed to increase the average size of research projects under the FPs, to develop the critical mass necessary to make a real impact and thus help achieve the ambitious goals set out for the Programme.

Despite these significant developments, many features of previous FPs are continued under FP6, albeit in modified form. Specific Targeted Research Projects and Coordination Actions continue in the tradition of previous shared-cost projects, while the horizontal actions to encourage the participation of SMEs and Innovation related activities also continue. The budget for Research mobility and training, in particular through the Marie Curie Actions, has been increased significantly, compared with FP5.

In terms of the thematic areas covered by the Programme, FP6 concentrates on fewer priorities than FP5, with a particular focus on areas where it is felt co-operation at a European level presents real added value. Nanotechnologies are included as a thematic priority for the first time.

Table 5.3: The Structure and Budget of FP6

Programme	Structure	Budget
FP6 (2002-2006)	**Focusing and Integrating Community Research** *Thematic Priorities* ❑ *Life Sciences, genomics and biotechnology for health* ❑ *Information Society Technologies* ❑ *Nanotechnologies* ❑ *Aeronautics and Space* ❑ *Food quality and safety* ❑ *Sustainable Development, Global Change and Ecosystems* ❑ *Citizens and Governance in a Knowledge Based Society* *Specific Activities covering a wider field of Research* ❑ *Policy support & anticipating S&T needs* ❑ *Horizontal research activities involving SMEs* ❑ *Specific Measures in support of international cooperation* *Non nuclear activities of JRC*	€ 13 345 million
	Structuring the European Research Area ❑ *Research and Innovation* ❑ *Human Resources* ❑ *Research Infrastructures* ❑ *Science and society*	€ 2 605 million
	Strengthening the Foundations of the ERA ❑ *Support for Coordination of activities* ❑ *Support for coherent development of policies*	€ 320 million
	EURATOM Framework Programme ❑ *Management of radioactive waste* ❑ *Controlled thermonuclear fusion* ❑ *Radiation Protection* ❑ *Other Activities* ❑ *Activities of Joint Research Centre*	€ 1 280 million
	TOTAL	**€ 17 500 million**

Source: DG Research

Participation in the Framework Programmes

As noted in the Second Report on Economic and Social Cohesion, analysis of the regional impact of the Framework Programmes is difficult because data on the geographical distribution of expenditure from the FPs is not published[18]. This said, a number of information sources are available. Firstly, the *Second European Report on S&T Indicators* (REIST-2), published in 1997, contains analysis and maps of regional

[18] Second Report on Economic and Social Cohesion, 31 January 2001, p.100

participation in Framework Programmes (FP3 and FP4). The main findings of the analysis are summarized in Box 5.1 below.

Box 5.1: Key Findings from REIST-2

Framework Programme participation (measured by both the total number of participations by region and by annual regional budget receipts divided by regional GDP) is highest in Northern Europe (with Baden-Württemburg having the highest participation[19]), with pockets of high participation in certain Greek regions and metropolitan areas of Spain and Portugal.

In an analysis of the impact of the FPs on technology cohesion (ie not territorial impact), focused on Objective 1 regions, the report found that Objective 1 regions were under-represented in the top participating regions in FP3 and FP4. Furthermore, it demonstrates the disproportionate importance of the educational sector in FP participation in Objective 1 regions, compared with non Objective 1 regions[20] and a tendency (albeit not very marked) to give smaller contracts to Objective 1 regions. The latter finding lends some support to the argument that Objective 1 regions receive marginal funding from FPs, despite fairly high levels of participation.

Overall, FPs contribute only a small fraction of R&D spending in all regions. As such their direct impact on technology creation should not be over-estimated. However, in contrast to national and regional R&D actions, they focus on R&D collaboration and associated knowledge and technology transfer. Network analysis shows that the most R&D intensive regions tend to attract the most requests for collaborations i.e. they are 'network attractors' and, moreover, that a series of networks of frequently collaborating regions existed in FP3. One of the main conclusions of this work was that the Framework Programmes were effective at 'tying the RTD excellence centers to the economically and technologically lagging regions'.

Unfortunately, the REIST-2 analysis relied on unpublished data, developed by the Commission services at the time and no single source of collated FP participation data is publicly available. Nevertheless, the CORDIS project database, compiled by the contractor for the CORDIS service (currently overseen by DG Enterprise) does contain accurate data on regional Framework Programme participation at NUTS II level. This disadvantage being that figures have to be obtained separately for each region, by running a series of searches. Work undertaken as part of this study for the ESPON makes use of the CORDIS data and is reported in Section 8.

[19] In a comparison of regional share of total FP funding compared with regional share of total EU GDP, Baden-Württemburg received almost 6 times its share of GDP in FP funding (CEC 1997: 378)

[20] In FP4 41% of FP funding to Objective 1 regions went to the educational sector, compared with 27% in other regions (CEC 1997: 381)

RTD Programmes and Territorial Balance in the European Union

One of the most intractable regional policy dilemmas in the EU has been the tension between the Framework Programmes, the main instrument for promoting research and technological development (RTD), and the Structural Funds, the main instrument for promoting territorial cohesion. More by default than design the Framework Programme 'is a *de facto* regional policy for the prosperous regions, where the key centres of excellence are located' (Cooke and Morgan, 1998). The overwhelming spatial bias to the 'islands of innovation' in the allocation of RTP funds attests to the significance not of cohesion criteria but the imperatives of competitiveness. In other words, in contrast to the allocation of Structural Funds, which are allocated on the basis of *equity* considerations, the RTD funds of the Framework Programme are supposedly allocated on the basis of *efficiency*, to existing centres of technical excellence. Whether this tension remains valid is an important line of enquiry for this study.

Notwithstanding the growing importance of EU Framework Programmes, the European Commission frankly concedes that the member state level is the most important spatial scale for promoting RTD, not least because the Framework Programme accounts for just 4% of publicly funded RTD in the European Union. The significance of this national level spills over into the wider EU level because intra-national RTD disparities explain a significant part of Europe's regional technological disparities (EC, 1996) and underpins the target agreed for national R&D expenditure in the Lisbon Strategy.

Core regions within member states are the main beneficiaries of national RTD programmes and these are the same regions that dominate the European technological space. With the exception of Germany, the core (ie capital) regions emerge as the main RTD centres in each member state. This is particularly evident in Sweden, France and Austria, where Stockholm, Ile de France and Vienna are the main focus for respectively 36%, 50% and 48% of national business R&D activities, while being home to less than 20% of their national populations. In Greece and Portugal, Attiki and Lisbon represent one third of the national population but carry out respectively 64% and 53% of national business R&D. With regard to government R&D activities a similar phenomenon is observed: for example, Lisbon, Vienna and Madrid undertake respectively 90%, 68% and 55% of government R&D. Lazio is even more distinctive because, though it accounts for just 10% of Italy's population, it accounts for some 48% of government R&D. While the national higher education R&D infrastructure is more equally distributed among regions, Vienna and Lisbon are still notable exceptions, with respectively 52% and 47% of higher education R&D personnel. Although government R&D and higher education R&D are important components of regional innovation systems, it is worth noting that the business sector accounted for 56% of European R&D personnel as against 17% for government R&D personnel and 27% for the higher education sector. What emerges here is that the most developed RTD infrastructure in less favoured regions tends to be in the government and higher education sectors, hence 'the stress in these regions should be put on stimulating a close collaboration between the different actors (government, universities and enterprises) in order to create an efficient innovation system' (EC, 1997).

Acutely conscious of the charge that the Framework Programme was a de facto regional policy for the core regions, a source of great tension between DG XII and DG XVI as the respective directorates were called in those days, the European Commission sought to promote greater synergy between the two instruments. In 1993 it published a communication called *Cohesion and RTD Policy: synergies between RTD policy and economic and social cohesion policy*, the first formal attempt to address the conflict between these two sensitive fields (EC, 1993; Morgan and Nauwelaers, 1999; Landabaso and Reid, 1999).

Before we examine the role of the Framework Programme (FP) and the Structural Funds (SF) in promoting RTD capacity it is worth noting the role of the STRIDE (Science and Technology for Regional Innovation and Development in Europe) programme, a key Community Initiative during the 1989-1993 period. STRIDE sought to promote RTD capacity in less favoured regions (LFRs) and it helped to raise awareness of these issues in the poorest regions. However the experience of STRIDE in Objective 1 regions revealed some important lessons, including:

- Low participation by the private sector and little attention to technology transfer projects

- Infrastructure measures designed to boost public centres, usually academic ones not closely involved with the enterprise sector

- Little or no participation in measures designed to foster links between the RTD centres and firms with international networks

- Little attention to the training of the workforce and retraining for human resources (Landabaso, 1995; Landabaso and Reid, 1999)

Two explanations have been offered to explain this mismatch. The first is the use of a linear model of innovation by the people who designed and delivered the STRIDE programme, where it was assumed that 'the injection of science into the system will automatically mean that the new R&D effort will have an economic effect on the market' (Landabaso, 1995). The second explanation relates to the lack of planning capabilities, not least the fact that 'administrations normally have little experience of the key strategic approaches in this field which inevitably require a multi-disciplinary approach with links to both the RTD community and the private sector' (Landabaso, 1995). Other Community Initiatives – like STAR, TELEMATIQUE, PRISMA, EUROFORM – have also sought to promote RTD infrastructures in LFRs.

However, an evaluation by CIRCA in 1993 found that while some progress had been achieved, two important concerns were emerging: first, more attention needed to be paid to the demand side of the RTD equation and, second, that national RTD budgets were being reduced when Community RTD aid was being increased, making the national RTD systems 'more dependent on aid from the Structural Funds' (EC, 1997). Some of these biases and weaknesses would show themselves in FP and SF programmes which aimed to promote RTD capacity in weak regions.

As regards the Third and Fourth FPs it is no surprise to find that the top 25% of participating regions are mainly from northern Europe, with Baden-Wurttemberg being the regions that participates most of all. As we can see from Table 5.4, Objective 1 regions' share of FP budgets is well below their population share. From FP3 (1990-1994) to FP4 (1994-1998) the Objective 1 regions increased their participation share from 11.86% to 12.24%, while their budget share went from 8.76% to 8.94%, which is nothing to celebrate. As regards who gets FP funds in Objective 1 regions it seems clear that the major beneficiary is the education sector, which increased its share from 36% of the overall Objective 1 allocation in FP3 to 41% in FP4, while the share going to SMEs in Objective 1 regions fell from 23% to 19%. This has led to growing concerns about the economic impact of LFR participation in FP networks because 'this kind of RTD collaboration might be limited to an elite club of universities and research centres with little spill-overs to the local industry' (EC, 1997).

Table 5.4 Objective 1 regions in the Framework Programmes

Indicator as a percentage of EU Total	***1990***	***1995***
Population	-	22.86%
GDP	13.65%	15.23%
R & D personnel	2.83%	4.11%
Patents (EPO)	2.43%	2.40%
Participation share in the Framework Programme	11.86% (third FP)	12.24% (fourth FP)
Budget share in the Framework Programme	8.76% (third FP)	8.94% (fourth FP)
Budget share of enterprise Sector in the Framework Programme	6.39% (third FP)	6.72% (fourth FP)

Source : EC (1997)

5.3. R&D Actions under the Structural Funds

The Mainstream Funds

Actions in the area of Research, Technological Development and Innovation financed by the Structural Funds have become comparable in size, although different in nature, to those financed by the Framework Programmes. R&D related actions have received a significant share of funding in Objective 1 and Objective 2 regions, under both the 1994-1999 and the 2000-2006 Programming Periods. The current distribution of Objective 1 and Objective 2 regions is shown in Map 5.1 below.

In broad terms, the Structural Funds are intended to develop the capacities for doing research rather than finance the research itself. For the programming period 1994-1999, 5.6% (or ECU 7 827.62 million) of total structural funding was allocated to R&D related actions (REIST-2 1997:390). This represented a significant increase on the 2.92% budget available for the 1989-1993 period.

"R&D related actions" under Objective 1 include RTD infrastructure; technology transfer and demonstration; support for the scientific and technological system; support for innovation; advanced training of human resources. For Objective 2, measures mostly concern:

- The stimulation of interaction between scientific bodies and the productive fabric
- The promotion of capabilities for absorption and exploitation of technology and the financing of innovation in SMEs
- The establishment of transfer structures, training programmes and consultancy services.

The tradition of academic and industrial research and relatively important and high quality research and technological development infrastructure, characteristic of Objective 2 regions, means that fewer Structural Funds have been allocated to 'pure' R&D projects than in Objective 1 regions. More emphasis has been placed on increasing the level of co-operation between existing R&D "infrastructure" and industrial firms with a view to product and process innovation[21].

In the current programming period (2000-2006) the distribution of Structural Funds between activities is recorded through the use of codes assigned to different Fields of Intervention. One of these codes (number 18) relates to actions in support of RTDI. The relevant intervention codes for current programming period are:

18 Research, technological development and innovation (RTDI)

181 Research projects based in universities and research institutes
182 Innovation and technology transfers, establishment of networks and partnerships between businesses and/or research institutes
183 RTDI Infrastructure
184 Training for researchers

Innovative Actions

1994-1999

To help overcome problems caused by a lack of absorptive capacity, and to redress the supply-side bias of earlier programmes like STRIDE, the European Commission launched one of its most innovative programmes under the aptly named Innovative Actions, which was financed under Article 10 of the ERDF. The most important programme was called RIS (Regional Innovation Strategies) and this was complemented by RITTS (Regional Innovation and Technology Transfer Strategies), which was financed under the Innovation Programme of FP4.

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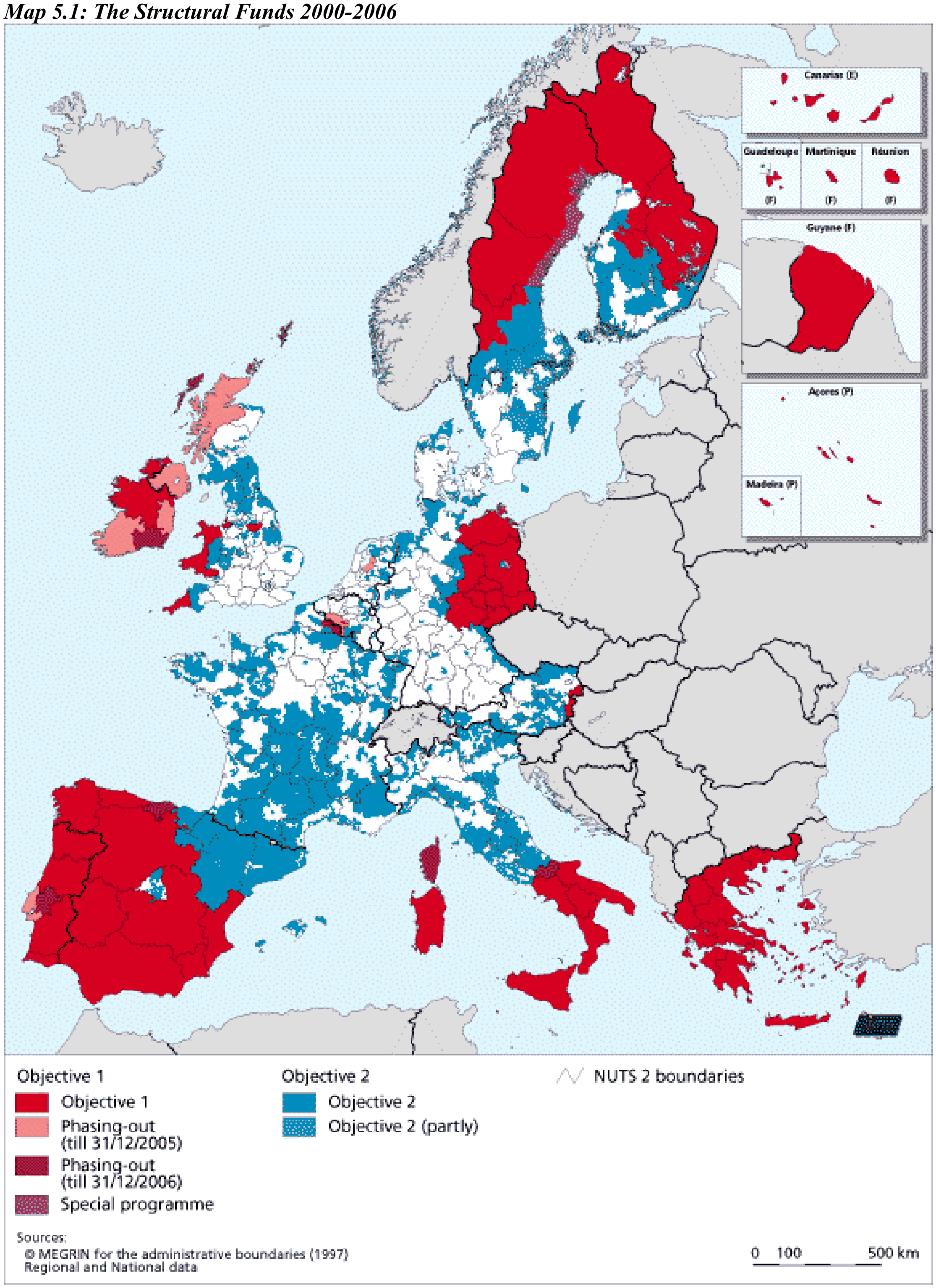
[21] Notably: technology and innovation centres; university transfer and spin-off interfaces; graduate placement schemes; new technology-related training.

Map 5.1: The Structural Funds 2000-2006



Source: DG Regio

The objectives of the RIS-RITTS exercises were twofold:

- To improve the capacity of the regional actors to develop policies which match the demands of the private sector and the supply capability of the RTD infrastructure

- To provide a framework within which the regional, national and Community authorities might be able to optimise their RTD investment policies at the regional level

- To build a consensus in the region about the problems and the prospectus for addressing them

Through RIS-RITTS over 100 regions have been assisted to develop regional strategies for innovation. These projects led to the establishment of the Innovating Regions of Europe (IRE) network, a joint platform for collaboration and exchange of experiences in the development of regional innovation policies and schemes: (http://www.innovating-regions.org/index.cfm). RIS was followed up by RIS+ projects in the period 2000-2002, designed to help implement the strategies developed in the RIS[22].

Although the RIS and RITTS programmes have introduced a welcome change to RTD policy in Europe, especially in their emphasis on the role of demand and social capital, there is no doubt that these have been challenging and demanding exercises for all concerned – for the European Commission, for regional governments, regional development agencies, RTD centres and of course for the firms themselves. Perhaps the biggest challenge of all, however, was the fact that poor regions were being asked to engage with something novel, and novelty is difficult to deal with in poor regions which have traditionally looked to the centre for guidance about how to act and how to think (Morgan and Nauwelaers, 1999; Landabaso and Reid, 1999; Morgan and Henderson, 2002; Oughton et al, 2002).

2000-2006

For the period 2000-2006, Innovative Actions comprise three strands: programmes of innovative actions and pilot projects; accompanying measures supporting exchange and networking; and competitions aimed at identifying and developing best practice. The number of strategic themes for Innovative Actions has been reduced from eight (in the period 1994-1999) to three:

- *Regional Economies based on knowledge and technological innovation: helping less-favoured regions to raise their technological level;*
- *EuropeRegio: the information society at the service of regional development*
- *Regional identity and sustainable development: promoting regional cohesion and competitiveness through am integrated approach to economic, environmental, cultural and social activities*.

[22] See *Regional Innovation Strategies under the ERDF: Innovative Actions 2000-02* for detailed project descriptions

The first of these themes covers RTD issues. It aims to help regions develop competitive assets based on innovation, rather than leave them to base their regional competitive advantage on costs, an advantage which can be quickly eliminated in a globalised economy (*The Regions and the New Economy: Guidelines for Innovative Actions Under the ERDF in 2000-06*).

Actions under this theme should focus on improving cooperation between business, RTDI bodies and others to establish an environment and a regional institutional framework, which will promote the creation, dissemination and integration of knowledge within the productive fabric.

All regions eligible in whole or in part under Objective 1 and Objective 2 and those receiving transitional support under these objectives are eligible to apply for Innovative Action funding. The entire region, including those areas not covered by Objectives 1 and 2, is considered eligible.

Examples of projects include:

- creation or reinforcement of co-operation networks between firms or groups of firms, research centres and universities, organisations responsible for improving the quality of human resources, financial institutions and specialist consultants, etc.;
- staff exchanges between research centres, universities and firms, particularly SMEs;
- dissemination of research results and technological adaptation within SMEs;
- establishment of technological strategies for the regions, including pilot projects;
- support for incubators for new enterprises which have links with universities and research centres; encouragement for spin -offs from university centres or large companies oriented towards innovation and technology;
- schemes for assisting science and technology projects carried out jointly by SMEs, universities and research centres;
- contribution to the development of new financial instruments (venture capital) for business start-ups[23]

The growth of regional innovation strategies in the EU since 1994 has raced ahead of our capacity to rigorously evaluate these new processes. One of the first texts to fully appreciate the scale of this challenge was produced by Clair Nauwelaers and Alasdair Reid, who drew an important distinction between two radically different kind of indicators (Nauwelaers and Reid, 1995). In the linear model of innovation the indicators tend to be a combination of inputs and outputs, which have the advantage of being easy to quantify, but suffer from being static and mechanical. In contrast, in the interactive model of innovation the emphasis is placed on process indicators which capture networking activities and relationships in the system, and these indicators are more

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[23] *The Regions and the New Economy: Guidelines for Innovative Actions Under the ERDF in 2000-06: 7*

qualitative and more dynamic. Future research could fruitfully pursue this promising approach to the evaluation of the new generation of regional innovation strategies.

5.4. Regions of Knowledge

Launched at the request of the European Parliament "Regions of Knowledge" is a new initiative by DG RTD. Calls for tender were published on Augusts 1st 2003 and must be submitted by 17th September 2003. It applies only to the current Member States of the EU (owing to legal constraints) and submissions must involve at least three Member States.

Regions of Knowledge consists of three strands covering:

- Technology audits and regional foresight exercises;
- Universities as drivers of regional development (regional innovation systems) and
- Mentoring initiatives supporting the development of less favoured regions (especially Objective 1) through collaboration with more technically advanced regions.

It is anticipated that around 10-15 projects will be supported. The overall budget for the initiative is 2.5m euro. The ethos of the pilot action demonstrates the increasing convergence of EU policy towards R&D through its emphasis on supporting the development of regional innovation systems as well as R&D infrastructure and individual R&D projects.

6. EXISTING TERRITORIAL IMBALANCES AND REGIONAL DISPARITIES IN R&D CAPACITY AND INNOVATION

6.1. The Approach

This section draws on the data collected through the project to provide an overview of the Research and Development and Innovation capacity of regions in the EU-27. *R&D Capacity* is a measure of a region's ability to perform R&D activities, whereas the measures of *Innovation Capacity* reflect our attempt to quantify the capacity of given territories to exploit the results of research and technological development. The analysis makes use of six basic indicators, chosen on the basis of their relevance to these two topics. A seventh indicator, patent applications, has also been collected but is not reported here. The indicators are:

R&D Capacity

- Expenditure on R&D as a percentage of GDP;
- R&D personnel as a percentage of the labour force;
- Employees with Tertiary level education working in a Science and Technology Occupation (HRSTC)[24] as a percentage of total employment.

Innovation Capacity

- Employment in High Technology and Medium High Technology Manufacturing as a percentage of total employment;
- Employment in High Technology Services as a percentage of total employment;
- Percentage of the Working Age Population (aged 24-65) having successfully completed some form of tertiary education.

The project team used the data collected to analyze territorial variations in R&D and Innovation performance across the EU-27. This involved comparing the performance of each region against each indicator to the average across all regions for which comparable data exists and producing two averaged "scores" (one for R&D and one for Innovation capacity) for each region, based on performance across all available indicators in each category. The most recent data available was used to produce a "snapshot" of R&D and innovation capacity the EU-27 and, where possible, trend patterns were calculated[25]. This analysis has been used in the development of a typology of European regions, which will be examined later in the report. Before this, however, the remainder of this section will examine the relative strengths, weaknesses and disparities that exist in the R&D and innovation landscape in the EU-27.

[24] Human Resources in Science and Technology "Core" – see Methodology for definition.
[25] This was only possible where data is available covering a sufficient time period.

6.2. R&D Capacity

R&D Expenditure

Gross domestic expenditure on R&D (GERD) is one of the most important indicators of R&D capacity available to us. It measures the combined expenditure for R&D performed in the Business enterprise, Higher Education, Government and Private Non-profit sectors. When expressed as a percentage of GDP, GERD is used as an indicator of the overall R&D intensity of a country or region. This is a very useful measure of the relative emphasis placed on R&D activities within a given economy, but does not tell us about the absolute level of R&D expenditure.

This last point is particularly important when comparing R&D intensity between regions with very different levels of economic development. A high R&D intensity does not necessarily indicate a high R&D effort in absolute terms, merely that a comparatively high proportion of GDP is accounted for by Research and Development activities.

Current strengths, weaknesses and disparities

When viewed on a European scale, the regional figures for R&D intensity show a marked concentration of European R&D in a relatively small number of core regions, at the expense of Less-Favoured Regions and more peripheral areas. A number of regions in the candidate countries perform very well against this indicator. Map 6.1 shows R&D intensity across the EU-27 against the EU average, based on current data availability. The strong performance of Sweden, Finland and parts of the UK, Netherlands, Germany, France and Austria is clearly visible.

The analysis of the most recent available data to a large extent confirms the familiar pattern of R&D strengths in Europe. Five of the European regions with the highest R&D intensity came from Germany[26], of which the top three were Braunschweig, Stuttgart and Oberbayern with an R&D intensity for 1999 of 6.34%, 4.84% and 4.76% respectively, compared with a EU-15 average of 1.93%. The regional top ten also includes two Finnish regions (Pohjois-Suomi and Uusimaa), Midi-Pyrénées and Sweden (where no regional expenditure data is available).

A more surprising finding is perhaps the strong performance of the Czech region of Stredni Cechy (the area surrounding Prague), where R&D expenditure accounted for 3.3% of GDP, placing it third in the regional ranking. The Prague region itself, the Polish region of Opolskie and the Hungarian region of Kozep-Magyarorszag (which includes Budapest) also feature in the top 25 regions, along with more traditionally recognized research centres such as Berlin, the East of England and Ile de France.

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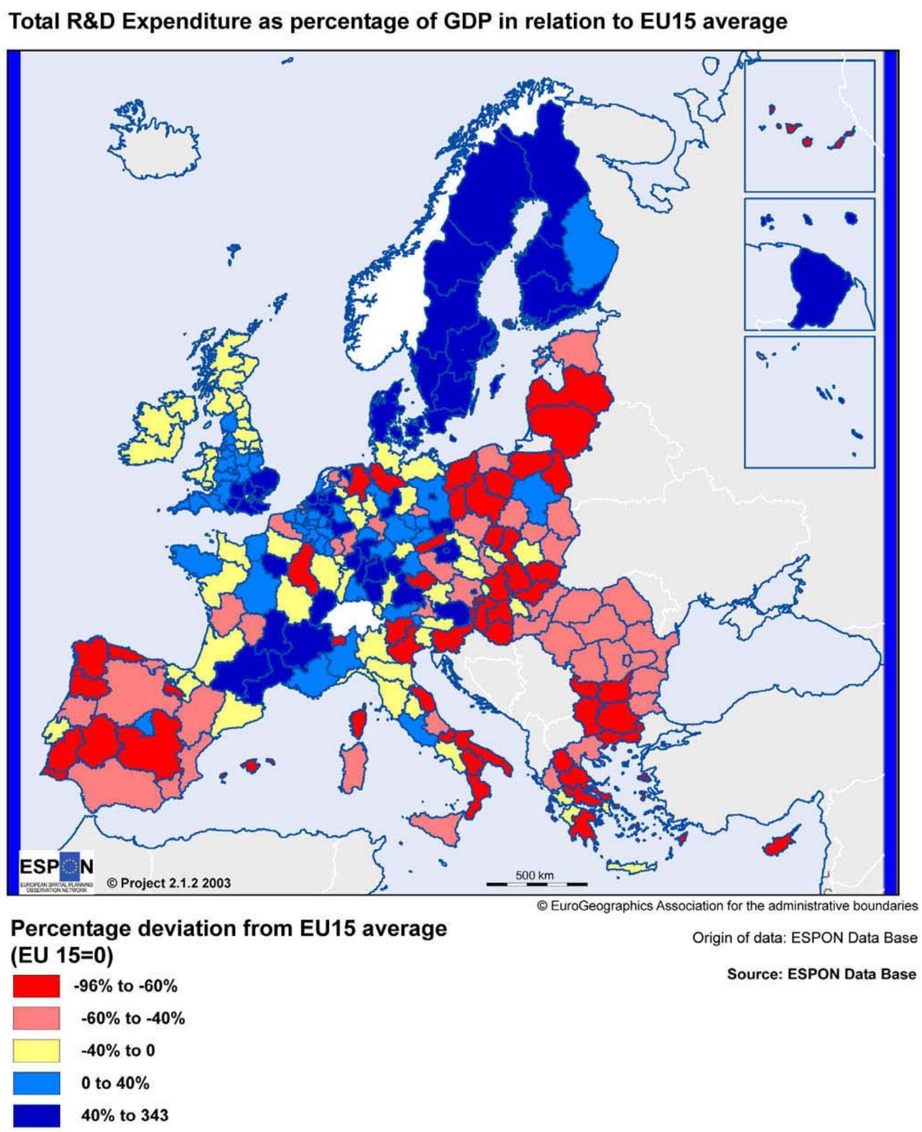
[26] This is in line with previous analyses of EU-15 regions: see *Statistics in Focus Theme 9: R&D expenditure and personnel in European regions 1997-99*, EUROSTAT, February 2003

Map 6.1: R&D Intensity in the EU-27



Data: NUTS II except UK (NUTS I) Sweden, Belgium, Ireland (NUTS 0) Year: 1999 (At 1998)

These high R&D intensity figures in key candidate country regions are significant, but should be interpreted with care, as the absolute levels of R&D expenditure in these areas remains low by European standards. As an illustration, although total expenditure on R&D in Stredni Cechy in 1999 accounted for 3.3% of GDP, it amounted to € 165.9 million or just 1.24% of total R&D expenditure in Ile de France, where the R&D intensity is at a comparable level.

In contrast to these areas, the average R&D intensity for regions in Greece, Spain and Portugal and all the Candidate Countries accept Slovenia and the Czech Republic[27]

[27] With average R&D intensities of 1.52% and 1.33% respectively

remains below 1% of GDP. In 2000, the average R&D intensity for the 11 candidate countries (excluding Malta, for which no data is available) was 0.77%, compared with an EU average for the same year of 1.93%. Cyprus, Romania and Latvia display the lowest R&D intensities (0.26%, 0.37% and 0.48%).

Disparities within countries

R&D intensity varies considerably between regions within individual countries and is often concentrated at a national level in a small number of regions, often near capital cities. In the EU-15, regional variation in R&D intensity is particularly high in Germany and Finland. However, this is largely explained by the regional characteristics of the sparsely populated regions of Finland and the exceptionally high R&D intensity figure for Braunschweig (the highest figure in Europe), which is significantly above the average for the German regions. Regional disparities are also pronounced in several of the candidate countries[28], particularly in the Czech Republic and Poland.

The concentration of R&D expenditure in capital regions is a particular aspect of this internal regional variation in several countries. This phenomenon is evident in Austria, the Czech Republic, Finland, France, Hungary, Greece and Portugal, where the top spending regions all account for around half of national R&D spending. In France, 45% of national R&D expenditure is concentrated in Ile de France (the region with the highest R&D expenditure of any European region in absolute terms), compared with a figure of 10% for Rhône-Alpes, the region with the second highest levels of R&D expenditure in France.

The Role of the Business Sector

The R&D sector as a whole can be sub-divided into the Business Enterprise Sector (BES), the Government Sector (GOV) and the Higher Education Sector (HES). The relative importance of these sectors also varies between regions, generally reflecting different economic structures and research traditions. In general terms, the proportion of R&D expenditure accounted for by the business sector can be viewed as an indicator of level of knowledge creation in firms in a given region.

The percentage of R&D performed by the Business Enterprise Sector (BERD) is considered as one indicator of the innovative capacity of a regional economy, although it should not be interpreted in isolation. The distribution of BES R&D in Europe in 1999 is shown in Map 6.2, based on current data availability. Whilst the overall pattern remains similar to that reported for GERD it is apparent that a number of high expenditure regions are dependent on the public funding of R&D. Business expenditure is rather more concentrated in a limited number of regions than Gross expenditure as a whole.

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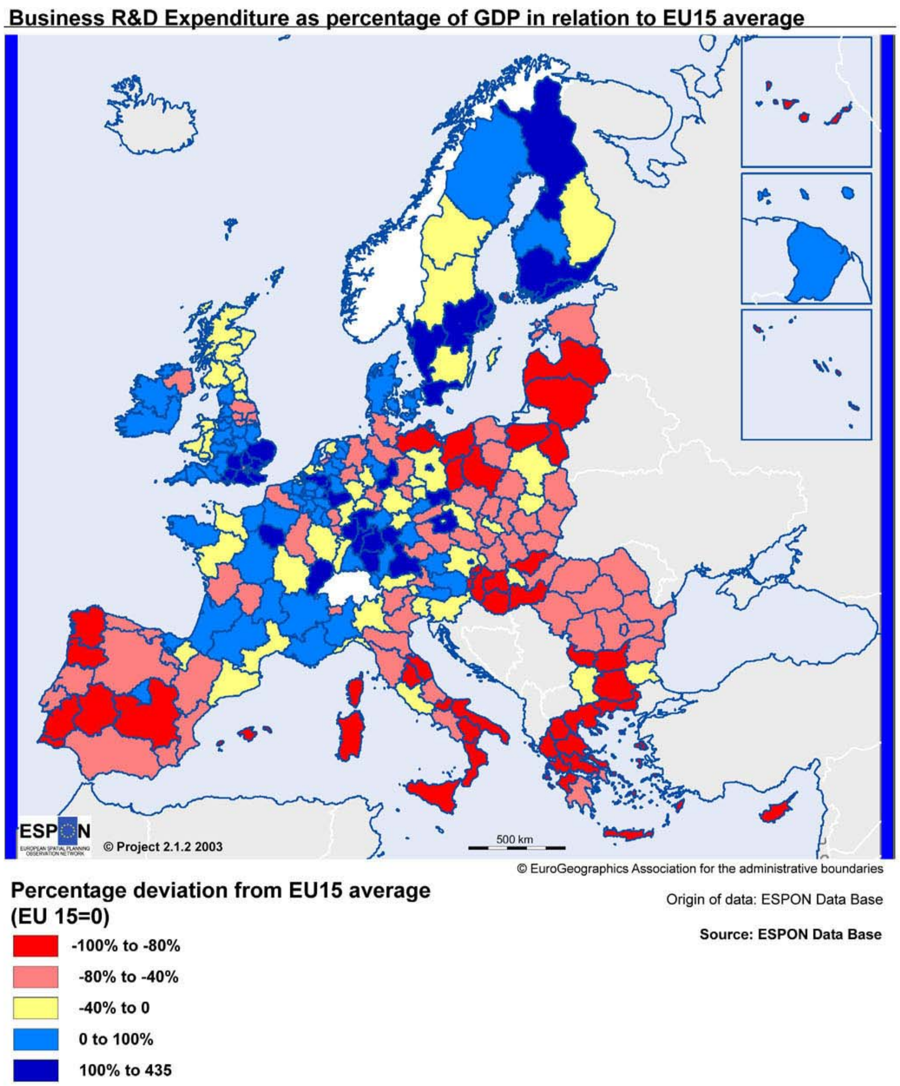
[28] It is only possible to consider this type of variation for the countries with NUTS II subdivisions and for which data is available (Bulgaria, Czech Republic, Hungary, Poland and Slovakia)

Map 6.2: Business R&D Intensity in the EU-27



Data: NUTS II except UK (NUTS I) Belgium, Ireland (NUTS 0) Year: 1999 (At 1998)

In 2000, BERD accounted for 65% of Gross expenditure on R&D in the EU-15, representing 1.26% of GDP. The highest intensities of BES expenditure were found in German, Swedish, Finnish and UK regions. Braunschweig and Västsverige stand out with particularly high levels. In absolute terms, Ile de France again has the highest levels of BES spend, while BES accounted for over 70% of total R&D spending in Sweden, Germany, Ireland and Belgium in 1997.

In the candidate countries, the level of business expenditure on R&D is significantly lower. For the same year, BERD accounted for only 46% of total R&D spending across the candidate countries (excluding Malta) and amounted to just 0.36% of GDP. Slovenia and the Czech Republic both have levels of business R&D expenditure significantly above the candidate country average (0.83% GDP in Slovenia (1999), 0.81% GDP in the Czech Republic (2000)), although these figures are still well below the EU-15 average.

BERD as a proportion of GERD is also among the highest in Slovenia and the Czech Republic (56% and 60% respectively), but even higher proportions are registered in Slovakia and Romania (66% and 70%), two countries with amongst the lowest levels of overall R&D intensity. These figures demonstrate the comparative weakness of the publicly-funded R&D sectors (government and higher education) in these countries.

R&D Personnel

R&D personnel as a percentage of the total labour force is a measure of the number of individuals directly employed in R&D activities, as well as those providing direct services in the R&D sector, such as R&D managers, administrators and clerical staff.

For the EU-15, this indicator is calculated on the basis of R&D personnel measured in headcount (the total number of people actually employed). As comparable data for R&D personnel measured in headcount are not available for the Candidate countries, the study team has calculated percentages on the basis of personnel measured in Full Time Equivalent (FTE). This means that the data for the proportion of R&D personnel in the labour force in these countries are underestimated in comparison to the EU-15 and that, as a result, direct comparisons between the EU-15 countries and Candidate countries should be made with great caution.

Current strengths, weaknesses and disparities

In the EU-15, the levels of R&D employment as a percentage of the labour force largely mirror the pattern of R&D expenditure, with the many of the highest regional concentrations of total R&D personnel located in the Northern part of the European territory. The average level of total R&D employment in the EU-15 in 1999 was 1.36% of the labour force, although analysis highlights a number of core regions with research employment rates considerably above this.

On the basis of available data 9 of the top 25 regions in terms of total R&D employment were located in Germany (the top three again include Oberbayern, Braunschweig, and Stuttgart with 3.72%, 3.41% and 3.04% of the labour force respectively[29]), three in Sweden and two in Finland. This said, core R&D regions, in terms of research personnel, are also evident in many other countries, in particular Slovakia (where Bratislavsky gains the highest overall score of any region), Hungary, the Czech Republic, Austria, France and Bulgaria. It should be noted that comparable total R&D employment figures are not available at regional level in the UK.

As highlighted above, direct comparison of candidate country scores with EU-15 levels of R&D employment are unwise, but the strong performance of key candidate country

[29] Figures for 1997, the most recent year for which data is available

regions is noteworthy, particularly as the FTE measure in the calculation used tends to underestimate the total number of personnel.

Once again reflecting the pattern of R&D expenditure, more peripheral regions of the EU-27, particularly in the cohesion countries and parts of Eastern Europe, exhibit the lowest levels of R&D employment. There is also considerable variation in the proportion of R&D personnel in the labour force between the candidate countries. While in Slovenia and Hungary, the levels of R&D employment are very close to the EU-15 average[30], R&D personnel account for a much smaller proportion of the workforce in many other countries, particularly in Bulgaria (0.48%) and Romania (0.39%).

Disparities within countries

As with R&D expenditure, there is considerable variation in the level of regional R&D employment in many EU-27 countries. Indeed, the pattern of national "core" regions in and around capital cities is even more marked when R&D personnel data is considered. The regions with the highest levels of R&D employment in the Candidate countries are all in capital regions. Bratislavasky, Közép-Magyarország (Budapest), Prague, Yugozapaden (Sofia), Mazowieckie (Warsaw) all appear in the top 25 EU-27 regions for this indicator. In contrast, peripheral regions in Bulgaria, the Czech Republic and Poland appear in the bottom 50 European regions for R&D personnel.

This core-periphery pattern is also very striking in France, Austria, Italy and Spain, although large disparities in terms of R&D employment appear to exist in nearly all European countries. Even in Germany, which has the largest number of regions in the top 25, there are also regions which appear in the bottom quartile of the R&D employment ranking.

Human Resources in Science and Technology

According to the OECD's Canberra Manual, Human Resources in Science and Technology (HRST) are defined by both education and occupation. Total HRST in a given territory is thus measured by the number of people having successfully completed third level education in a Science and Technology field of study (referred to as HRST – Education / HRSTE) and the number of people not formally qualified at this level, but who are employed in a S&T occupation where the above qualifications are normally required (HRST – Occupation / HRSTO). In practice, HRSTE covers nearly all educational fields. Those people who have third level education and work in a S&T occupation are referred to as the HRST "core" or HRSTC.

HRSTC is thus a valuable measure of the skilled human resources, actively engaged in some of the most dynamic sectors of the economy, including engineering, pharmaceuticals and information technology. While HRSTC is not an equivalent to R&D personnel, which is much more tightly defined and concerns only research activities, it does have the advantage of including only highly qualified individuals

[30] 1.36% and 1.11 % of the labour force respectively – Eurostat National figures

(whereas R&D personnel also includes lower qualified administrative staff). As such, it is a good measure of the number of individuals in a position to engage in innovative activities in the wider economy. It can be viewed as an indicator of "knowledge creation potential" in a broader sense than pure R&D.

HRST data is only available for the EU-15 at present, but is collected more consistently across the Union and very often for more recent years than R&D personnel data. The study team has therefore used HRSTC data, expressed as a percentage of total employment, as an additional indicator of research or knowledge creation capacity.

Current strengths, weaknesses and disparities

The pattern of HRSTC, as a percentage of total employment in EU-15 regions is shown in Map 6.3 below. It illustrates a slightly different picture to that portrayed simply by R&D Based indicators.

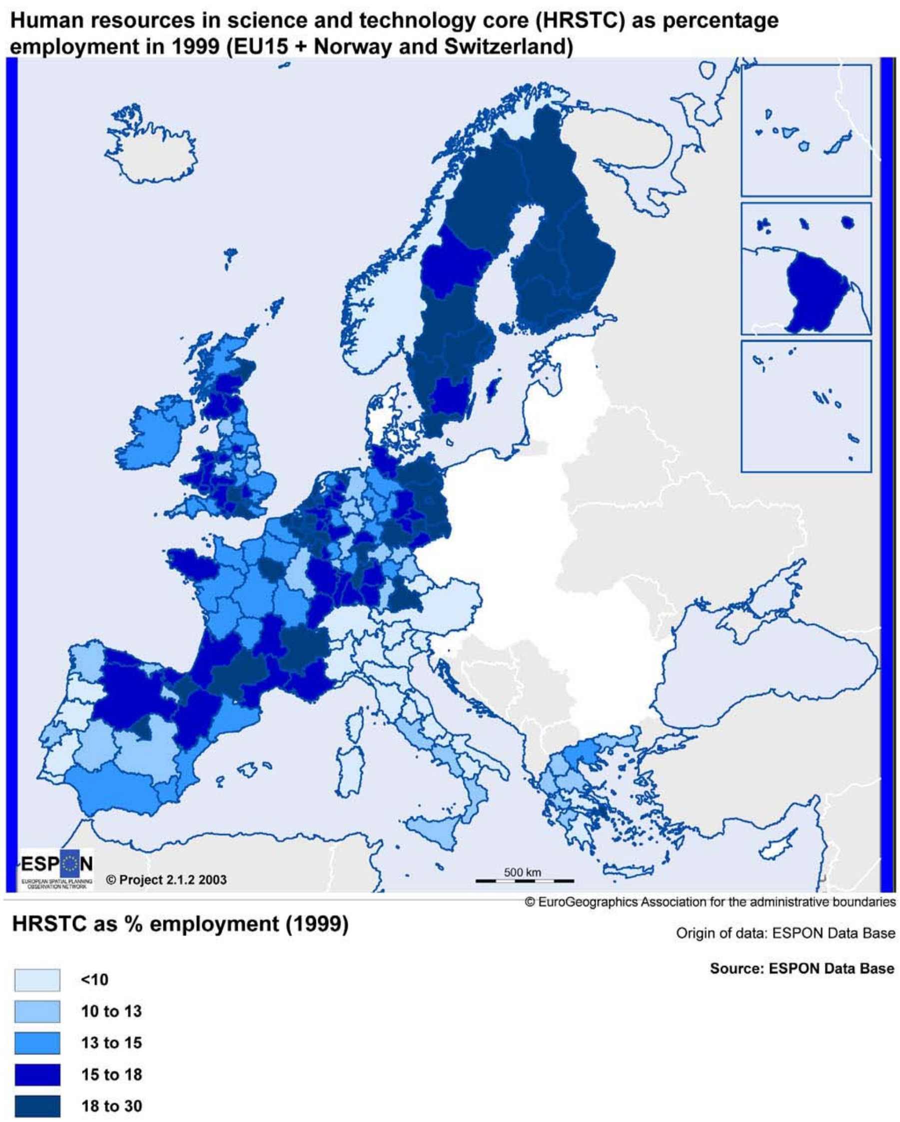
The pattern of distribution of HRSTC as a proportion of total employment across the EU-15 produces interesting results. Two countries come out as clear leaders: Sweden (6 out of the top 25 regions, including Stockholm with the highest overall figure) and Belgium (7 out of the top 25 regions). This is largely explained by the fact that both these countries have high levels of the working age population with tertiary education and important concentrations of high technology sectors (both countries perform particularly well in terms of total employment in High Technology Services). Both these factors are explored in more detail in the next section.

Other leading regions in the EU-15 include core or capital regions in Finland (Uusimaa, Manner-Suomi), the UK (Inner London), Germany (Berlin), France (Ile de France) and the Netherlands (Utrecht). The lowest scoring regions against this indicator are found in Portugal, Greece, Italy and Austria. Italy and Austria also record comparatively low levels of tertiary level education, even in core economic areas. This most probably reflects differences in the exact classification of the educational qualifications used and demonstrates one of the problems associated with international comparisons involving educational attainment levels.

Disparities within countries

As noted above, some countries, such as Sweden or Belgium, Italy or Greece, perform consistently well or consistently poorly against this indicator, across nearly all regions. Nevertheless, some countries in the EU-15 do show marked regional disparities in terms of core human resources in science and technology. The UK and Spain emerge as the most unequal countries in this respect, ranging from London and Madrid in the top 25 regions in the EU-15 to Cornwall and the Isles of Scilly, Tees Valley and Durham and the Canaries, which are among the bottom 50 performing regions.

Map 6.3:



Data: NUTS II except Ireland (NUTS I), Switzerland and Norway (NUTS 0)

6.3. Innovation Capacity

Employment in High Technology Sectors: High and Medium High Technology Manufacturing

The medium high and high technology manufacturing sectors include chemicals, machinery, office equipment, electrical equipment, telecom equipment, precision instruments, automobiles and aerospace and other transport (based on the NACE industrial classification). As these sectors are viewed as the most innovative within the manufacturing economy, the proportion of the workforce employed in these fields is an indicator of the capacity of the economy as a whole to exploit the results of R&D and innovation. This said, caution must be exercised in interpreting the figures, as they include employment in assembly plants that are often reliant on the outputs of R&D activity conducted elsewhere. However, as we are assessing innovation capacity here rather than R&D capacity this need not be a significant issue.

Current strengths, weaknesses and disparities

Map 6.4 shows the level of employment in High and Medium High Technology manufacturing sectors across the EU-27 for the most recent years for which data is available.

The average level of employment in High and Medium High Technology manufacturing sectors in the EU-15 in 2001 was 7.57%, compared with a figure of 6.63% across the candidate countries. The highest proportions of employment in these sectors in the EU-15 are found in Germany, where the top seven regions are all located. The region with the highest proportion of the labour force engaged in high technology manufacturing sectors is Stuttgart with 21.08%. Other top performing regions include Franche Comté, Piemonte and Comunidad Foral de Navarra.

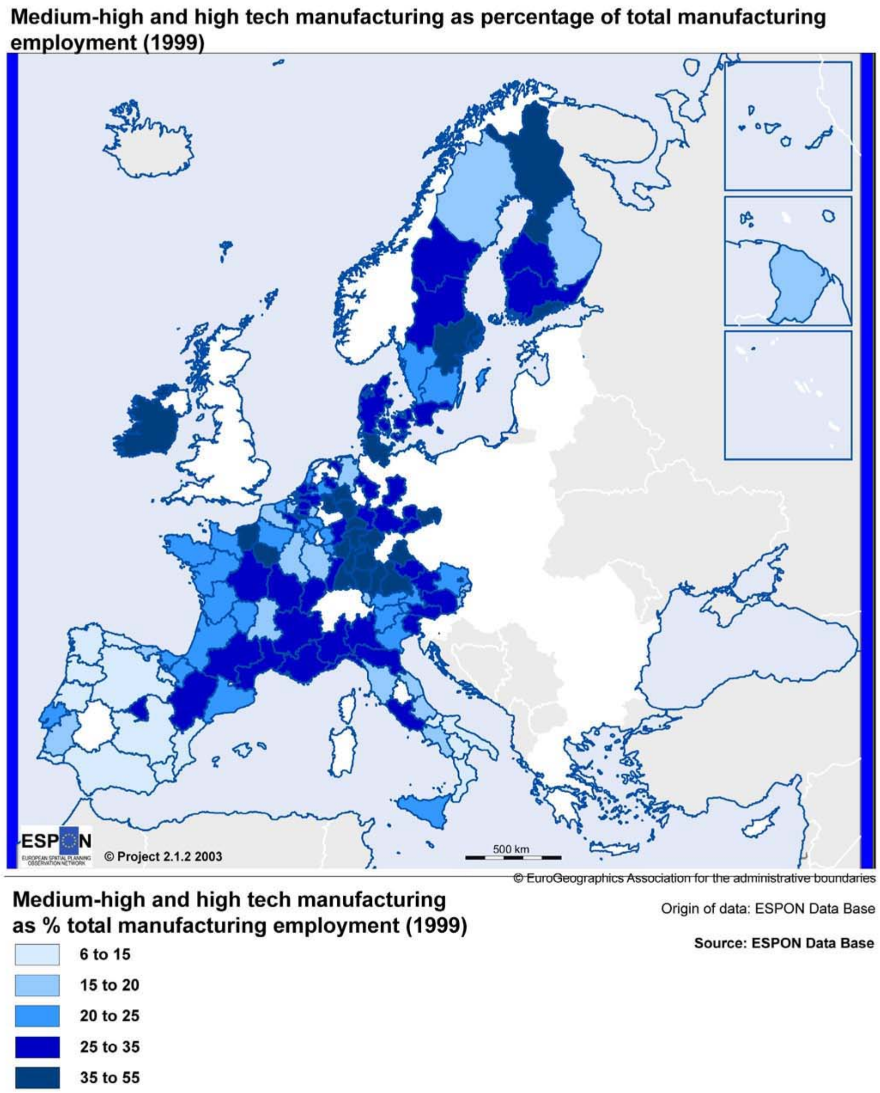
The bottom 50 regions include a high proportion of regions from cohesion areas of Southern Europe, along with a number of regions from core economic areas of the continent such as Outer London (1.96%), Utrecht (2.14%) and Noord Holland (2.56%). The figures for these latter regions reflect the proportionately dominant role of the service sector in these areas.

The highest rates in the candidate countries are found in the Czech Republic, Hungary and Slovenia, all of which have levels of medium high and high tech manufacturing above the EU-15 average. Cyprus, the three Baltic States and Romania all have rates of employment in these sectors well below the EU-15 and candidate country average

Disparities within countries

Particularly marked regional disparities in terms of the level of high technology manufacturing employment occur in Germany, Spain and Italy. These variations reflect profound differences in the economic structure of regions in these countries, between some of the manufacturing heartlands of Europe and the rural periphery.

Map 6.4



Employment in High Technology Sectors: High Technology Services

This indicator focuses on three leading edge sectors that produce high technology services: post and telecommunications, information technology including software development and R&D services (NACE 64, 72 and 73). These sectors provide services directly to consumers and inputs to the innovative activities of other firms in all sectors of the economy. This indicator is considered to be a more accurate indication of innovative potential in the service sector than "knowledge intensive services", which includes a far wider range of sectors.

Current strengths, weaknesses and disparities

In 2001, 3.61% of the EU-15 labour force was employed in High Technology Services. The highest levels of employment in these dynamic sectors of the economy are found in North Western Europe, in London and the South East in the UK, in Stockholm, Helsinki, Utrecht and the Paris region. Berkshire, Buckinghamshire and Oxfordshire, all in the UK, registered the highest figure at 4.65% of the labour force.

In the candidate countries, 2.34% of the labour force in 2001 was employed in high tech services. The highest proportion was found in Estonia (3.38%), with similarly high levels in the Czech Republic, Hungary, Malta and Slovakia (3.22%, 3.24%, 3.06% and 3.03% respectively). Romania, Cyprus and Latvia had the lowest rates of employment in these sectors (1.43%, 1.83% and 2.01%).

Disparities within countries

As with many of the other indicators examined in this report, strong concentrations of employment in High Technology services are found in capital regions, such as London, Paris, Madrid or Stockholm. For obvious reasons, the levels of employment in these parts of the economy are much lower in peripheral and rural areas of the continent. In the absence of reliable regional data for the candidate countries, it is not possible to comment on the national distribution of employment in these states.

Population with Tertiary Education

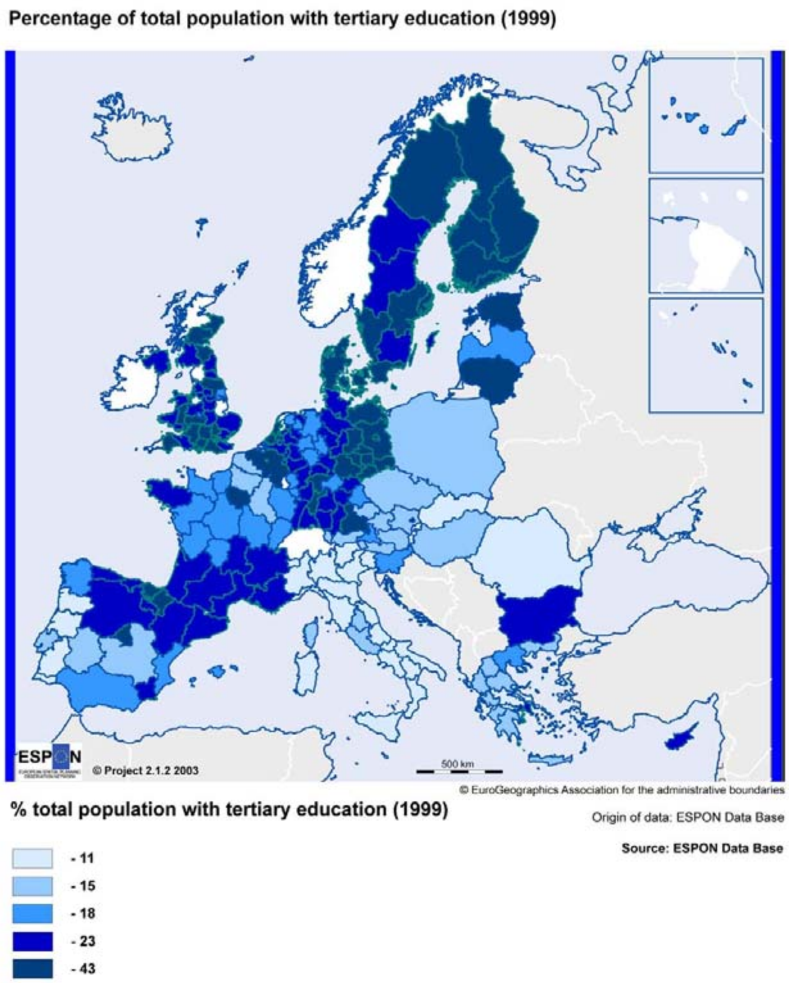
This indicator shows the percentage of the working age population (aged 25 to 64) with some form of post secondary education (ISCED 5 and 6). This is a general indicator of the supply of advanced skills in the economy. It is not limited to science and technical fields and, as such, is less useful as an indicator of the scientific knowledge base. However, the adoption of innovations in many areas, particularly in the service sectors, depends on a wide range of skills, which may not be captured by an overly narrow focus on scientific subject areas. Tertiary education is generally considered to act as a reasonable proxy for the capacity of a region to adopt new innovations.

One of the major drawbacks of the indicator is relates to the comparability of national educational systems. Differences in national systems, in particular concerning the level of attainment required to enter third level education make it very difficult to make meaningful international comparisons. As such differences between countries should be interpreted with care.

Current strengths, weaknesses and disparities

Map 6.5, based on data currently available to the project, shows the NUTS II regional picture for tertiary level educational attainment for 2000.

Map 6.5: The proportion of working age population with tertiary education in the EU-27



The aggregate proportion of the working age population with tertiary education in the EU-15 for this year was 21.2%. As can be seen, the regions with the highest levels of highly qualified people in current members of the Union are concentrated in the Nordic Countries and parts of Germany, the Netherlands and the UK. The lowest levels are found in Northern Portugal, parts of Italy and Greece. The disparity between the Länder of the former GDR (characterized by high levels of tertiary education) and the rest of

Germany reflect the legacy of different education systems and illustrate why international comparisons on the basis of this indicator need careful interpretation.

There are very large disparities between the tertiary education levels in the candidate countries. While the overall proportion of the candidate country population of working age with tertiary education was 13% in 2001, Bulgaria, Cyprus, Estonia and Latvia all have rates above the EU-15 average (with rates of 21.3%, 26.8%, 29.4% and 45% respectively). The Latvian figure is particularly high, most probably reflecting differences in the definition of tertiary education in this country. Poland, Romania, Slovakia, Hungary and the Czech Republic all have similar proportions of the working population with tertiary education of between 10 and 15%.

6.4. Research and Innovation Infrastructure

One factor that can assist in the development of a strong and innovative economy is the strength of supporting infrastructure. At a European level the strength of the local university base, presence of recognised science parks and Business Innovation Centres can all play a role. Analysis of the location of this infrastructure across Europe demonstrates some strong patterns (Table 6.1).

1. 4% of EU regions account for 40% of the leading research universities and institutes; 46% of recognised Science Parks and 25% of Business Innovation Centres. In contrast, 76% of regions contain none of these.

2. All EU-15 Member States contain at least one region in this leading group, although the institutional mix varies. In general, the leading regions have a very strong university base, or a balance between Science Parks, Business Innovation Centres and Universities.

Table 6.1 Research Infrastructure

Member State	*Number of leading regions*	*Strength*
Austria	1	University base
Belgium	2	University base
Denmark	1	Balanced
Finland	4	University base
France	4	Balanced, although Paris all university-base
Germany	1	University base
Greece	1	Balanced
Ireland	2	Balanced
Italy	8	Balanced, although Roma all university-base
Luxembourg	1	No university
Netherlands	1	University base
Portugal	3	Balanced
Spain	12	Science Parks and BICs, universities

		concentrated in 3 of the 12 regions
Sweden	5	Balanced
UK	3	Balanced

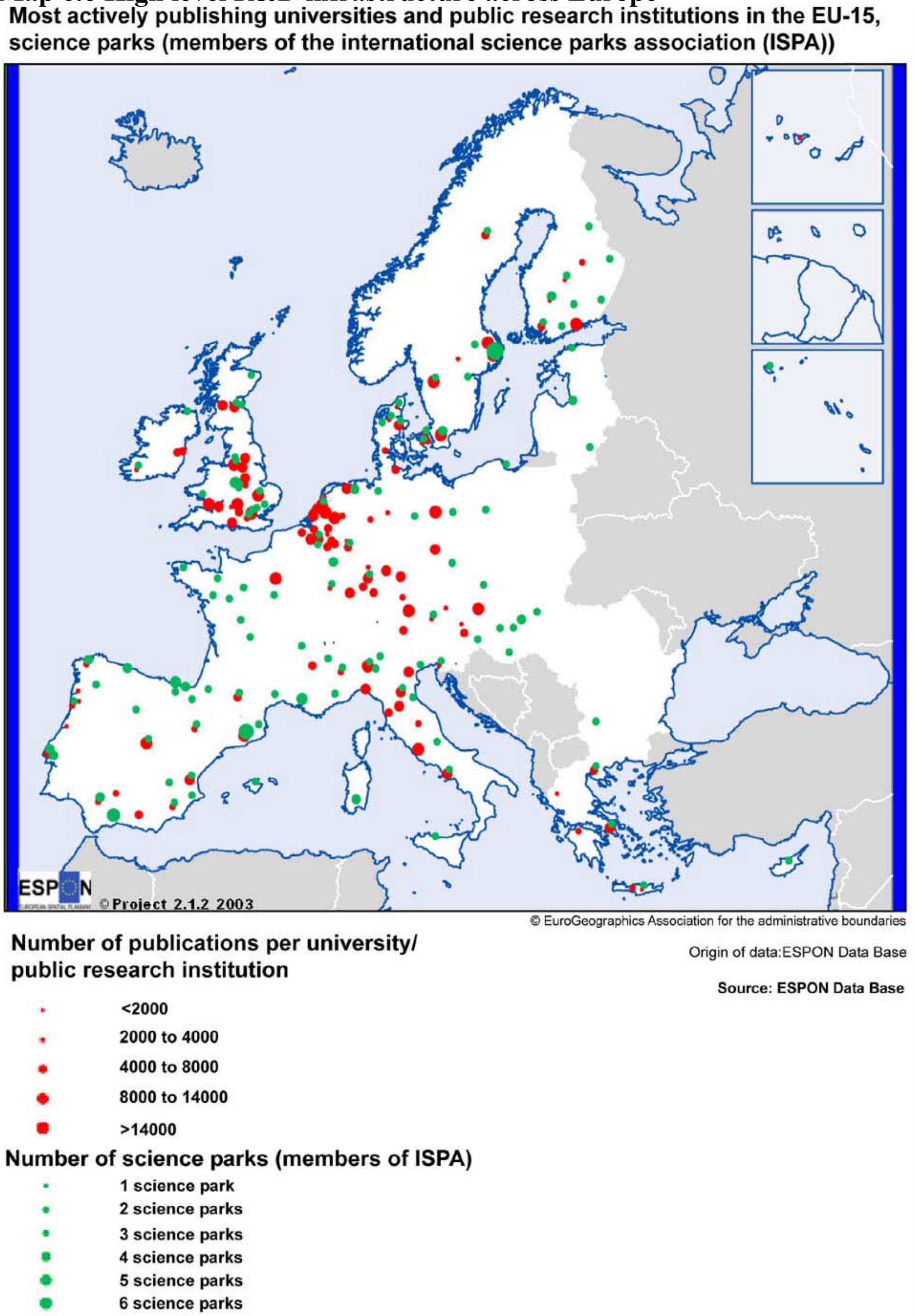
3. In the 12 Accession Countries the distribution of research infrastructure is spread more thinly, with just 18 recognised Science Parks and 10 Business Innovation Centres.

4. The concentration of research infrastructure is not just at a national level. More than half of the research infrastructure in the leading EU regions is located in just 7 regions, representing a significant endowment of knowledge and opportunity. These are distributed between different Member States with the common denominator being the fact that all are capital city regions. The regions are:

- Stockholm Län
- Paris
- Barcelona
- Dublin
- Grande Lisbon
- Communidad de Madrid
- Attiki
- Roma

Map 6.6, illustrates the distribution of the University and Science Park research infrastructure across the European territory. Note that Universities in the Accession State or Candidate Countries are not included in this assessment.

Map 6.6 High level R&D infrastructure across Europe



7. DEFINING A REGIONAL TYPOLOGY

Based upon the data analysis undertaken a regional typology has been produced which conceptualises the strength of a region in terms of its capacity to undertake R&D and for innovation. The method adopted is based upon combining the indicators for each category and assigning Z scores for the 3 indicators. High, medium and low scores are based upon the European average.

- R&D Scores – average of the Z scores for 3 indicators (regions only included if at least 2 of the 3 available) – classified high, medium, low (top, middle and bottom third of scores)

- Innovation Scores– average of the Z scores for 3 indicators (regions only included if at least 2 of the 3 available) - classified high, medium, low (top, middle and bottom third of scores)

The typology is then produced on the basis of the combined scores. The typology is based upon 5 'types' of region as described in Table 7.1.

Table 7.1 Typology of regions

Type	*Description*
Type 1	High R&D capacity and high innovation capacity
Type 2	High R&D capacity but low or medium innovation capacity
Type 3	Low or medium R&D capacity but high innovation capacity
Type 4	Medium R&D capacity and medium innovation capacity
Type 5	Low R&D capacity and low innovation capacity

Essentially, Types 2 and 3 are special cases in the context of regions that perform well either as producers of R&D or as users of R&D that is produced elsewhere. They reflect the potential reality of the EU as an area of transnational and transregional knowledge flows but may also suggest asymmetries in the regional innovation systems in these places. Types 4 and 5 should not necessarily be seen as the 'worst cases'. As has been identified in the earlier conceptual work for this study, not all regions will find a high R&D capacity a desirable objective.

The typology has been applied to all EU 15 Member States. It has proved impossible to apply to the regions of the Accession States and Candidate Countries owing to weak levels of information on innovation data. Instead we have included these Countries in the typology at a national level. The breakdown of the typology across 160 territories is set out in Table 7.2 below with a more detailed breakdown set out in Table 7.7.

Table 7.2 Number of regions by Type

Type	*Number of territories*	*%*
Type 1	33	21
Type 2	18	11
Type 3	16	10
Type 4	47	29
Type 5	46	29

For 12 Member States data is available at a regional level. This demonstrates that some States display sharp differences in performance, whilst for others the picture is more homogenous (Table 7.3). Overall, most Type 1 regions are located in the northern part of the EU but the pattern for Type 5 regions, whilst skewed towards southern EU Member States, does also illustrate the disparities that exist in some Member States.

Table 7.3 Distribution by country

	Type 1	*Type 2*	*Type 3*	*Type 4*	*Type 5*
Austria	1	-	-	2	6
Germany	12	4	8	13	-
Spain	2	-	1	5	9
Finland	4	1	-	-	-
France	4	3	-	9	5
Greece	-	-	-	2	4
Italy	-	1	1	4	13
Netherlands	2	5	1	1	3
Portugal	-	-	-	-	3
Sweden	3	1	-	1	-
UK	4	-	3	5	-

There is a close correlation between the level of GDP per capita and the different Types of region, as is illustrated in Table 7.4 below. The direction of this relationship is though uncertain.

Table 7.4 - GDP/Capita Quartiles by Typology Groups (1 lowest, 4 highest)

	GDP/Head Quartiles				Total
	1	2	3	4	
Type 1	0.0	18.2	21.2	60.6	100.0
Type 2	16.7	22.2	22.2	38.9	100.0
Type 3	12.5	25.0	43.8	18.8	100.0
Type 4	23.4	31.9	31.9	12.8	100.0
Type 5	52.2	23.9	17.4	6.5	100.0
Total	24.8	24.8	25.5	24.8	100.0

162 Valid Cases
Pearsons Chi-Square: 0.000 (Significant relationship)

Although there exists a strong relationship between levels of GDP and the regional typology this does not extend to a significant relationship with rates of growth, either in terms of innovation capacity within the region or levels of R&D capacity (Tables 7.5 and 7.6). There appears to be some evidence that the least well-endowed regions are ‘catching’ up in terms of R&D capacity, whilst the picture in terms of innovation capacity is less clear.

Table 7.5 - Growth Quartiles of R&D Capacity (1 lowest, 4 highest), by Typlogy Groups
% of cases

	Growth Quartiles				Total
Typology Groups	1	2	3	4	
Type 1	28.6	23.8	38.1	9.5	100.0
Type 2	42.9	14.3	14.3	28.6	100.0
Type 3	50.0	33.3		16.7	100.0
Type 4	20.5	23.1	33.3	23.1	100.0
Type 5	14.7	26.5	20.6	38.2	100.0
Total	24.8	24.8	25.7	24.8	100.0

113 Valid Cases
Pearsons Chi-Square: 0.137 (No significant association)

Table 7.6 - Growth Quartiles of Innovation Potential (1 lowest, 4 highest), by Typology Groups
% of cases

	Growth Quartiles				Total
	1	2	3	4	
Type 1	19.4	29.0	25.8	25.8	100.0
Type 2	33.3	33.3	26.7	6.7	100.0
Type 3	20.0	46.7	13.3	20.0	100.0
Type 4	23.3	20.9	34.9	20.9	100.0
Type 5	28.6	14.3	19.0	38.1	100.0
Total	24.5	25.2	25.2	25.2	100.0

147 Valid Cases
Pearsons Chi-Square: 0.258 (No significant association)

Table 7.7 Regions by type

Type 1

NUTS	Region	NUTS	Region	NUTS	Region
at13	Wien	de92	Hannover	fr62	Midi-Pyrénées
be	Belgique-België	dea2	Köln	fr71	Rhône-Alpes
de11	Stuttgart	ded2	Dresden	nl31	Utrecht
de12	Karlsruhe	es21	País Vasco	nl32	Noord-Holland
de14	Tübingen	es3	Comunidad De Madrid	se04	Sydsverige
de21	Oberbayern	fi14	Väli-Suomi	se08	Övre Norrland
de25	Mittelfranken	fi15	Pohjois-Suomi	se0a	Västsverige
de3	Berlin	fi16	Uusimaa (suuralue)	ukh	East Of England
de71	Darmstadt	fi17	Etelä-Suomi	uki	London
de72	Gießen	fr1	Île De France	ukj	South East
de91	Braunschweig	fr43	Franche-Comté	ukk	South West

Type 2

NUTS	Region	NUTS	Region
cz	Ceska Republika	it6	Lazio
de5	Bremen	lu	Luxembourg (Grand-Duché)
de6	Hamburg	nl11	Groningen
ded1	Chemnitz	nl22	Gelderland
ded3	Leipzig	nl33	Zuid-Holland
fi13	Itä-Suomi	nl41	Noord-Brabant
fr72	Auvergne	nl42	Limburg (NL)
fr81	Languedoc-Roussillon	se06	Norra Mellansverige
fr82	Provence-Alpes-Côte d'Azur	sk	Slovenska Republika

Type 3

NUTS	Region	NUTS	Region	NUTS	Region
de13	Freiburg	dee1	Dessau	lt	Lietuva
de23	Oberpfalz	dee2	Halle	nl23	Flevoland
de26	Unterfranken	es22	Comunidad Foral de Navarra	ukc	North East
de27	Schwaben	ie	Ireland	ukd	North West
de73	Kassel	it11	Piemonte	ukg	West Midlands
deb	Rheinland-Pfalz				

Type 4

NUTS	Region	NUTS	Region	NUTS	Region
at22	Steiermark	ee	Eesti	gr3	Attiki
at33	Tirol	es13	Cantabria	hu	Magyarorszag
de22	Niederbayern	es23	La Rioja	it13	Liguria
de24	Oberfranken	es24	Aragón	it2	Lombardia
de4	Brandenburg	es41	Castilla y León	it4	Emilia-Romagna
de8	Mecklenburg-Vorpommern	es51	Cataluña	it8	Campania
de93	Lüneburg	fr23	Haute-Normandie	nl21	Overijssel
de94	Weser-Ems	fr24	Centre	pl	Polska
dea1	Düsseldorf	fr25	Basse-Normandie	se09	Småland med öarna
dea3	Münster	fr26	Bourgogne	si	Slovenija
dea4	Detmold	fr41	Lorraine	uke	Yorkshire And The Humber
dea5	Arnsberg	fr42	Alsace	ukf	East Midlands
dec	Saarland	fr51	Pays de la Loire	ukl	Wales
dee3	Magdeburg	fr52	Bretagne	ukm	Scotland
def	Schleswig-Holstein	fr61	Aquitaine	ukn	Northern Ireland
deg	Thüringen	gr12	Kentriki Makedonia		

Type 5

NUTS	Region	NUTS	Region	NUTS	Region
at11	Burgenland	es62	Región de Murcia	it52	Umbria
at12	Niederösterreich	es7	Canarias	it53	Marche
at21	Kärnten	fr21	Champagne-Ardenne	it71	Abruzzo
at31	Oberösterreich	fr22	Picardie	it72	Molise
at32	Salzburg	fr3	Nord - Pas-De-Calais	it91	Puglia
at34	Vorarlberg	fr53	Poitou-Charentes	it92	Basilicata
bg	Bulgaria	fr63	Limousin	it93	Calabria
cy	Kypros/Kibris (Cyprus)	gr14	Thessalia	ita	Sicilia
es11	Galicia	gr23	Dytiki Ellada	itb	Sardegna
es12	Principado de Asturias	gr24	Sterea Ellada	lv	Latvija
es42	Castilla-la Mancha	gr25	Peloponnisos	nl12	Friesland
es43	Extremadura	it31	Trentino-Alto Adige	nl13	Drenthe
es52	Comunidad Valenciana	it32	Veneto	nl34	Zeeland
es53	Illes Balears	it33	Friuli-Venezia Giulia	pt11	Norte
es61	Andalucía	it51	Toscana	pt12	Centro (P)
				pt13	Lisboa e Vale do Tejo

8. HYPOTHESIS ON THE TERRITORIAL EFFECTS OF EU R&D POLICY

The following section examines the territorial effects of the Framework Programmes and the Structural Funds. In the case of the Framework Programme it does so through an assessment of the extent to which regions participate in the Framework Programme, through firms and other organizations, such as educational institutions, located in the region. For the Stuctural Funds, intervention code data is analysed according to a number of broad categories.

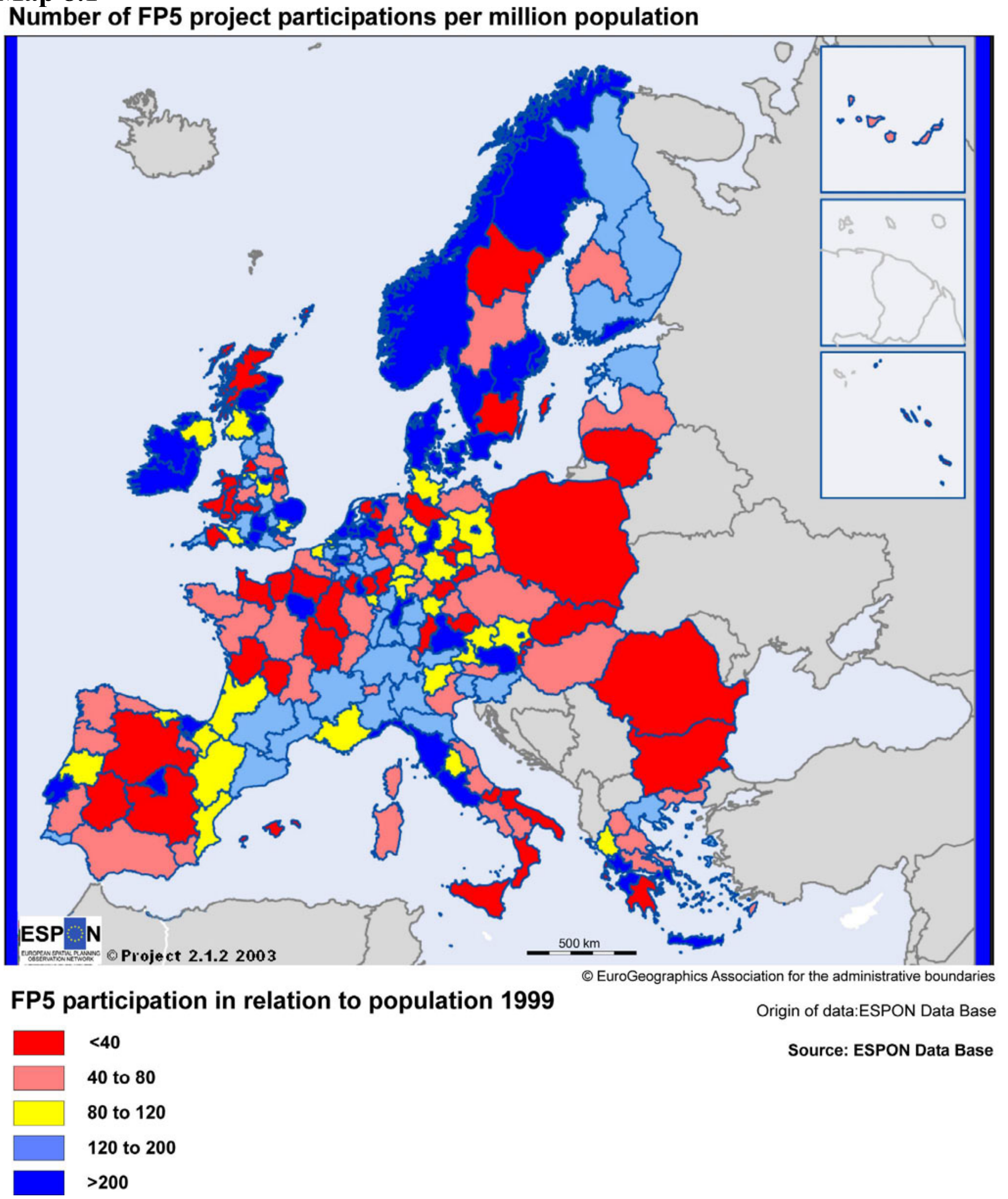
8.1. Framework Programme participation

Framework Programme participation is dispersed across the European territory. Strong islands of participation in the 15 EU Member States are clearly visible in Map 8.1. This map shows the total number of project participations in the Fifth Framework Programme (both Prime and Subsidiary contractors) across the EU-27, Norway and Switzerland, weighted by population. Participation levels in Accession Countries and Candidate Countries are lower, although this increases somewhat if participation is weighted by GDP rather than population.

Comparing FP participation by Type of Region

The territorial effects of the Framework Programme activity are more evident when compared to the typology of regions, developed earlier. Participation in the Framework Programmes is highest in Type 1 regions. This pattern has remained stable between Framework Programme 4 and Framework Programme 5. In both periods 67% of Type 1 regions featured in the top quartile of regions by number of projects funded through the Framework Programme. Type 2 regions also register strong levels of participation, possibly reflecting their higher capacity for R&D activity.

Map 8.1



Data Source: CORDIS Project Database.

Between Framework Programme 4 and Framework Programme 5 there is some, albeit marginal, evidence of increasing levels of participation by some Type 5 regions, whilst participation levels by Type 3 regions have fallen back (Tables 8.1 and 8.2).

Table 8.1 - FP4 Participation (per head) Quartiles (1 lowest, 4 highest), by Typlogy Groups

	FP4 Participation Quartiles				Total
	1	2	3	4	
Type 1	3.0	6.1	24.2	66.7	100.0
Type 2	16.7	16.7	22.2	44.4	100.0
Type 3	18.8	25.0	43.8	12.5	100.0
Type 4	28.3	30.4	30.4	10.9	100.0
Type 5	42.2	37.8	15.6	4.4	100.0
Total	24.5	25.2	25.2	25.2	100.0

157 Valid Cases
Pearsons Chi-Square: 0.000 (Significant relationship)

Table 8.2 - FP5 Participation (per head) Quartiles (1 lowest, 4 highest), by Typlogy Groups

	FP5 Participation Quartiles				Total
	1	2	3	4	
Type 1	3.0	9.1	21.2	66.7	100
Type 2	22.2	5.6	27.8	44.4	100
Type 3	31.3	18.8	43.8	6.3	100
Type 4	19.6	37.0	32.6	10.9	100
Type 5	44.4	35.6	13.3	6.7	100
Total	24.5	25.2	25.2	25.2	100

157 Valid Cases
Pearsons Chi-Square: 0.000 (Significant relationship)

Comparing FP participation by GDP

Participation in the Framework Programmes is also significantly related to levels of GDP. Regions in the lowest quartile of regions based on the level of GDP per capita tend to have the lowest levels of participation in the Framework Programmes. Those regions in the highest quartile have the highest levels of participation (Tables 8.3 and 8.4).

Whilst the picture between Framework Programme 4 and Framework programme 5 remains broadly similar there are signs that participation levels by less favoured regions are increasing. However, not withstanding this, the highest levels of participation remain the preserve of those regions with the highest levels of GDP per capita.

Table 8.3 - FP4 Participation (per Head) Quartiles (1 lowest, 4 highest), and by GDP quartiles (1 lowest, 4 highest)

	FP4 Participation Quartiles				Total
Quartile GDP/Capita	1	2	3	4	
1.0	68.4	18.4	5.3	7.9	100.0
2.0	19.5	48.8	22.0	9.8	100.0
3.0	7.3	17.1	48.8	26.8	100.0
4.0	5.1	15.4	23.1	56.4	100.0
Total	24.5	25.2	25.2	25.2	100.0

157 Valid Cases
Pearsons Chi-Square: 0.000 (Significant relationship)

Table 8.4 - FP5 Participation (per Head) Quartiles (1 lowest, 4 highest), and by GDP quartiles (1 lowest, 4 highest)

	FP5 Participation Quartiles				Total
Quartile GDP/Capita	1	2	3	4	
1	50.0	34.2	10.5	5.3	100.0
2	22.0	41.5	29.3	7.3	100.0
3	19.5	7.3	43.9	29.3	100.0
4	7.7	17.9	15.4	59.0	100.0
Total	24.5	25.2	25.2	25.2	100.0

157 Valid Cases
Pearsons Chi-Square: 0.000 (Significant relationship)

Cohesion effects

The Framework programmes are supportive of actions in Objective 1 regions but participation is skewed more strongly to non-objective 1 regions. The reasons for this are numerous but reflect available infrastructure as well as the nature of the respective economies.

Firms and organizations based within Objective 1 regions of the EU account for approximately 14% of total participation in the RTD Framework Programmes (FP). This proportion has remained stable in both FP4 (1994-1998) and FP5 (1998-2002). Proportionately, slightly more projects have been led by organizations based in Objective 1 regions in FP5 than previously (12% compared to 11%).

The average number of participants in FP5 in an Objective 1 region is some 63% of the EU average. This is slightly below the average level of GDP for an Objective 1 region (70%) suggesting that FP participation is disproportionately greater in non-objective 1 regions. Notwithstanding this, participation is relatively high in a number of Objective 1 regions, particularly in Ireland, Portugal and some regions of Greece.

Objective 1 regions account for some 22% of the EU population. Objective 1 regions are thus also underrepresented in comparison to their share of population, although a mixed picture is visible with some regions in Ireland, Greece and Portugal demonstrating higher participation levels. Overall, participation levels weighted for population appear to be slightly lower than those weighted for GDP.

The regional effects of projects supported through the Framework Programmes

From the case study analysis undertaken to date the following initial effects have been identified. This element of the work programme still remains to be completed and further analysis will be undertaken.

Infrastructure and equipment investment: the picture varies but the Framework Programme generally has little impact in terms of improving the research infrastructure of the region. Some small, project-specific, effects can be identified through support for the purchase of project-related hardware.

Employment effects (jobs created directly etc.): Important short-term employment effects can be identified through the creation of research posts, bursaries and fellowships. In the best cases new jobs have been initiated with a longer-term character, but this appears to be the exception. Actual longer-term job creation is dependent upon the uptake of processes and products developed through supported projects by industry.

Development of local knowledge or technology capacity: Some of the most significant effects occur in this area, although in the worst cases the benefits are limited to the participating organization. Unfortunately this appears to be the case on many occasions, with several reports of accrued knowledge not ‘spreading’ beyond the boundaries of the institutions or firms directly involved in a particular project. It appears that knowledge and know-how is more likely to spread throughout the consortia, and so outside of the region/country, rather than within the region. A number of strong examples of beneficial local effects have been reported and further analysis of the mechanisms for this is intended. In particular there is some evidence suggesting that the Framework Programmes are contributing to the development of clusters of activity in the best examples.

Development of networking and knowledge flows (within the regional and beyond): The single most important area for reported effects. The contribution that the Framework Programme makes to knowledge flows between regions and across Europe must not be underestimated. The Programme is reportedly resulting in wide-spread and high-frequency knowledge networks with strong ties. The networks and projects also foster ties between research institutions and firms contributing to the development of active innovation networks. These are leading to new practices of working and communicating and promoting trust – a key feature of in the progress of R&D and its ultimate adoption through new innovations.

Impact on strategy and working methods of organizations: The Framework Programmes are having an effect on the development of new methodologies and interactions between different actor-groups. This enhances organizational and scientific practice. Trans-regional co-operation is also affecting working methods.

Overall, the benefits of being involved in the Framework Programmes are hard to quantify. FP4 and 5 have certainly funded a wide range of projects across many scientific, technological and socio-economic sectors and have involved a wide range of players. The 'large players' in particular are reported to have benefited from the opportunity to develop new products and processes within trans-national partnerships. However there is little evidence of the development of sustainable network creation within regions most job creation (or safeguarding) has been of a transient and temporary nature. However, the benefits of increased levels of social capital and networking and the widening of networks to an international scale are all important features which, at the very least, avoid the danger of regional 'lock-in' and at best promote more effective innovation and R&D.

8.2. Use of Structural Funds

Analysis of records held by DG Regional Policy enables us to identify the manner in which the Structural Funds are being used to support R&D activity, and where this is occurring. The analysis is based upon planned expenditure as records of actual expenditure are very limited. In each case we report on the planned expenditure under the relevant Field of Intervention (FOI) code and the proportion of Structural Fund expenditure in the programmes containing these codes.

In total some 10.6bn euros are intended to be spent on R&D activity in the 2000-2006 programming period. This represents 8.5% of expenditure in relevant programmes or 5.1% of all Structural Fund expenditure (208.5bn euros); a slight decrease on the 5.6% reported for the 1994-1999 period. Around three-quarters (74%) of expenditure is contributed by the ERDF and a quarter (25%) from the ESF.

The type of activities supported

Just under half of all planned expenditure is intended to support innovation and technology transfers, establishment of networks and partnerships between businesses and/or research institutes (FOI code 182). Support for research projects based in universities and other research institutes (FOI code 181) and the development of RTDI Infrastructure (FOI code 183) represent the other two main areas of activity. There is a much lower level of funds directed towards training for researchers (FOI code 184), although it constitutes a higher proportion of the value of those programmes which contain this field of intervention than do the other RTD fields. This is illustrated in Table 8.5.

Table 8.5 Expenditure by Field of Intervention

FOI Cd (2000-2006)	FOI Total Structural Fund	Total Structural Fund Amount	FOI as % of Total Structural Fund
18	808,847,311	22,153,615,108	3.65%
181	2,376,827,389	84,831,125,985	2.80%
182	4,962,567,749	113,613,066,458	4.37%
183	2,261,620,615	97,716,209,540	2.31%
184	273,536,783	6,089,414,666	4.49%

Source: adapted from DG Regional Policy records

The distribution of activity between Objective 1 and 2 (Table 8.6) varies with a stronger emphasis in Objective 1 regions on actions supporting innovation and technology transfers, establishment of networks and partnerships between businesses and/or research institutes. In contrast, a higher proportion of funds is focused on supporting the development of RTDI infrastructure in Objective 2 areas. This is contrary to previous estimates of the mix of activities between Objective 1 and 2 regions. Of course, absolute values of support in Objective 1 regions are higher across all categories. Interestingly, only France plans to make expenditure under FOI 184 through Objective 3 programmes.

Table 8.6 Distribution of R&D expenditure by Objective

FOI	*Objective 1*	*Objective 2*	*Objective 3*
18	5.6%	10.6%	-
181	29.1%	24.4%	91.7%
182	44.5%	37.7%	-
183	18.0%	26.5%	-
184	2.8%	0.8%	8.3%

Source: adapted from DG Regional Policy records

The balance of activity by Objective

Structural Fund actions in support of R&D are heavily focused on the Objective 1 regions of the EU. This reflects the overall focus of the Structural Funds as a whole with planned R&D expenditure in Objective 1 regions representing a similar proportion of overall activity as the balance of Structural Fund expenditure as a whole (76% of R&D spend is planned in Objective 1 regions versus 77% of overall Structural Fund expenditure). Given that Objective 1 regions have a GDP of some 70% of the EU average and a population of just 22% of the EU average this does suggest that EU policy in this direction is supportive of territorial cohesion.

The balance of activity within programmes which feature R&D activity, tends to be more supportive of R&D actions within Objective 2 regions rather in Objective 1 regions, as Table 8.7 demonstrates. The Objective NA category primarily reflects the INTERREG Community Initiative.

Table 8.7 Balance of R&D expenditure by Objective

	FOI Total Structural Fund	Total Structural Fund Amount	FOI Total Structural Fund
Objective 1	8,149,155,896	101,432,817,916	8.03%
Objective 2	2,328,758,828	21,544,106,755	10.81%
Objective 3	9,026,885	4,487,762,400	0.20%
Objective NA	193,828,829	3,550,927,028	5.46%
Total	10,680,770,438	131,015,614,099	8.15%

Source: adapted from DG Regional Policy records

The national balance of R&D supported activity

By value, the largest expenditure on R&D actions supported by the Structural Funds are planned in Spain, closely followed by Italy and then Germany (Table 8.8). As a proportion of total Structural Fund expenditure Luxembourg and Finland plan the greatest support for R&D activity, closely followed by Italy. The lowest levels are planned in the Netherlands and Greece. Naturally, many Structural Fund programmes are focused on areas where R&D activities are not necessarily appropriate and this may lead to an understatement of the support planned. Examining the proportion of funds dedicated to R&D actions in only those programmes which feature these FOI codes provides a slightly different picture. In many countries there appears to be a concentration of activity in a limited number of programmes, with RTD actions approaching (and exceeding) a quarter of all Structural Fund activities in a number of cases.

Table 8.8 National balance of R&D support

Country	FOI Total Structural Fund	Total Structural Fund Amount	FOI Total Structural Fund	Total national structural Funds	FOI% of overall total
Belgium	159,613,980	1,417,720,466	11.26%	2,083,000,000	7.66%
Denmark	26,416,106	189,000,000	13.98%	828,000,000	3.19%
Germany	1,991,713,813	20,889,458,296	9.53%	29,764,000,000	6.69%
Greece	418,154,903	10,052,473,693	4.16%	25,000,000,000	1.67%
Spain	2,695,002,743	30,429,550,000	8.86%	56,205,000,000	4.79%
France	591,808,719	10,176,578,667	5.82%	15,666,000,000	3.78%
Ireland	246,486,322	854,140,923	28.86%	3,482,000,000	7.08%
Italy	2,508,423,859	20,331,480,092	12.34%	29,656,000,000	8.46%
Luxembourg	9,020,000	41,000,000	22.00%	91,000,000	9.91%
Netherlands	24,663,342	969,860,000	2.54%	3,286,000,000	0.75%
Austria	141,379,152	974,000,000	14.52%	1,831,000,000	7.72%
Portugal	683,765,542	13,897,246,000	4.92%	19,700,000,000	3.47%
Finland	202,868,900	1,450,440,000	13.99%	2,090,000,000	9.71%
Sweden	132,634,077	986,000,000	13.45%	2,186,000,000	6.07%
United Kingdom	642,201,111	14,379,982,600	4.47%	16,596,000,000	3.87%
Total	***10,474,152,569***	***127,038,930,737***	***8.24%***	***208,464,000,000***	***5.02%***

Source: adapted from DG Regional Policy records

Patterns of expenditure through the Structural Funds do not bear a significant relationship to patterns of public expenditure on R&D more generally. Although Finland dedicates the largest proportion of GDP to public R&D expenditure, Sweden and the Netherlands follow closely. Neither of the latter two Member States are in the top third of proportionate expenditure on R&D through the Structural Funds. Of the three Member States that currently spend the lowest proportion of GDP on public expenditure both Ireland and Spain rank more highly in terms of Structural Fund expenditure in this area. Analysis of potential reasons for this is beyond the bounds of the present study.

Regional distribution of activity

The distribution of planned Structural Fund expenditure on R&D activities by region demonstrates some marked variations, as Table 8.9 illustrates. Whilst most regional programmes contain some allocation for actions in support of R&D the proportionate value of this can range from a high of 30% to a low of 0.5%. In the following section we examine how these funds are being used in a little more detail and intend to build on this analysis more strongly in subsequent work.

Ireland, Portugal and Spain have all allocated significant resources to the promotion of R&D in areas for support under Objective 1 of the Structural Funds through central programmes. In these cases significantly less resources are available through the regional programmes themselves. This distinction is most stark in Spain where, typically, some 20% of Structural Fund expenditure in Objective 2 programmes is planned to be directed in support of R&D activities, but less than 3% of regional programmes in Objective 1 areas. It is not possible to identify the planned territorial distribution of these central programmes.

Table 8.9 Regional balance of R&D support

Country	range	Regional average	Regional programmes containing FOI code 18	Total number of regional programmes
Belgium	3.9%-19.5%	14.5	6	8
Denmark	na	14.0	1	1
Germany	2.6%-20.9%	6.8	15	17
Greece	0.6%-3.7%	1.3	11	13
Spain	0.5%-30.9%	4.5	17	19
France	0.7%-22.3%	5.8	27	27
Ireland	na	1.2	1	2
Italy	0.1%-8.7%	2.2	19	21
Luxembourg	na	22.0	1	1
Netherlands	1.5%-5.2%	2.6	4	4
Austria	7.8%-23.7%	14.5	9	9
Portugal	0.6%-2.0%	1.3	7	7
Finland	12.6%-16.4%	14.5	4	5
Sweden	2.0%-20.5%	13.5	5	6
United Kingdom	1.0%-10.7%	6.3	18	20

Source: adapted from DG Regional Policy records

Unfortunately we have not yet been able to assess the relationship between Structural Fund programmes and the regional typology developed. This will require the identification of the NUTS categories of the areas eligible for support under the Structural Funds. We will be seeking to undertake this more detailed analysis in the coming weeks.

Focus of EU RTD interventions supported by the Structural Funds

This section of the report draws on initial findings from the regional case studies to examine the focus of Community measures financed through the structural funds. The case studies undertaken as part of TPG 2.1.2 analysed the nature of R&D and innovation-related actions specified in regional Objective 1 and Objective 2 programmes for the periods 1994-1999 and 2000-2006, as well as the focus of Community-funded Regional Innovation Strategies and the recent round of Innovative Actions. The analysis for the period 1994-1999 has been based on regional programming documents, where available, relevant evaluation studies and interviews with regional stakeholders. For the current Programming period, case study experts have examined the policy orientations and planned measures set out in the programming documents for the regions concerned.

Objective1 regions are generally characterised by low levels of R&D investment and poorly developed research and innovation infrastructure. As a result of these basic weaknesses, R&D-related actions in early Objective 1 Programmes have traditionally been focused on infrastructure development (support for research establishments, capital investment as so on). However, the evaluation of Research, Technological Development and Innovation (RTDI) actions in Objective 1 regions under the 1994-1999 Programming period notes a shift in emphasis from 1994 onwards, away from a concentration on science and technology supply and towards market demand. This change in focus is seen to have been motivated by a recognition that regional capacity to innovate depends not only on the local supply of technology, but also on the receptiveness (or absorptive capacity) of the local economy and in particular Small and Medium-sized Enterprises (SMEs)[31].

This trend in policy focus is reflected in the policy interventions supported by Structural Funds in Objective 1 regions in both the 1994-1999 and 2000-2006 programming periods, as highlighted by the case studies. In broad terms, the types of action supported fall into four broad groups, as follows:

- *Physical Infrastructure and Equipment.* There is still a considerable focus in the R&D and innovation activities supported by the Objective 1 Programmes analysed in the case studies on infrastructure development. Examples of this from the 2000-2006 period include direct support for centres of scientific excellence (such as a grant to a *Max Planck Insitut* in Greifswald in Mecklenburg-Vorpommern), upgrading business support structures (Mecklenburg-Vorpommern, Puglia) and provision of sites for developing production-related research (West Wales). Although the level of funding

[31] Impact of Structural Funds 1994 - 1999 on research, technology development and innovation (RDTI) in Objective 1 and 6 regions, CIRCA, May 1999, p.35

available under Objective 2 means that the large-scale infrastructure investments undertaken in Objective 1 areas are not possible, Objective 2 programmes often contribute to physical infrastructure development. Examples include support for expanding business parks and educational establishments (for example in East Netherlands, Lorraine and Cologne) or for the acquisition of equipment, such as computer software (Liguria).

- *Direct support for the knowledge base.* This includes support for public or private research, such as direct grants for R&D projects and R&D-related productive investment in businesses, contributions to the cost of recruiting R&D personnel and subsidies for the registration of patents (the latter action noted Mecklenburg-Vorpommern, for example)
- *Business support services*. Support is in some cases directed at the provision of advice and consultancy to business, in particular to SMEs. This includes assistance with Business plans and training and advice about innovation management for existing businesses, as well as support for start-ups. An example of this latter type of intervention is the "*Gründungsoffensive*" in Cologne, a start-up initiative supported by the Objective 2 Programme, which has provided a range of services to fledgling businesses. Funding in this areas is often channelled through existing innovation support structures.
- *Technology Transfer and Networking*. This encompasses a wide range of projects aimed as developing links between different actors in the regional innovation system, whether on the supply or demand side. Initiatives co-financed by Objective 1 Porgrammes include the expansion of Business Innovation Centre and creation of a network of business incubator support infrastructure in Wales, the development of a "one-stop shop" at a university in Calabria and promotion of R&D co-operation among business in Mecklenburg-Vorpommern. Transfer and networking can be promoted through support for intermediary organisations or initiatives such as graduate or researcher placement schemes (examples in East Netherlands, Liguria). Networking activities designed to promote clustering effects among firms are also supported (in Vienna, for example).
- *Development of human capital*. This category of action includes training initiatives with a specific focus on R&D or innovation (as opposed to more general skills development actions, aimed at the wider population). Examples of this are evident in many current Objective 1 Programmes and can involve direct support of science and technology training or training for innovation support personnel (such as Innovation Centre staff). Courses and seminars on the management and implementation of new technologies, aimed at small businesses are a further example of activities in this area.
- *Direct support for research and innovation projects*. A few examples of this type of intervention were highlighted by the case studies in Objective 2 regions. In Liguria, for example, funding under the 2000-2006 programme has been set aside for the development of industrial and pre-competitive research activities, while assistance for business support agencies or the provision of venture capital in other regions could be directed to R&D projects (Vienna, Lorraine).

The case studies carried out for this study highlight the trend towards measures focusing on the demand side of the innovation system in Objective 1 programmes. That said, the examples also demonstrate that support for infrastructure and equipment continues to account for a significant proportion of total support for R&D and innovation in Objective 1 programmes in 2000-2006. In Calabria, for example, the Objective 1 Programme for 2000-2006 places more emphasis on innovation in the enterprise sector than the previous Programme, which often focused on actions to preserve or develop employment[32]. The Objective 1 Programme in West Wales and the Valleys reflects the priorities of the Regional Technology Plan (RTP), produced in the mid-1990s, with a clear focus on developing the innovative capacity of business and "social capital" in the region. The Wales Case Study report does, however, note that the dominant role of the higher education sector in R&D in Wales mean than many actions are still centred on this sector, often with the aim of improving the links between HE institutions and the surrounding economic fabric.

In general terms, it is clear that R&D and innovation-related activities in Objective 2 areas tend to focus more on the demand side of the innovation system than measures in Objective 1 areas. This is partly a function of the level of funding available under Objective 2, but probably also reflects the relative strength of existing supply side R&D infrastructure (particularly in the field of Higher Education) in Objective 2 areas, when compared to Objective 1 regions.

A focus on innovation support activities is evident in programmes under both programming periods, although different programme structures often make it difficult to compare the focus of measures from one period to the next. An increased emphasis on technology transfer and networking, including support for existing innovation intermediary bodies in the regions is evident in a number of programmes, however, however. One interviewee involved in overseeing the Objective 2 Programme in Cologne, noted an even clearer shift from support for infrastructure development in 1994-1999 to investment in human capital and networking between enterprises in 2000-2006.

RTP, RIS and RITTS

Regional Technology Plans (RTPs) were pilot projects to develop Regional Innovation Strategies, financed in four Objective 2 and three Objective 1 regions under Article 10 of the European Regional Development Fund (ERDF) in the period 1994-1996. Almost at the same time, the then DG XIII launched the Regional Innovation and Technology Transfer Strategies (RITTS) programme, a similar exercise, with a particular emphasis on technology transfer and innovation, open to all European regions. Following the initial RTPs, a further round of projects was launched, this time entitled Regional Innovation Strategies (RIS). Regions having participated in either RTP, RIS or RITTS initiatives were later eligible for funding under the RIS+ programme, to implement specific measures and projects stemming from their RITTS/RIS strategies.

Both RTP/RIS and RITTS projects involved the development of a plan for supporting innovation at the regional level. However, whereas RTP/RIS focused on innovation based

[32] Calabria Case study report.

regional development in general, RITTS were more specifically centered on the efficiency of the innovation support infrastructure and policies.

RTP/RIS projects all involved three main phases:

- A discussion and negotiation phase, when a steering committee and management team and the sectoral focus were settled;
- An analysis phase to assess the innovation needs of firms (through surveys) and the innovation supply available in the region to respond to the needs identified. This was complemented by inter-regional analysis;
- A phase for elaborating the regional innovation strategy, to be translated into a concrete action plan, a list of pilot projects etc.

RITTS involved the same basic phases, with a more explicit focus on regional innovation support structures.

All the RTP/RIS and RITTS projects examined in the case study regions had an initial focus on networking different actors involved in innovation in the region and raising awareness of each other and of the importance of innovation. Indeed, the development of links and exploration of possible synergies between different organizations, encouraged through this phase, is viewed as one of the most important outcomes of the projects in several regions studied (Auvergne, Vienna, Lorraine, for example).

Despite following a similar format, the goals of RTP/RTP and RITTS projects did vary between region. While, as noted, the networking of a wide range of innovation players was a key objective in some regions, other projects focused on specific economic sectors (agro-food and tourism in the Calabria RIS, for example), or streamlining the existing innovation support structures (Limburg (B) RIS). In general, it appears that RITTS projects tend to have focused more on developing specific actions and pilot projects, whereas strategy and networking were more significant in RIS. This said, pilot projects were an outcome of both types of intervention. Examples include the Campus Enterprise project, link universities and the business sector in the Calabria RIS and an R&D voucher scheme in the RITTS developed in the Uusimaa region of Finland.

Innovative Actions 2000-2006

All the regions with areas covered by Objectives 1 or 2 are eligible for innovative action grants from the ERDF in the period 2001-2006 and the first of this new generation of projects have been launched. Funding is available for projects under three strategic themes: the information society and regional development; regional identity and sustainable development and "knowledge-based regional economies and technological innovation".

The last theme aims to help the regions acquire competitive assets based on technological innovation through cooperation between the public sector, the bodies responsible for RTDI and businesses with a view to creating efficient regional innovation systems.

By definition, the projects funded under this scheme vary considerably in their focus. They include projects focused in individual regions and projects to create networks between regions. A number of illustrative examples from the case study regions are presented below.

- *VERITE*: This project, based in the Cologne region, aims to inform regional authorities involved in RIS-RITTS initiatives on Innovation Management Tools (techniques, methods, and technologies), which may enhance the capability of regional actors to develop and apply innovations. The activities of VERITE are divided into the following categories: personal contact activities (workshops, conferences etc.), online discussion through a discussion group, provision of directory services for SMEs and regional authorities and diffusion of IMTs (Innovation Management Techniques) to SMEs.

- *STRINNOP*: Strengthening the Regional Innovation Profile a network of which the Vienna region is a member, focuses on creating synergies between the member regions and identification of potential areas for inter-regional co-operation; best practice methodology; support of regional SMEs within their innovation activities.

- The *ILSRE* programme (Iniziative locale per lo sviluppo regionale – Local initiatives for Regional Development) in Calabria focuses on new methods of local development based on regional identity and sustainable development, without reference to technological innovation

- *InnoELLI*. This project in the Uusimaa region is part of the eEuropeRegio theme, focused on the information society at the service of regional development. The programme was prepared by the South Finland Regional Alliance, which is a regional co-operative organ for seven regional authorities (Regional Councils). The time frame for the programme is two years until the end of year 2003. The aim of the InnoELLi programme is to create a new type of co-operation between different actors and regions within the sectors of logistics and environmental technology. The fields were chosen because of their importance to the economic activity in the programme area. Besides, the sectors were seen to have a strong potential of benefiting from advances in ICT. The InnoELLI programme includes three cross-regional logistics projects and two environmental technology projects have been funded.

9. POLICY CONCLUSIONS

9.1. Conclusions and recommendations on the improvement of sector policies and instruments considering territorial governance

Clear disparities exist between regions across the European territory in terms of their capacity to undertake R&D and innovation. These disparities exist both within States and between States, with a close correlation to levels of GDP per capita. The direction of this relationship is not evident though. The concentrated distribution of high-level R&D infrastructure across the European territory is symbolic of these disparities, although demonstrating the strength of certain capital city regions rather than a 'core' of activity within Europe.

In terms of gross expenditure on R&D the central position of a limited number of areas is clearly evident. This concentration of activity is even greater when the distribution of private sector expenditure on R&D is considered. The reliance of many regions on publicly funded R&D may be seen as a potential weakness, but it also provides a lever through which to encourage a more effective regional innovation system.

A nascent polycentric structure can be identified in the European territories, although this is not evenly balanced. The Accession and Candidate Countries, Spain, Portugal, Greece and Italy are noticeable in their limited areas of European strength in this sector. It is not clear whether this polycentric pattern is a force for positive development or not. European policies have not, so far, explicitly identified this as a pattern to be developed.

Participation in the Framework Programmes is strongly linked to regional R&D capacity. This pattern has not changed significantly between the 4th and 5th Framework Programmes, although there are some, modest, signs of increasing rates of participation amongst those regions with the weakest capacity for R&D and innovation. The Typology of regions developed for this study demonstrates a strong correlation between participation and strength of regional R&D capacity.

However, a number of less favoured regions do demonstrate relatively stronger levels of participation in the Framework Programme than might be expected based upon their existing population or GDP base. This does suggest that the Framework Programmes are having a small positive influence on cohesion objectives. Capital city regions are strongly represented in this area, a position that is, perhaps, reinforced by their strong base of R&D infrastructure.

Overall, the benefit of participation in the Framework Programmes tends to be gathered by the institutions involved. Networking and knowledge creation are regarded as significant gains but are often limited to the partners involved. Knowledge development within regions is present, but only in the best cases. Intra-regional capacity building is thus considered to be limited. In this respect the involvement of regions with weaker R&D capacities may not be accruing the regional benefits that could be achieved through participation in international knowledge networks.

The Structural Funds are focused on supporting the development of less favoured regions. Structural Fund support broadly follows this pattern, with higher levels of support allocated to Objective 1 eligible areas, than those eligible for Objective 2. Proportionately, a greater amount of Structural Fund support is focused on R&D activities in Objective 2 programmes than in Objectove 1 programmes. Overall, the policy approach is thus broadly supportive of cohesion objectives.

The balance of activity targeted on R&D actions varies strongly between eligible regions in some Member States. It is not possible to tell whether this is justified or not. Further work is planned to assess the fit between Structural Fund support and the regional typology developed.

The Structural Funds are more strongly supportive of technology transfer and other knowledge building activities than other forms of R&D intervention. This is a positive reflection on the focus of the Funds. Support for R&D infrastructure remains important, with, proportionately, a stronger focus in Objective 2 programmes, a counter-intuitive finding.

The development of R&D infrastructure is most effective when it is well embedded into a strongly functioning regional and national innovation system. Support for the development of this institutional capacity is limited following the end of the RIS/RITTS initiatives. The Innovative Actions programme continues to support actions in this field although its scope is much wider. The recent launch of a Regions of Knowledge pilot action by DG research may make an important contribution in this field but further support for such activities through the Structural Funds, or other policy initiatives, would be merited.

The distinctions between the Framework Programmes and the Structural Funds offer an important opportunity to balance the twin European objectives of promoting efficiency and equity in the field of R&D capacity. There need not be a trade-off between these two activities and efforts need to be directed towards securing closer synergies between the two within eligible regions. There are some positive examples of efforts made towards supporting the intra-regional transfer of knowledge and capacity generated through participation in the Framework Programmes. It would be valuable if Structural Fund actions could support such actions further. In part this reinforces the need to give more attention to strengthening regional innovation systems in practice.

The move from a simple focus on support for R&D towards one that acknowledges the role of innovation and the complex relationships between the two is gradually being reflected in many European policy approaches in this field. Whilst the two are intrinsically inter-related there is no evidence that they have to occur in the same region. The Framework Programmes offer the epitomy of this. This is one reason we have developed the regional typology to take this into consideration. The typology retains a strong focus on R&D actions and there is the possibility that it is biased towards regions with larger R&D intensive firms. Given that this is a feature of R&D activity across Europe this is not seen to be problematic.

In summary EU R&D policy is broadly appropriate in its overall focus. The Structural Funds and the Framework Programmes are both making a positive contribution to improving the capacity of regions to engage in R&D and innovation. There is a recognition that support for frontier research is not appropriate in all regions and efforts are targeted towards supporting the development of absorptive capacity. At present this capacity is not well distributed across the European territory and efforts by the Structural Funds are broadly positive in this respect. Participation in the Framework Programmes is also assisting in avoiding regional lock-in, although whether the potential they offer is being maximized is a moot point. It should, of course, be recognised that support for R&D may not be an appropriate strategy for all regions in Europe and this study is unable to assess whether the focus attached to R&D targeted actions at a regional scale is appropriate or not.

Whilst the overall focus of EU R&D policies does seem to be broadly appropriate the fact remains that R&D capacity is unevenly balanced. It is also true that the potential intra-regional benefits of participating in the Framework Programmes seems to be undervalued. The importance of promoting effective regional innovation systems has been acknowledged by the Commission through current and past pilot actions and it would appear that this remains a key connection in the bid to improve the overall competitiveness of the European economy. It is at the regional level that connections between supply and demand-side measures can best be made and support to institutional structures to achieve this is to be encouraged. Such actions, coupled with those currently supported are likely to promote increases in regional R&D and innovative capacity, without these then the value of the good work being promoted is unlikely to be maximized. Our key recommendation lies in developing substantive actions which will support the development of well-functioning regional innovation systems, with the objective of increasing the flow of knowledge generated through international networks throughout a region.

In the coming weeks we intend to explore the potential of the regional typology developed further, in order to assess whether it might signal different types of actions as appropriate in different types of region. This may offer the potential for developing a more targeted approach than is currently adopted.

9.2. Conclusions and recommendations on the institutional aspects of the spatial co-ordination of EU and national sector policies

Conclusions and recommendations on this aspect of the work programme will require analysis of the regional case study material.