



RIP-WATCH

ANALYSIS OF THE REGIONAL DIMENSIONS OF INVESTMENT IN RESEARCH

CASE STUDY REGIONAL REPORT: CATALONIA (SPAIN)

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Case Study Regional Report on the Regional Dimensions of Investment in Research

OBJECTIVE

The main objective of this regional case study report is to provide a better understanding of the structural techno-economic characteristics of the analysed European region, to present the key factors conducive to increased investment in R&D and to identify key R&D policy challenges the region is facing.

BACKGROUND

In partnership with DG Research, the Institute of Prospective Technological Studies of the Joint Research Centre (JRC-IPTS) has been implementing a watching brief on policy developments aimed at promoting both private and public investment in R&D (RIP-WATCH). A stated aim of this policy watch activity is to take stock of developments aimed at increasing investments in R&D in the European regions.

In the design phase of the activity, a typology of the European regions was produced. A balanced mix of twenty regions was selected from each of the nine identified regional types representing fifteen member states of the European Union.

COVERED REGIONS

Phase 1		Phase 2	
1. Andalusia (ES)	2. Catalonia (ES)	11. Bavaria (DE)	12. Corsica (FR)
3. Carinthia (AT)	4. Crete (EL)	13. Emilia-Romagna (IT)	14. Etelä-Suomi (FI)
5. Dél-Dunántúl (HU)	6. Jihozápad (CZ)	15. Balearic Islands (ES)	16. Lorraine (FR)
7. Norte (PT)	8. Sicily (IT)	17. Midi-Pyrénées (FR)	18. Saxony (DE)
9. Styria (AT)	10. Wielkopolskie (PL)	19. Scotland (UK)	20. Västsverige (SE)

THE REPORTS

The regional reports are structured according to the following two interrelated dimensions of regional techno-economic systems:

- **Regional knowledge base**, including the research, technological development and innovation (RTDI) infrastructure, human resources, RTDI efforts and outcomes and knowledge transmission mechanisms in the region
- **Regional economic structure**, including the productive structure, regional clusters and networks, international position and financial capacities and instruments

Each report examines these dimensions from two points of view: their current state as reflected in a selected set of regional indicators and their policy context (i.e. policy framework, actors, objectives and instruments).

In addition to the regional case study reports, a **synthesis report** will be produced that combines and interprets the information contained in the case study reports, presents the strengths and weaknesses of the regions covered and the factors that determined the trajectories of development of their R&D and innovation capacities, and discusses the main R&D and innovation challenges identified.

JRC-IPTS launched the first phase of the activity in June 2006 with the contribution of the ERAWATCH Network. The work has been undertaken between June and December 2006 by a project team led by LOGOTECH S.A. (EL) with the participation of iDeTra (ES), IKU Innovation Research Centre (HU), Institute of Fundamental Technological Sciences of the Polish Academy of Sciences (PL); Instituto de Estudos Sociais e Economicos (PT), Joanneum Research InTeReg (AT), Nomisma (IT), Poznan University of Economics (PL), Technology Centre of the Czech Academy of Sciences (CZ), The Bigger Splash (ES) and Transdanubian Institute of Centre of Regional Studies of Hungarian Academy of Sciences (HU).

A first set of ten regional case study reports is now available on the ERAWATCH web-site at <http://cordis.europa.eu/erawatch/index.cfm?fuseaction=intService.home>

The second phase of the activity was launched in December 2006. A second set of ten regional case study reports and a synthesis report are expected to be available on the ERAWATCH web-site by October 2007.

Table of Contents

1	Introduction	6
2	Regional Knowledge Base	7
2.1	Description of the regional knowledge base.....	7
2.1.1	Knowledge Creation Capacity.....	7
2.1.2	Knowledge Diffusion Capacity of the Region:.....	11
2.1.3	The knowledge absorption capacity of the region:	12
2.2	Policy context	13
2.2.1	Policy framework and actors	13
2.2.2	Policy objectives and instruments	14
2.3	Conclusions regarding regional knowledge base.....	17
3	Regional economic structure.....	19
3.1	Description of the economic structure	19
3.1.1	The characteristics of the productive structure of the region's economy.....	19
3.1.2	Systematic characteristics of the region	21
3.1.3	Catalonia in an international context:.....	23
3.1.4	The local financial market:	23
3.2	Policy context	24
3.2.1	Governance structure and actors.....	24
3.2.2	Policy objectives and instruments	24
3.3	Conclusions regarding regional economic structure	28
4	Conclusions.....	30
4.1	Assessment of the RIS	30
4.2	Assessment of policies	33
4.3	Challenges and trends of the knowledge economy	34

Exhibits

Exhibit 1: RTDI policy mix affecting the region	51
Exhibit 2: Effects of policies complementary to RTDI instruments on R&D and innovation capacity of the region	53
Exhibit 3: Matching of knowledge and economic specialisation	54

Annexes to the Case Study Report

Annex 1: Data and further information related to main points of the text	
Annex 2: Exhibits	

Abbreviations

MC	Management Committee
PM	Project Management
ToR	Terms of Reference
ANBERD	Analytical Business Enterprise Research and Development Database
BERD	Expenditure on R&D in the business enterprise sector
CIDEM	The Centre for Innovation and Business Development
CG	Consolidate Research Group, as recognised by the Generalitat de Catalunya
DURSI	Department for Universities, Research and the Information Society
EPO	European Patent Office
GBAORD	Government budget appropriations or outlays for R&D
GDP	Gross domestic product
Generalitat	Generalitat de Catalunya, autonomous government of Catalonia
GERD	Gross Domestic Expenditure on R&D
GUF	General university funds
HERD	Expenditure on R&D in the higher education sector
ISIC	International standard industrial classification
IPTS	Institute of prospective Studies, Seville, Spain
NACE	Nomenclature générale des Activités économiques dans les Communautés Européenes
NP	National Plan for Scientific Research, Development and Technological Innovation 2004-2007
N.E.C	Not elsewhere classified
PPP	Purchasing Power Parity
PRI	Innovation and Research Plan 2005-2008

1 Introduction¹

Catalonia is one of the 18 autonomous Spanish regions. Catalonia comprises approximately six percent of the total land area of Spain and, with nearly seven million inhabitants, has approximately 16 per cent of the total population.

It has been an autonomous region since September 18th 1979 and has had its own autonomous government (The Generalitat de Catalunya) since 1980. Relations with the Spanish national government are governed by a Statute which was re-negotiated in 2006 giving the region more competencies in a range of policy areas.

Catalonia is one of Spain's leading economic regions, and contributes close to 20% of the nation's GDP. Catalan GDP per inhabitant (23 359 EUR) is significantly higher than the average for Spain (19 642 EUR) and just above the average for the EU-25 (22 449 EUR).

Catalonia is a principal industrial region of Spain, with automobile construction, electronics, chemicals and textiles as the leading sectors, with the agri-food sector making more of contribution in recent years. It has a higher economic activity rate (60.1%) than the Spanish and EU average (55.7% and 56.6% respectively) and lower unemployment (9.7%) than the average for Spain (11.0%) although higher than the average for the EU-25 (9.2%).

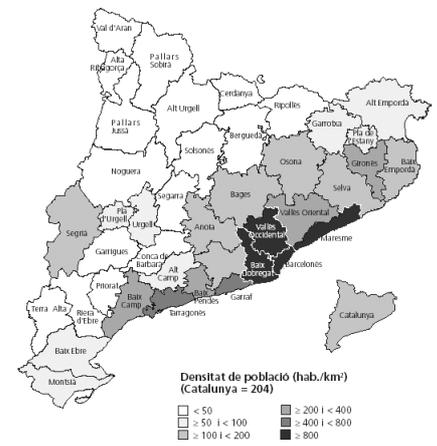
Its geographic situation between France and Spain, a long standing industrial tradition and powerful commerce and tourism sectors meant that Catalonia opened up to the European market more quickly than other Spanish regions and now accounts for nearly 30% of Spanish imports and exports.

Currently, construction and tourism are driving economic development with some estimates putting 50% of all jobs in the region in these two sectors. Its industrial tradition has provided the region with a large number of companies, the vast majority SMEs (93.8% of companies have less than 20 employees), in a wide range of mostly medium technology sectors with traditions of practical entrepreneurship and openness that provide a potentially strong foundation for further transition to the knowledge economy. However, there are some weaknesses in knowledge absorption such as poor levels of general education and low uptake of doctorates in business that may present some problems in the near future.

In 2004, expenditure on R&D in Catalonia was 2 106 870 thousand EUR, which represented 1.44% of its GDP, putting it above the Spanish national ratio of 1.07% but significantly below the EU25 ratio of 1.90%. The business sector financed 66.4% of Catalonia's R&D. R&D expenditure in Catalonia represents 23.6% of the total R&D expenditure in the Spanish State.

Knowledge production indicators and innovation performance have improved in the last decade, and the region performs very well nationally and leads the way in certain fields, in particular biomedicine. However, from an international perspective in terms of knowledge production and innovation Catalonia is either at or just below averages for the EU and a long way from the performance of leading nations.

Within the region policy documents suggest that the innovation system could be improved further and that one of the key areas for attention is the linkages between its component parts.



¹ Sources: 'Figures of Catalonia 2005' and 'Research and Innovation Plan for Catalonia' both Generalitat publications and both drawing on source data from Institut d'Estadística de Catalunya (IDESCAT), National Institute of Statistics (INE), ministries of regional and national government and Eurostat. The map of Catalonia in Europe from the Observatori del Paisatge, regional demographic map IDESCAT.

Therefore, the latest policy frameworks for research and innovation focus on above all else on 'wiring up' the system and getting it to work to its full potential.

2 Regional Knowledge Base

2.1 Description of the regional knowledge base

2.1.1 Knowledge Creation Capacity

Research spending in business: Business R&D expenditure (BERD) between 1997 and the most recent figures in 2004 has been consistently around 28% of the Spanish national total². In 2004 the figure stood at 28.64% of the national total (in absolute figures 1 393 324 thousand EUR up from 553 615 thousand EUR in 1997) and this was the highest figure of any region in Spain, the next closest being Madrid with 28.43% of the national total. The majority of this spending takes place in the chemicals sector (35%) and the car industry (21%) with food also playing an important role.

When BERD is considered as a proportion of GDP Catalonia performs better than the Spanish average (0.95% as opposed to an average of 0.61% but is behind other leading regions (in order, Navarra, Basque Country, Madrid). Catalonia performs well in terms of spending on technological innovation, spending 2.15% of GDP (2 916.821 thousand EUR) and is a close second to Madrid on this indicator (Madrid, 2.37% of GDP on innovation and a total of 3 079 181 thousand EUR)

Research spending in higher education: In terms of higher education expenditure on R&D (HERD), Catalonia is again the highest spending region in absolute terms in 2004 with 19.35% of the national total (511 232 thousand EUR, up from 16.14% and 213 351 thousand EUR in 1997) while Madrid is the second with 15.87% of the total. In this case, in contrast to the figures for BERD, other regions dedicate quite high levels of resources to R&D with both Andalusia and Valencia almost equalling the total for Madrid (14.78% and 14.95% respectively).

In terms of R&D in higher education as a percentage of the GDP Catalonia performs above average but is outperformed by a number of other regions. Catalan spend is 0.35% of GDP while the average for Spain is 0.33% and the highest performers are Navarra with 0.57% and Valencia with 0.51%. However, Catalonia dominates R&D expenditure by private non-profit institutions at national level with 47.38% (5 532 thousand EUR) of the total with Madrid taking up 31.32% of the remainder.

Evolution of research spending: From a historical perspective, the total R&D spend in Catalonia as a percentage of regional GDP has grown from 0.94 in 1997 (877 761 thousand EUR) to 1.44 in 2004 (2 106 870 thousand EUR) which puts it second in terms of total spend to Madrid and fourth in terms of percentage of GDP behind Madrid, Navarra and The Basque Country. In terms of percentage of Spanish total the Catalan share has remained basically the same over the last decade (21.73% of total in 1997 and 23.55% of total in 2004). From these data concerning R&D and innovation expenditure we can see that over the last decade Catalonia performs very strongly in a national context in general³, sometimes taking the role as leading region and always performing in the top three or four regions at national level but generally slightly behind European average performance and significantly behind EU leaders.

Research Funding: The Catalan university system receives R&D&I funding from a variety of sources but mostly from central government and from the resources allocated by the Generalitat. Data for 2003⁴ show where the university R&D&I funding came from and where it was spent. Of a total of 236 million EUR the largest portion came from the central government

² Source data from INE. See full data in tables Annex 1, 1.1 and 1.2.

³ The position of Catalonia in relation to other Spanish regions over the last decade is clear in the tables at Annex 1.1 and 1.2.

⁴ Data from Generalitat de Catalunya, DURSI.

(84 million EUR) while the Generalitat contributed another 33.5 million. Local authorities contributed over 8 million and the EU 22.5 million while university own funds made up 25 million. Business funded over 51 million and not for profits another 10 million. In terms of spending, nearly half went on R&D&I projects across the range of disciplines and personnel ate up another 57 million EUR. Infrastructure, large installations and other actions account for the bulk of the remainder.

Key public investments in research infrastructure: The last major round of targeted public investment and new ideas in research and development came between 2001 and 2006 when over 90 million EUR were invested to try to overcome the gap between Catalonia and the leading European nations and try to attract other private investments to the region. Catalonia invested heavily in updating existing and building a number of new research institutions (in photonics, genomics, telecoms, the internet, health sciences, in fact the biomedicine scientific park has only opened in 2006 after five years of construction). This network of new centres is intended to form a new internationalised leading edge of Catalan research. These centres are new and in the absence of evaluation it is impossible to assess their impact⁵.

Major private investments in R&D infrastructure: There is no current comprehensive overview of major private R&D investments so knowledge is partial. Investments by the private sector are on a smaller scale but have been significant in the last few years. For example, in 2002 Intel opened an R&D lab in conjunction with the Polytechnic University of Barcelona and a new Yahoo lab is to open late 2006, the first outside of the US. Recently, SmartDesign, a leading design and advertising agency opened an office in Barcelona which is a recognised centre in this field. The private sector investment is consistent and rather focused, often taking place in conjunction with university centres, rather than widespread or strong enough to have a yet measurable impact on driving local economic developments through spin outs and stimulating knowledge supply chains.

The Catalan Universities and Research Centres: There are 12 Catalan universities four of which are private institutions⁶. The university system here has undergone very rapid expansion over the last twenty or so years, for example, from three universities in 1986 to twelve by 2003⁷. As well as the universities, there is a network of research centres operating in the region. There are 15 centres of the Spanish National Government with their headquarters in Catalonia (the CSIC (the Higher Council for Scientific Research) Centres)⁸. As well these major CSIC centres there is a complex network of other R&D centres promoted by the Generalitat to carry out research in priority areas for the region, technology centres promoted by CIDEM, research centres located inside universities and other centres linked to public research institutions and private not for profit centres. The list of centres, including the CSIC centres totals 123 and breaks down as follows: humanities 16; social sciences 22; sciences 13; life sciences 17; medical science and health 24; engineering and architecture 31⁹. On top of this network of centres the government also recognises more than 120 networks and over 450 'consolidated' research groups across the university system in all topics. It is fair to say that in terms of numbers of nodes this is a well endowed regional infrastructure.

The size of the institutions: The universities in the region vary significantly in size – the older and more established ones being much larger than the younger private ones or recently established public ones. The largest is the University of Barcelona with over 4 000 academic staff and over 56 000 students with 501 doctorates awarded in the year '04-'05¹⁰ across all

⁵ For more information about these new investments in the period 2001-2006 see Annex 1, 1.27. The table at this annex is a summary of the main investments in R&D by the Generalitat. The projects described do not comprise the totality of the Generalitat's R&D programme but do represent the main economic investment in buildings and facilities.

⁶ Full institutions and student numbers see Annex 1, 1.3.

⁷ For other data regarding the rapid growth of the university system see Annex 1, 1.4.

⁸ For a list showing the range of the CSIC centres funded by the national government see Annex 1, 1.5.

⁹ Full list with links to all centres: http://www10.gencat.net/dursi/AppJava/arbrecerca_flags.jsp?flag=3.

¹⁰ For full details see Annex 1, 1.6. Annex 1, 1.7 is a time series for doctorate production over the last decade showing that numbers in all areas have grown slowly.

disciplinary areas. The universities offer courses in a full range of subject areas including science and technology with some focusing in these fields more than others so that science and technology is well represented in the excellent mix of fields on offer but not promoted over and above other options for study and research.

In terms of overall numbers, the proportion of inhabitants of Catalonia to the national Spanish total (approx. 16%) is reflected in the numbers of university students. The relatively small numbers of science and engineering students against the higher numbers of social science and humanities students also reflects the situation at national level. Added together, the numbers of humanities and social science students 129 000 far outweigh the numbers of science students together with engineering and architecture 73 000¹¹.

The quality of the institutions: Objective, qualitative evaluation is not a part of the Catalan university system and it is very difficult to get a view of quality¹². However, various opinions are often heard, unofficially, informally and anecdotally it must be emphasised, about the quality of the university and research system, for example: that the class sizes and small amount of contact with staff encourages a passive and unquestioning attitude in students one consequence of which is the failure to encourage entrepreneurialism; that, as the vast majority of staff are civil servants in secure positions, there is little incentive to renew curricula, publish, have contact with industry etc; the systems is not good at producing entrepreneurial academics and dynamic successful individuals are not encouraged and supported as much as they should be; that resources are spread too thinly to include research fields in which Catalan researchers are not highly ranked and lots of second-rate research is carried out. The University of Barcelona is ranked 1st in Spain in the oft-quoted 2005 World University Rankings carried out by Institute of Higher Education, Shanghai Jiao Tong University, China and 61st in the ranking of European Universities. No other Catalan university reaches the top 100.

Orientation and concentration in knowledge creation capacity in the public sector: It is policy in Catalonia to promote as much research activity in all areas as possible and not to link the setting of research agendas very closely to the shorter term needs of regional industry¹³. Therefore, with very few exceptions (see the Biocat initiative, below) the intention is not to orient the knowledge creation capacity along well defined lines or towards clearly specified outcomes. However, in practice it is possible to see that the research system has developed nodes of focus and of excellence, although no evidence exists to suggest that these have developed as a result of policy and planning or for other reasons. One very clear case of concentration and orientation of knowledge does exist - the very striking emphasis on life sciences and medical and health research is, *possibly*, a result of the fact that the regional administration has full competencies over health spending in the region and, therefore in practice, full control over health-related research and might, therefore, constitute a policy-led concentration of knowledge creation capacity although further research into this sector would be needed to provide any evidence of this.

It is possible to see the weight given to various fields by looking at the distribution of the 'consolidated research groups' in the region¹⁴. A 'consolidated group' (CG) is one recognised

¹¹ See Annex 1, 1.5.

¹² Only one such evaluation has come to light carried out by the European University Association in 2005 of a single university, the UPC (Politecnical University of Catalonia). This, it must be hoped, will form the basis for a region-wide evaluation of university performance and a better understanding of the contribution these institutions are making to society and economic development. Some key findings were: an excessive focus on data collection and planning not balanced by qualitative judgement and structured activities in response to clear problems; trying to do everything and not focusing on doing less but better; lack of clarity in strategic direction; failure to encourage student team work, project based learning, respond to individual student needs or encourage active citizenship. It is also suggested that the repeated complaints about underfunding are not entirely well founded and that, in fact, while not luxurious the level of funding is adequate and comparable with other similar institutions in the EU and. In fact, it might be suggested, although impossible to provide evidence for without further detailed studies of institutions, that the university system in general at all levels suffers a lack of efficiency rather than a serious lack of money.

¹³ For more on this 'philosophy' underpinning research policy making see page 32, below.

¹⁴ Source, Department of Universities, Research and the Information Society (DURSI) quoted in Institut D'estudis Catalans 'Introduction to Research and the Catalan System of Science and Technology', 2004.

by the government as performing at an internationally important level. In 1996-'97 academic year there were 257 CGs out of a total of 468 research groups. In 2002-'03 this number had grown to 478 CGs from a total of 607 research groups in all fields. Between these two years, the spread of CGs was: Life sciences 25%, medical science and health 17%, other sciences (maths, physics, chemistry and geology) 22%, engineering and architecture 17%, humanities and social sciences 19%. The orientation towards life sciences and medicine is very clear with 42% of the leading research groups in the region. The preponderance of this field is also seen in the system outputs in the section below.

Private sector research concentration: Private sector research concentration reflects the relative strength of the sectors in which it takes place, so, in 2000 expenditure on innovation expenditure was highest in Catalonia in the sector 'machinery, transport materials' where the 753 301 thousand EUR spent on innovation activities was 27% of the Spanish national total. In chemicals, which is an important sector in this region, 370 858 thousand EUR was spent representing 50.7% of the national total. The other sector where Catalonia dominates the national scene is in 'textiles dressmaking, leather and footwear' where 61.7% of the national total was spent (179 634 thousand EUR) which reflects the fact that Catalonia is highly competitive in areas of design and the arts.

In general not strong co-evolution between public and private: Historically, the connections between private and public sector research efforts have tended to be weak and sporadic and currently there are not many examples of close and systematic cooperation. However, the one area where there is a very clear convergence of government policy, private sector research capacity along with public sector research capacity is in the area of biotech which is currently being promoted very heavily here. The Generalitat is promoting a biocluster (Biocat) which brings together the ministries of research, health, economy and industry and which has been central to policy since it started in 2004¹⁵.

Knowledge output indicators: Historically speaking, between 1981 and 2002 the scientific output of Catalonia in terms of scientific publications constituted 22% of the output of the Spanish state. 28% of Catalan articles during this time were produced in international collaborations. Compared to other EU countries in 2001, per capita scientific production put Catalonia in fourth place with 0.45 articles per researcher after Italy, Holland and the UK (0.48, 0.45 and 0.44, respectively). Despite this, if quality is taken into account, measured by the number of citations per article, the region is ranked below the EU average which stood at 6.04 citations per article with 5.33 citations per article but above the Spanish national figure of 4.99. In this respect, as in many others, Catalonia is between the national and EU average figures and well below the leaders, in this case the USA with 7.42 citations per article or Holland with 7.21.¹⁶

In terms of publications according to broad fields biomedicine dominates in Catalonia with 48.2% of all publications in all fields and 55.6% of all citations. Other sciences are in second place with 45.1% of publications and 42.7% of citations while engineering is in third position with 11.9% of publications and 6.3% of citations¹⁷. These data demonstrate the dominance of biomedical research and publication activity in the region and throw very clear light on the reasoning behind the current promotion of this field as a government priority area.

In terms of patent applications, again the picture for Catalonia is strong at national level but comparatively weak when international comparisons are made. According to data from the Spanish Office of Patents and Trademarks for the year 2003 713 patents were applied for by Catalan residents which accounted for 25.43% of the patents applied for in Spain and makes it the first among the autonomous communities for patent numbers. However comparative figures

¹⁵ For data regarding the Biocat network please refer to Annex 1, 1.8.

¹⁶ Source Statistics on Science and Technology in Europe (EUROSTAT 2004), data processed for The Plan for Research and Innovation of the Generalitat de Catalunya (PRI) 2005-2008. Also see Annex 1, 1.9 for detailed absolute and relative figures for publication data for Catalan universities in different fields for between 1996 and 2002.

¹⁷ Source: Research group on bibliometrics and science evaluation (BAC), IMIM-UPF, quoted in PRI.

for 2001 show that 392 European patents were applied for which equals 62 applications per million inhabitants (the Spanish figure being 28.75) while the mean for the EU was 168.33 applications per million inhabitants and stronger nations such as Germany showing 320.36 and Finland 377.43.¹⁸

2.1.2 Knowledge Diffusion Capacity of the Region:

Knowledge diffusion networks: The knowledge production infrastructure in Catalonia is supported by a very comprehensive network of knowledge diffusion organisations. There are region-wide networks of centres to support innovation, spins-offs, private investment in technology business, technology dissemination etc. These networks are described in greater detail at Annex 1, 1, 23.

Science parks network: The Catalan science parks are grouped into a network known as XPCAT. There are 11 full member parks and 4 associate members. The network is the first point of contact between the business community and the research stakeholders represented on the parks and so acts as a key intermediary in the diffusion and transfer of technology. In 2003 there were 58 institutes and research centres represented in the network and 115 research groups. 178 companies are represented on the member parks among which there are 34 university spin outs. The investment to date has been 353 million EUR in the member park sites with the total constructed area soon to reach over 600 000 square metres. 4 490 people are employed on the member parks.

The OTRI Network: The other key transfer network is the national network of Offices for the Transfer of Research Results (OTRI). Each public Catalan university has an OTRI dedicated to brokering deals between research communities and business stakeholders. Activities involve managing patents, managing licensing contracts, encouraging spin offs, linking companies with specialist expertise inside the universities. In 2003 there were 170 staff in the Catalan OTRIs, 103 of whom were technical staff (with an average of 15 per university) and the remainder managers. This figure compared with 58 staff in the Madrid region and 133 for the whole of the rest of Spain and it is therefore fair to say that the Catalan OTRIs are a dominant force in this national network.

University knowledge diffusion indicators (from the OTRIs): While no attempt has been made to attribute direct cause and effect for the role of the OTRI various output data are reported for the Catalan universities in their field of activity and are, in fact, the best data available regarding university knowledge diffusion. For example: Catalan universities obtained 80 of a total of 411 patents awarded to Spanish universities in 2003, which was a higher figure than for Madrid (73); Catalan universities achieved 15 percent of the national total in licensing (although the number of technology transfer licenses was actually small, standing at 15), again a higher figure than for Madrid (9%); however universities in Madrid (with a total of 62 974 million EUR) were more successful in 2003 at earning income from contracts, agreements and offering other services to business than were the Catalan (with a total of 58 243 million EUR). While the OTRIs play some role in these successes they do not make enough money to make themselves self financing. In fact, in 2003 the Catalan OTRIs earned nothing from licensing and only 32% of their costs were covered by income from activities, the rest being made up from host institution funds and other national, regional or European funding sources¹⁹.

²⁰During 2002 ten spin-offs were reported in Catalonia, in '01 there were 13 while in 2000 there were only three. However, in 2003 64 were reported which was a total much higher than for the

¹⁸ Source: Eurostat data treated and presented in PRI.

¹⁹ All data in relation to OTRIs are from the OTRI 2003 member questionnaire reported in 'The Innovation Situation in Catalonia' published by the Ministry of Industry of the Generalitat, March 2006.

²⁰ The OTRI annual questionnaire which informs this section is the best source for information regarding spin-off in the region. Clearly, spin-offs may have been formed without the knowledge of the OTRI team in each case, but nonetheless they remain the best source of information in this area.

rest of Spain combined (49 from 30 Spanish universities). This is a massive leap forward in numbers and it is not clear yet if it has been sustained over the following years. Two universities contribute almost all the new spin offs – the private Ramon Llull (31 spin-offs) and the technology focused Polytechnic University of Catalonia (23 spin-offs). Almost all the new ventures received financial support from the Technology Trampolines network mentioned above and it is possible that this is an example of the success of this policy. However, it should be remembered in the same year only 15 technology transfer licences were brokered in the same group of universities and that the other universities saw spin offs at more or less the same rate as the previous years. With the passage of time it will be possible to judge whether this year's results were exceptional or the start of a new rapid growth of spin-offs in the region²¹.

2.1.3 The knowledge absorption capacity of the region:

Educational levels: Data on educational level of the working population suggest some serious problems with knowledge absorption capacity. For example, in 2002 in the population aged between 18 and 24, 29% did not continue beyond basic obligatory schooling; the average for the EU was 19% while between the ages of 25 and 34 41% had not gone beyond the obligatory stages which is one of the highest percentages in the EU where the average was at 28%. Even basic education is not rated highly, with a recent OECD study showing low levels of achievement in basic reading and maths among children²². A recent report from the Jaume Bofill Foundation finds Catalan spending on education at 2.8% against OECD average of 5.9% GDP and well below the Spanish regional average²³. This under funding of education creates basic problems with supply of well educated citizens to work in the knowledge economy. And, also, this is one of the few 'framework' areas where the regional administration could really make a big difference for the better. Other data show, for example, that in 2002 London was the region with the highest rates in Europe for higher education (41.66%) and continuing education (25.5%) while the average was 21,78% and 8.25% respectively. Catalonia is slightly above average for higher education at 24.96 (although behind The Basque Country as the leading Spanish region at 34.18%) but fails badly at continuing education with only 3.03% of the population engaged in it, below even the low average for Spanish regions at 4.97%²⁴. These data suggest that there may be problems in the region with the need for rapid adaptation to technological change which characterises modern European economies and which depends on a well educated, talented workforce.

Science and technology human resources: In terms of science and technology human resources Spain performs well in terms of numbers of researchers. In 1999 (the last year where disaggregated data is available) there were 61.568 researchers of which total 33.840 were employed in the higher education sector. At this time Spanish researchers represented 3.3% of the total for EU working in business, 9.1% of those working in the public administration and 10.73% of the EU total in higher education, at time when the GDP of Spain represented only 6.9% of the EU total. The Catalan share of this total was 19.24%. However there were, and it is probable that there still are, some key differences between Spain and the rest of the EU. The average number of researchers in the higher education across the EU was 35% while in Spain it was 55% while only 25% of the total number worked in companies, compared to a 50% EU average and 80% of the total in the USA²⁵. These data suggest that Catalan firms are not incorporating researchers well enough and that companies do not have high levels of advanced

²¹ Source, PRI.

²² All these data from various sources collected in document 'The Innovation Situation in Catalonia' published by the Ministry of Industry of the Generalitat March 2006.

²³ 'Inequalities in Education in Catalonia', Jaume Bofill Foundation, 2004, p.21.

²⁴ 'Regional Innovation Performance 2003', quoted in Institut D'estudis Catalans 'Introduction to Research and the Catalan System of Science and Technology', 2004.

²⁵ A recent review of Spanish universities points out the extraordinarily high levels of nepotism that persists in Spanish higher education institutions (Catalonia cannot be excepted from this) and the very limited degree to which staff circulate between institutions. For example, 93.3% of all academic staff work at insitutions where they received their degree, compared with 17% in the UK and 10% in USA. 'The Professional and Academic Trajectories of University Academics' CSIC, 2006.

technology absorptive capacity, certainly in comparison with the more advanced knowledge economy in the USA.

Life long learning: Data on life long learning for 2003²⁶ show that the percentage of the population between 25 and 64 years old who participate in continuing professional education in Catalonia is only 3% with the average at national level being 5%. The average for the EU-15 was 8.4%. However, in terms of workers in medium/high technology sectors Catalonia performs better (10.36% of population) than both Spain and the EU average (5.35% and 7.40% respectively) while specifically in high technology sectors Catalonia (2.77%) is below the EU average of 3.60% but above that of Spain (2.77%). Therefore, in terms of continuing professional education Spain in general, and Catalonia specifically has fallen significantly behind in EU averages and this is a weakness as a technologically competent workforce is a key to future competitiveness.

2.2 Policy context

2.2.1 Policy framework and actors

Policy actors at national Level: When the new Socialist government took power in 2004 responsibilities for overseeing the coordination of research, technology development and communication in these areas which had previously been the responsibility of a single Ministry of Science and Technology was shared between two Ministries. The Ministry of Education and Science (MEC) became responsible for policy making and programme implementation for universities, research and technological development while the Ministry of Industry, Tourism and Commerce took responsibility developing innovation policy and managing the CDTI (Centre for Industrial Technological Development) network. The Economic Office of the President also contributes to policy in these areas. Overall responsibility for coordinating policy formulation and implementation resides with the Inter-Ministerial Commission on Science and Technology. The General Council on Science and Technology has the task of coordinating national and regional efforts and other bodies make an input to policy formulation such as the Advisory Council on Science and Technology which is the mechanism whereby the views of the business community and civil society are fed into the policy process.

Policy framework at regional Level: In Catalonia the Interministerial Council for Research and Technological Innovation (CIRIT) is the government unit responsible for planning and coordinating research and innovation policies and developing major strategic actions. CIRIT works with all government ministries to develop coordinated RTDI policies for the region through regular plenary meetings of all stakeholders. CIRIT has been instrumental in developing the current Plan for Research and Innovation (PRI) 2005-2008 which is currently being implemented.

As well as coordinating RTDI planning within the region CIRIT also manages coordination with the Spanish State General Administration and with the European Commission. At national level the task is to ensure that the Catalan plan is coherent with and complementary to the national Spanish plan which is embodied in the Spanish National R+D+I Plan (the current one is known as the National Plan for Scientific Development and Technological Innovation 2004-2007 (NP)). As far as possible the regional and national plans are made complementary and joint actions are planned wherever it is mutually beneficial. At European level, CIRIT is responsible for developing actions to coordinate regional activities with those of the European Commission, in particular increasingly Catalan participation in the development of the European Research Area.

²⁶ Source, PRI.

As far as the distribution of competencies between the region and central government is concerned, the situation is complex. For example, in the case of the Secretariat for Universities and Research²⁷ the situation for universities is much clearer than for research. In accordance with laws at national level from 2000 and 2003 the Generalitat has full powers in relation to higher education and it allocates funding on the basis of objective indicators and formulas taking into account the principle of equality between all students in the system to provide basic funding for the universities to carry out their teaching and research functions. The question of research however, is more complex and uncertain. The Statute, or agreement between Catalonia and the central national government specifies that the Generalitat has exclusive responsibilities in research without affecting article 149 of the Spanish Constitution which gives the State exclusive responsibility in the promotion and general coordination of scientific and technical research. The result of this overlap of competencies and a strict interpretation of the law is that the resources dedicated to research have never been transferred (only resources for food agriculture, oceanography and aquaculture are fully transferred) to Generalitat control which restricts what the Generalitat can do in this field.

Despite constitutional and statutory barriers the various ministries and research centres of the Generalitat have been making research plans and allocating resources²⁸ both individually and institutional level and collectively, the latest version of which is the 'Plan for Innovation and Research for Catalonia 2005-2008' (PRI) which for the first time brings together the themes of research and innovation in an attempt to link them more closely as previously had been addressed mostly in isolation one from the other. In industry, the Generalitat has a great deal of liberty in promoting research in SMEs through the Department of Employment and Industry as it is recognised that such research promotion can effectively only take place 'on the ground' at local level and that in all Spanish regions the question of raising the technological capacity of SMEs is vital to the economy. In general, researchers see having two main sources of funding as an advantage and use them in a complementary manner also drawing in funding from the EC's Framework programme where possible and appropriate.

2.2.2 Policy objectives and instruments

Policy objectives national level: At national level the current relevant RTDI plan is the National Plan for Scientific Research, Development and Technological Innovation 2004-2007. The plan was drawn up with the input of a wide range of stakeholders from the business, research and civil society communities including input from the regional administrations. The highest level objectives are to increase the quality and quantity of science research undertaken in Spain; increasing the number of researchers in both the public and private sectors to bring it up to the EU national average; making the position of researchers inside the system more secure; increasing the internationalisation of Spanish science and technology in particular increasing participation in the European Research Area; improving the public understanding of science and improving communications between researchers and citizens. The plan calls for ambitious but still achievable spending increases: for research funding to reach 1.4% of GDP by 2007 and for all innovation spending to reach 2.5% by the same year which would entail the country as a whole spending 4.8 billion EUR a year on innovation up from 4 billion in 2003²⁹.

Policy objectives at regional level: Catalonia is currently in the process of implementing its Innovation and Research Plan 2005-2008 (PRI) which was finalised early in 2005. It is the first plan to integrate research and innovation and builds on a previous research plan and a separate innovation plan both of which ended in 2004.

²⁷ Note that this Secretariat is only a 'holding' institution which will be re-organised and re-named after the regional election which took place in early November 2006. It is not yet clear where responsibility for universities and research will reside.

²⁸ The most recent research on this shows that regional governments on average dedicated nearly 40% of the total received from the Spanish national government from their own budgets. See. The Report on SME Support Policies and Practice in Catalonia' developed as part of the Interreg III project 'E-Teams', September 2005, p. 31.

²⁹ For more details of the action lines and priority thematic areas of the plan see Annex 1, 1.11.

PRI is the 'master plan' into which all other public sector plans in this area will be incorporated. The overall mission is to push Catalonia forward to become one of the leading research and innovation nodes of Europe by integrating public policy, linking the public and private sectors more effectively and promoting a knowledge based entrepreneurial culture. At the highest level it responds to the weaknesses in many aspects of the innovation capacity of the region (as outline above sections) which place the region at or above the national level for most indicators but often far behind leading EU and world competitors. The ten objectives of the PRI cover a wide range of issues designed to improve regional competitiveness and quality of life³⁰.

There are also six 'transversal activities' to support projects that underpin progress towards the ten objectives and five complementary activities designed to create an environment that strengthens the culture of science technology and innovation in all spheres of society and to encourage widespread innovation³¹. Both complementary and transversal activities are set out with detailed goals, a series of baseline indicators, priority action plans and details of the support to be offered to the activity area by the Generalitat. At the same time there are a number basic priority areas where all efforts will be focused. The priority lines of research are: biomedicine and health science, ICT engineering, agro-food, social and cultural development, sustainability and the environment. There are also strategies for priority thematic areas with a more business focus to raise regional competitiveness, these are in the following areas: production technologies, new materials, nanotechnology, ICTs, energy technologies, biotechnology and organisational science. In the business sector these objectives will be pursued mostly by competitive programmes of research grants.

Relationship between objectives at national and regional level: It is clear from the description of the two RTDI plans that overlap in Catalonia, the national and the regional, that they share many objectives in common, in particular in terms of the horizontal actions such as those to do with the promotion of scientific culture, boosting entrepreneurship, the internationalisation of research, improving the access to the FP funding and making contributions to the European Research Area. In these areas the regional plan is more detailed and nuanced and focused on the activities that can best be carried out by regional actors who understand the specificities of the local innovation system. In most areas of basic research the bulk of the research funding comes through the large national programmes in the priority areas set out in the national plan.

Policy Instruments at both national and regional level: The policy instruments that are being used to work towards the policy objectives are set out below under the common pre-set headings of this report template³².

- **Improve innovation and R&D governance:** In the NP there is some attention given the questions of developing governance capabilities with some mention of evaluation and of foresight. On closer inspection evaluation is mostly proposal evaluation and perhaps annual monitoring and review while foresight is not systematically used. However, under the new 'Ingenio 2010' programme there is a new focus on evaluation at intermediate and ex post phases and this new emphasis should be recognised and praised as it represents a part of the beginning of a culture change in central government concerning innovation. At regional level mention is made again of evaluation, but once again it really means management and monitoring. Foresight at regional level is not done.
- **Creation of an innovation and entrepreneurial friendly environment:** At national level there are a range of actions in this category under the heading of 'Horizontal Actions'. For example; the National Programme to Foster Business Competitiveness is a programme to strengthen the innovation system by funding initiatives that motivate the business sector to embark on new RDTI activities and to apply the results of basic research more effectively. Also at national level, the major programme called Ingenio 2010 has as one of its core objectives the creation of 130 new technology spin offs by the year 2010. At regional level a number of actions are planned in the sections of the PRI called Transversal and Complementary measures. The funding for this line of action will

³⁰ See Annex1, 1.12. for table of Objectives.

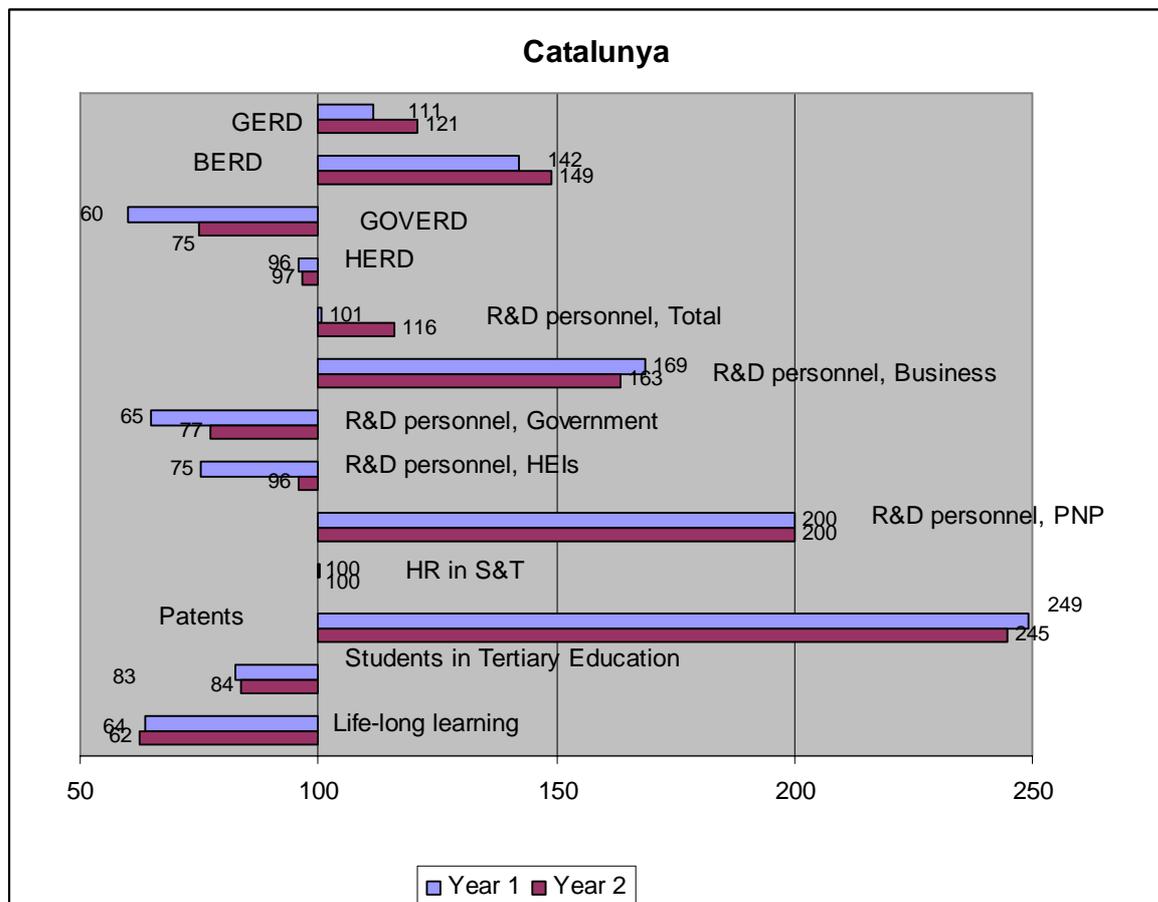
³¹ See Annex1, 1.12. for table of Transversal and Complementary Activities.

³² For more detail on the policy instruments at national and regional level see Annex 2, Exhibit 1.

take the form of seed or pre-concept funding and concept capital to support entrepreneurs in the earliest stages of business development. Over the duration of the planning period (2005-2008) 23.4 million EUR will be dedicated to this action line.

- **Development of human capital:** At national level policies for the developing human capital are implemented through the transversal strategic action called the National Programme on the Development of Human Resources. At regional level, human capital is highlighted in the PRI as a transverse measure which has objectives structured in the same way as at national level.
- **Networking, co-location and clustering measures:** At national level activities under this heading take place mostly under the National Programme for Scientific and Technological Research Equipment and Infrastructure where science parks are promoted as a form of technological infrastructure alongside large scale scientific facilities. The parks are intended to act as a catalyst for greater cooperation. At regional level there is much greater focus on networking and clustering measures. In fact, Catalonia, for many years in the mid-nineties cluster policies dominated the industrial policy making and more than forty clusters were identified and to some extent supported by the regional government. Times have changed considerably since then and clusters are no longer the main thrust of policy making but are seen rather as very useful tools to be used in certain instances. The promotion of networks, however, underpins all transverse and complementary measures of the PRI, in fact, it is one of the main conceptual drivers of the whole programme of work.
- **Knowledge and technology transfer to enterprises:** At national level the challenge of undertaking knowledge and technology transfer to industry falls under the programme Support for Business Competitiveness. At regional level knowledge and technology transfer to industry is undertaken through the Transverse Measure called Technology and Knowledge Transfer Support Programme. The main objective of this programme is to create technology transfer interfaces to facilitate technology transfer to the market and the subcontracting of technology by private sector enterprises from research centres. The budget for this Transverse Measure will be 77 343 million EUR over the four years of the PRI.
- **Research collaboration of public research organisations with private sector:** At national level this area of work is covered under the programmes: Support for Business Competitiveness and in the programme for Scientific and Technological Research Equipment and Infrastructure. At regional level the business relevance of all new infrastructure development is taken into account when developing new infrastructures and links between public and private innovation stakeholders are encouraged at every level.
- **Support of public research:** At national level the support for public research is the core of National Plan. The funding for infrastructure and centres of excellence is channelled through the programme Scientific and Technological Research Equipment and Infrastructure as explained in the section above. Grants for R&D projects implemented in universities and other public research organisations are allocated by the management organisation which is responsible for the Priority Areas which have been identified in the National Plan. At regional level support to public research follows the same basic lines as at national level.
- **Financial R&D measures for the private sector:** Direct and indirect financial R&D measures for the private sector are part of the National Plan. Direct actions are mostly targeted at project funding, including for the private sector, indirect actions are aimed at simplifying access to tax benefits for R&D and catalytic actions include loan guarantee facilities through financial institutions and mutual guarantee societies to cover the loan requirements of technology innovation projects undertaken by the private sector stakeholders in activities across the priority areas. At regional level private sector direct R&D measures are a key part of the PRI and priority areas for innovation in the private sector have been identified as these underpin the competitiveness of key regional sectors. The regional administration is also very active in the area of catalytic measures, specifically in the development of regional venture capital markets with the Financial Support Programme.

2.3 Conclusions regarding regional knowledge base



Knowledge production: The headline regarding knowledge production is that in Catalonia all indicators have improved in the last decade, that the region performs very well nationally and leads the way in some dimensions and certain fields, in particular biomedicine. However, when the viewer draws back to take an international perspective we generally see Catalonia either at or just below averages for the EU and a long way from the performance of more advanced European regions. On the positive side, in terms of absolute numbers of publications and citations, for instance, the research system is mature and stable and performs consistently to provide a firm and well established base of knowledge production which should have the potential to facilitate the transition to a knowledge based economy if it is organised and directed towards that goal.³³ In the private sector there is a low level of R&D, patenting and innovation activity³⁴ compared to EU leaders which is probably explained to some extent by the medium technology level and small size of the vast majority of the Catalan businesses with few if any specialised research staff and no perceived need for them.

Knowledge diffusion: Catalonia has many networks for knowledge diffusion, every aspect is covered at every level of user need from the smallest start up to larger technology companies. In principle, an excellent range of service is available, through general purpose basic capability development to raise competence in technology and business practice, through sector specific development service to higher level technology development services leading to services to access the research base. However, there are low levels of patenting and spin-offs, low levels of employment of researchers in the private sector and a correspondingly high level proportion

³³ For absolute numbers as well as ratios of publication performance see Annex 1, 1.9.

³⁴ 25% of the total in 2004 according to INE and IDESCAT figures against 44% in the EU 15 according to CIS – 3 data.

of total numbers of researchers employed in the public sector. Clearly there is considerable room for improvement in the system here³⁵ as the intermediary networks are in place, their role recognised in policy and they are adequately funded but, as will be seen in later sections (Section 3) on economic indicators their activities over the last decade have had no impact on employment or the proportion of high technology business in the region.

Knowledge absorption: Knowledge absorption indicators are somewhat less positive than those for knowledge production. There are weaknesses at all levels, from basic education in public schools, to the life long education of employees through to the take up of highly qualified researchers in the private sector. So, while the regional system produces knowledge well within its national context absorption indicators suggest that the system is science-led and production-heavy and that more work will be needed in the area of promotion of absorption of knowledge if the region is to begin to work more effectively as an integrated knowledge economy.

Policy instruments at regional level: The role that the Generalitat plays is, in the words of a senior policy maker, an 'interstitial' one. For example, the funds available for funding research policy at regional have grown year on year and have been targeted at human resources and infrastructures³⁶. Basically what the regional authority does is, on the one hand, to tackle the things that are not done well or at all at national level using their understanding of local conditions and needs and, on the other, to use the major funding from national sources to address objectives that are developed by regional stakeholders for the advancement of regional interests. In this respect the PRI is a useful document and sets out a helpful programme of framing and facilitating activities at the 'meso level' between the local and the national to try to make the latent and potentially powerful innovation system work more efficiently and effectively. The role of the Generalitat is basically about 'wiring up' the innovation system by connecting all its constituent parts (it is a very well endowed system) and linking them to the national and international levels as seamlessly as possible. It is important to note that this is the first plan that has been developed by all the ministries responsible for research, universities and industry and innovation.

Policy instruments at national level: At national level there are the beginnings of a shift in the way that funding is allocated. The National Plan is still 'live' but recently the new national government has developed a programme 'Ingenio 2010' that shares the same high level objectives as the NP (to increase R&D spend, raise level of innovation in companies etc.) but which delivers things differently. The focus of 'Ingenio 2010' is on groups and networks of researchers rather than on senior individual researchers, on lines of investigation rather than on individual projects, on longer term work rather than smaller, shorter term projects, on bigger projects rather than a large number of small actions, on in-term and *ex post* evaluation rather than on *ex ante* evaluation alone. All this will be funded by more public resources which will grow at a rate of 25% a year between 2006 and 2010 in contrast to an annual growth of 15% between 2001 and 2004. This new programme promises a lot and seems to represent a new culture in RDTI policy making with ambitious new objectives and the appearance of what appear to be international best practice elements (for example, the new promise to evaluate and learn is very fresh and striking and will make a big difference if carried through) picked up either from seeing what other countries have been doing or from better use of international consultants and the internationally experienced experts in government circles. However, this promising groups of actions has only just started and it is impossible to say anything about the difference it has made.

³⁵ However, it should be noted that there is insufficient data to draw conclusions here about how the more business oriented and sector based diffusion institutions are performing. Such organisations do not deal with research knowledge, on the whole, and the indicators collected for this report are mostly to do with research. More and different research would be needed to comment on the impact of non-research technology diffusion programmes on the regional economy and their longer term impact of improving business learning capacity and ability to use research knowledge.

³⁶ For a breakdown of the fields where funding supporting research policy is has been spent over the last decade see Annex 1, 1.13.

3 Regional economic structure

3.1 Description of the economic structure

3.1.1 The characteristics of the productive structure of the region's economy

General data: Macroeconomic aggregate data for 2004 show that Catalan GDP is around 19% of the Spanish national total and that the GDP per inhabitant is significantly higher than the average for Spain and just above the average for the EU-25³⁷.

	Catalonia	Spain	EU-25
GDP (millions EUR)	157 124	837 557	10 289 222
GDP per inhabitant	23 359	19 642	22 449
Gross value added (million EUR)	139 814	735 386	9 560 199
agriculture (%)	1.5	3.6	2.0
industry (%)	25.5	16.4	20.5
construction (%)	9.3	11.0	5.9
services (%)	63.7	69.0	71.6

High tech sectors: The most important high tech industrial sectors are: pharmaceuticals, office machinery and computing materials, electronic components, radios, television and communications, medical instruments, precision instruments, optical equipment and watch making. However, in terms of proportion of high tech companies the region lags significantly behind the EU 15 average (1999 data) of 12.3% of companies with only 7.6% even if this is in advance of the Spanish average of 6.7% (2004 data)³⁸.

Medium-high tech sectors: The most important medium-high-tech industries are chemical industry (excluding pharmaceuticals) machinery and equipment, electrical appliances, the automobile industry and other transport materials. In these sectors of the Catalan economy the most important are the chemical industry which generate over a quarter of the total added value of the economy, the automobile industry (22%), the machinery and equipment sector (close to 19%) and the pharmaceutical industry (12.6%). 33.6% of Catalan companies fall into this category as opposed to 27.1% for the rest of Spain and 31% for the EU 15 average.

Medium-low tech sectors: In terms of medium to low tech sectors, Catalonia has a smaller percentage of these businesses (26.2%) than the Spanish average (27.9%) but a significantly higher percentage than the EU average of 23.9%. Regarding low technology business, Spain has a high percentage (38.3%) while Catalonia is close to the EU average at 32.6, the average being 32.8%. Therefore, the Catalan economy is characterised by a very high proportion of SMEs (93.8% of companies have less than 20 employees) mostly grouped in medium high and medium to low technology sectors.

Added value: Added value in the Catalan medium high & high-tech sectors:³⁹ Using the OECD categories, medium high and high tech sectors account for 38% of industrial added value in the region, slightly up from 34% in 1993. Of the 34% added value accounted for by medium-high and high tech industries in 1993, 27% of this is attributed to high tech businesses with pharmaceuticals accounting for 19% of this total. In 2004 contribution of high tech had declined to 20% of the total of med-high and high tech value added, with pharmaceuticals

³⁷ Source 'Figures of Catalonia 2005' Generalitat publication and drawing on source data from Institut d'Estadística de Catalunya, National Institute of Statistics (Spain), for more general economic performance data see Annex 1, 1.14.

³⁸ Data for this and subsequent paragraph presented in José Garcia Quevedo 'Recent evolution of innovation policy and its application in Catalonia', CIDEM, Feb. 2006, sources are IDESCAT and Bank of Spain.

³⁹ For details see Annex 1, 1.24.

accounting for 15% of this total. So, while the total for medium-high and high tech has grown as a proportion of regional value added, the contribution of high tech has reduced between 1993 and 2004. Therefore, added to the low number of high tech business (see below), the contribution to gross value added appears to be declining. This might also be used as a partial indicator of the success or otherwise of innovation policy and the increasing research effort and the growth of the university system over the same period. It could be contested that the declining role of high tech sectors over the ten years between 1993 and 2004 indicates that in general terms the research system has not been contributing positively to growth in the this key segment of the industrial fabric of the region. There has also only been a 4% rise in the contribution of the whole collective of medium-high and high tech industries over the same ten year period which might also suggest that the contribution of research spending and support programmes might have been positive but that it has been unspectacular⁴⁰.

Number of companies: Annex 1, 1. 26 shows the number of industrial companies in 1993 and 2004. These tables show a very stable picture for the number of companies between these two dates. In general, the proportions, and in many cases the absolute numbers of companies in the different industries remain unchanged. Most importantly of all for this study the proportion of companies in the medium-high and high technology sectors has remained exactly the same at 15% of the total number of companies. Over this ten year period, therefore, the these sectors are not taking a greater proportional role in the economy and there appears to have been no restructuring in favour of a growing influence of technology based business. Once again this suggests that the efforts in policy, research, technology transfer and encouraging entrepreneurialism that has been dedicated to increasing the numbers of new business in these sectors has had no effect in increasing the role of technology based business in the industrial economy as a whole. This might suggest that it would be sensible from now on to focus much more effort on the remaining 85% of less technology based industry, moving away from an academic focus on research and putting the universities at the service of the economy much more actively.

Employment: In terms of employment, Catalonia has a higher participation rate for both men and women and lower unemployment rate than the average for Spain. However, it is worth noting that short term, unstable contracts are common and that some estimates put the number of employees engaged in tourism and construction alone as high as 50% of the workforce total⁴¹ It is also worth noting an extraordinary wage discrimination⁴² between men and women which applies in Spain and Catalonia. Recent research suggests that women on average earn 34.7% less than men for the same work, with the greatest difference being seen in the private sector (where the inequality is 50%) and the least discrimination being seen in the public sector (10.7%), another reason why, alongside secure contracts, the public sector is an attractive employment option in Spain. In 2004 the labour market was as follows⁴³:

	Catalonia	Spain	EU-25
Active population (1.000)	3 440	20 185	214 339
Activity rate (%)	60.1	55.7	56.6
males (%)	70.4	67.2	65.2
females (%)	50.3	44.7	48.6
Employment (1.000)	3 107	17 71	194 440
agriculture (%)	2.3	5.5	5.0
industry and construction (%)	35.6	30.4	27.9

⁴⁰ The period for which there are IDESCAT data illustrating this paragraph and the ones immediately below coincides with the period in which the Generalitat has been making innovation and research plans, the first one started in 1993 in the same year as these data sets.

⁴¹ For example, the data presented in the Interreg III c project 'e-Teams' collected by the University of Girona team for the Catalan benchmarking study of SMEs in the region, September 2005.

⁴² See, El Periodico newspaper (18.01.05) reporting research from Josep Oliver from the Autonomous University of Barcelona.

⁴³ 'Figures of Catalonia 2005' Generalitat publication and drawing on source data from Institut d'Estadística de Catalunya, National Institute of Statistics (Spain).

services (%)	62.1	64.1	67.1
Unemployment rate (%)	9.7	11.0	9.2
males (%)	7.8	8.2	8.5
females (%)	12.3	15.0	10.1
Under 25 year olds (%)	21.2	22.0	18.5

Annex 1, 1.25 shows that the proportion of people employed in med-high and high tech industries has not changed between 1993 (33%) and 2004 (34%). So, this segment has seen, as mentioned in the paragraph above on added value, a 4% increase in added value with a 1% increase in proportion of total industrial employment which suggests a marginal increase in efficiency over this period. However, there has not been significant growth in medium or high tech areas as a portion of the regional economy and in this respect it might be suggested tentatively, that innovation support programmes and research have had no effect on the overall industrial employment structure of the region over this period at sector level – there has been visible trend of Catalan industry become more high technology based at this level of resolution.

Company size: Regarding the industrial structure of Catalonia the following data show the number of industrial companies and their size both in overall terms and in key sectors⁴⁴.

Size (employees)	less than 20	20-49	50-99	100 or more	Total
Number of Companies	29 165	3 995	1 050	966	35 137
People employed (1000)	172.3	120.6	73.3	258.9	625.2

Business is concentrated in the province area of Barcelona where over 75% of companies are located. Most companies (65.5%) with sales over 1.2million EUR are family owned. These companies employ 57.1% of the workforce and are responsible for 54.9% of overall sales⁴⁵. In the industrial sector the number of people employed by company size in the leading industrial fields can be seen at Annex 1, 1.20

Innovativeness of business: Regarding innovativeness of businesses in Catalonia, in 2003 industry showed higher rates of innovativeness than services. In terms of total innovation expenses the largest spending sector is the chemical industry followed by the machinery, electronics, instruments, cars and transportation and textiles. While total spend is clearly important, more significant is innovation intensity which measures the % of investment in innovation as a % of total turnover. In this respect textiles, clothing, leather and shoes comes out as the leading sector at 9.9% followed by two service sectors, namely, IT Services and Transportation with intensity rates of 8.8 and 4.7% respectively. Other key sectors such as chemical (3.5%) and motor vehicles (2.5%) have lower rates of intensity. In terms of percentages of innovative companies the leading sector is IT Services with 47% of companies innovating followed by Chemical Industries (44.0%) and Motor Vehicles (40%). The figures put the Catalan business innovativeness performance at something below the EU level where the average, for example of innovative business in industry is almost 50% and 40% for services⁴⁶.

3.1.2 Systematic characteristics of the region

Clusters and networks in the region: Cluster policy was a very important part of policy making in Catalonia in the 1990s and while still has some background role it is not part of the current planning in innovation and research⁴⁷. We can say the same thing, on the whole, for networks. However, there are current examples of major projects that could be called networks,

⁴⁴ Source: Catalan Statistics Institute (IDESCAT). For details of the number of people employed by company size see Annex 1, 1.20.

⁴⁵ Source: Interreg III c project 'e-Teams' collected by the University of Girona team for the Catalan benchmarking study of SMEs in the region, September 2005.

⁴⁶ Source: IDESCAT.

⁴⁷ For more on the development of clusters policy in the region see Annex 1, 1.15.

but are in fact, probably better understood as networks of networks trying to promote the region as a whole as a key international node in the knowledge economy. The best example of this is the Biocat project mentioned earlier which is a regional effort, supported by the regional government to bring together all stakeholders in this field. In fact, this is the only example that we can point to currently that appears to be promoted as a major network/clustering based initiative.

Linkages: The perceived scarcity and weakness of the links in the region between innovation knowledge providers, users and intermediaries is a source of serious concern for government policy makers. Indicators such as the low numbers of university spin-offs, the low level of qualified research employees in business, the fact that in general the university research system is not related to the needs of business, that medium high and high tech sectors have stagnated in terms of company numbers, the reduction in the proportion of high tech industry's contribution to regional added value etc. suggest both directly and indirectly that there is a problem with linkages between all levels of the mostly innovation system⁴⁸. As an underpinning problem that reinforces all the other weaknesses of inputs and production in the innovation system when compared to EU competitors, the failure of networking is mentioned repeatedly in the intervention logic of the PRI: for example 'These weaknesses are accentuated by the insufficient development of support infrastructures for innovation, such as technology centres and other entities. Particularly worthy of mention is the scarcity of centres of a sectoral nature and the scant participation of the private sector as an instigator in such structures⁴⁹, or '...the co-ordination of the different agents of the research and innovation system (companies, universities, public research and development centres, public administration and support infrastructure for innovation) is still insufficient, especially in regard to the lack of alignment and bonding between university research and innovation in companies, due to the serious weaknesses in the knowledge transfer processes'.

Evidence in support of the perception of weak linkages: While the dimensions of the problem are not given in any detail in the PRI, clearly there is a strong and pervasive sense that the system, as system, is not working. There are a few other studies, although evidence is very scarce, that support the sense that there are weak linkages between knowledge users and producers in Spain which we can probably extrapolate for the region of Catalonia although there is no specific regional study to show if or how national trends are reflected here. A COTEC study from 1998⁵⁰ and a study led by Bricat in 2000⁵¹ showed the weakness in mutual understanding and shortcomings in the transfer of technology from universities to firms. Firms, on the other hand, generally have a poor opinion of universities as a source of innovative ideas, placing them last in a list of possible sources of innovation inputs in a National Statistical Institute study of 1998 although in science based sectors such as pharmaceuticals the opinion of firms was much more positive. Using the Griliches-Jaffe knowledge production function (which observes change at spatial rather than firm level) in Spain for the period 1994-1996 another study⁵² showed that except in the electronics industry there is no evidence of a positive relationship between university research and regional innovation. These findings were supported by a slightly later study⁵³ using data for the years 1996-2000 which showed again that high tech sectors were the ones in which universities could be detected as providing a positive influence on regional innovation performance and that this influence was probably a result of the increased research expenditure in universities and the effects of the expansion of

⁴⁸ See Annex1, 1.19 for a note on the role of systematicity in policy making in the region.

⁴⁹ It is the opinion of the author that there is no scarcity of institutions (perhaps the opposite is the case, see earlier sections on the number of institutions in the system) and that various factors conspire against industry taking a leading role in now institutions, in particular the academic bent of policy making as discussed in Section 4. As so often here, it is not a question of system endowment but of evaluation, benchmarking, focusing on effectiveness and efficiency which are much harder and more sensitive targets to hit than placing the blame on basic endowment shortages.

⁵⁰ 'The Spanish System of Innovation. Diagnoses and Recommendations'.

⁵¹ 'University 2000 Report', Conference of Rectors of Spanish Universities.

⁵² García Quevedo, 'University Research and the Localisation of Patents in Spain', 2002.

⁵³ Barrio and García Quevedo, 'The Geography of Innovation: Effects of Academic Research', 2003.

technology transfer services such as the OTRI network. The most recent research indicates that in the EU 9% of innovative companies cooperate with universities in Catalonia this figure is only 4% (the 2000 figure for Spain as a whole according to INE figures was 5.5% up from 3.6% in 1996)⁵⁴. So, while it should be a topic for further detailed study, it seems fair to say that the Catalan innovation systems suffers from a weakness of linkages between knowledge users and producers.

3.1.3 Catalonia in an international context:

FDI in Catalonia: Historically, between 1994 and 2003 Catalonia received 18.8% of the total foreign direct investment (FDI) for the whole of Spain which totalled 25 151 million EUR invested in the region⁵⁵. 90% of foreign firms are located in the Barcelona area which means that there are approximately 2 700 foreign firms located close the Catalan capital out of a total of approximately 3000 firms. Catalonia has established itself as a very favourable location for new international investments and in 2003 was second in Europe for the number of major international investments with 82, only Greater London has a greater number with 112.

Export Orientation of local firms: Regarding the export orientation of local firms, in 2005 Catalan firms exported goods to the value of 42 087.03⁵⁶ million EUR, a growth of 7.1% on the previous year. OECD defined high tech products saw a growth of 19% on the previous year and they represent 37.7% (and a value of 5 067.04 million EUR) of the total Spanish exports in these sectors showing that Catalonia is relatively specialised in the national context in these fields. Medium-high level tech products form 52.2% (with a value of 21 397.03 million EUR) of the total and saw a growth of 7.5% between 2004 and 2005. In terms of geographical distribution of exports the EU is the main destination (73.8% of total, in particular Germany, France and Italy). The main exporting sectors in terms of export value were the chemical industry with 9 322.9 million EUR, the automotive sector with 8 955.3 million EUR and the electronic machinery sector with a value of 4 197.1 million EUR in 2005.

3.1.4 The local financial market:

Description of the Catalan financial market: The financial market for new business investment has expanded rapidly in Catalonia in the last decade as can be seen from the following table⁵⁷:

Origin of new funding	1998	1999	2000	2001	2002	2003
Financial Institution	0	2.0 (37.8%)	62.7 (48.8%)	129.4 (83.3%)	29.0 (34.6%)	225.4 (89.2%)
Other businesses	0	1.8(32.5%)	30.8(24.0%)	0.9(0.6%)	24.6(29.4%)	16.3(6.4%)
Public investors	0	1.6(29.7%)	6.9(5.4%)	2.0 (1.3%)	12.3 (14.6%)	8.0(3.2%)

(Million EUR and percentage of total)

However, while the financial market has been expanding rapidly, the bulk of the investment is taken up with traditional sectors and with business expansion rather than business set up.

Target	1998	1999	2000	2001	2002	2003
Start up: High tech	n/a	n/a	9.6	5.0	16.7	5.8
Start up: Not high tech	n/a	n/a	6.4	8.1	3.7	6.0
Expansion: High tech	n/a	n/a	20.0	1.6	7.9	3.3
Expansion: Not high tech	n/a	n/a	69.7	133.7	48.2	223.6

(Million EUR. Not including buy-outs)

⁵⁴ García Quevedo, The Recent Evolution of Innovation Policy and its Application in Catalonia, Feb, 2006.

⁵⁵ For more detail see Annex 1, 1.16.

⁵⁶ Source Catalan institute of Statistics IDESCAT.

⁵⁷ Source: 'Risk Capital in Catalonia', José Martí Pellón, Generalitat, 2004.

Challenges for the financial market: Clearly, while the business finance market has grown rapidly and is now a well established feature of the regional economy, the challenge for policy makers is to develop this sector by diversifying investment to the early stages of firm development and in a greater range of sectors, in particular new technology based businesses. Responding to this challenge CIDEM has taken steps over the last ten years to bring together different regional players supporting small firms through the life cycle from seed to maturity and of filling any remaining gaps with initiatives of its own⁵⁸. So, the financial market is growing rapidly and while new business and new high tech business in particular is not very strongly supported steps are being taken by policy makers to guide the market in this area and to encourage entrepreneurs to take up the opportunities that are increasingly on offer.

3.2 Policy context

3.2.1 Governance structure and actors

Governance structure at regional level: The Generalitat is the autonomous government of Catalonia. Its relationship with the Spanish state government is governed by an agreement called the Statute which was renegotiated mid 2006⁵⁹. The new Statute contains some increases in tax retention for the region which would appear in principle to give the Generalitat more money to set and implement policy in key areas. However, the Statute is just a few months old at the time of writing and its effects cannot yet be estimated. The new Statute has brought a greater degree of decentralisation of power to the region which has the potential to improve the innovation system significantly. One of the problems of greater decentralisation is the duplication of roles and institutions in the public sector in general including in the innovation system. There are a vast number of organisations and institutions ('anarchy' in the words of the European Innovation TrendChart Country report 2006 for Spain), partly because of the duplication between national and regional level and partly because of a general tendency not to set priorities and focus resources against quality and performance. There is a pressing need for objective, international benchmark based overview of resources, capacity and quality to help streamline the system.

Policy making at regional level is devolved down to Ministries for key areas of the economy and society (health, universities, education, culture etc.) At the head of each department is a Conseller (minister) who is responsible for the work of the ministry. Whether the ministries are consultative, delegating and networked or not depends on where you are standing. Each minister has a range of experts in his close cabinet with whom they consult and can call for wider consultations including public consultation if they deem it necessary. And so, those inside the system tend to consider that their processes are well networked and consultative. However, to those used to more team based and flat working environments they remain hierarchical and command-based institutions with little in the way of team working or systematic consultation in their policy making processes.

3.2.2 Policy objectives and instruments

Policy objectives: Below are a number of policy areas which create the framework in which research and innovation takes place. These policy fields affect the way R&D is done and how investments are decided there is no evidence at all to suggest whether or how they have done so and even in policy documents they are not linked to questions of R&D, unless they are the ones we have already covered in the body of the report, which are explicitly research and innovation policies and programmes. So, this section is offered as an illustration of the policy context rather than as evidence of 'policies that have affected R&D investments and innovation in the region' as this evidence does not exist. It should, of course, be kept in mind that as the above sections have demonstrated, the basic indicators on growth and employment in

⁵⁸ For details of these initiatives see Annex1, 1.17.

⁵⁹ For more details of governance at regional level see Annex 1, 1.18.

technology intensive sectors has been stagnant over the last ten years and so, on the ground, these policy areas, singly or in combination, can't be considered effective facilitators of growth in the industrial sectors as it has not taken place.

- **Fiscal policy in the region:** Fiscal policy is set at national level and is aimed at being very favourable to R&D investments in Spain in general.
- **Industrial Policy in the region:** Key policy objectives are to internationalize the economy and to focus increasing funding on the internationalization of Catalan businesses, in particular to reinforce Catalonia's role as a leading centre in the Mediterranean region. There is a priority also on attracting further foreign investments.
- **Labour Policy in the region:** There are three key objectives in this area. Firstly, a key driving objective here is to increase the numbers of jobs available in the region while, secondly, to attempt to reduce the numbers of precarious short term contracts and improve the conditions of employment. The third key objective here is to support the provision of professional and on the job training, which is a weakness in Catalonia as suggested in an earlier section of this report. All this will be done in negotiation with the unions and businesses. There is also a focus on the promotion of self employment and micro-businesses proposing assistance with business planning and micro-credits.
- **Policy to improve competitiveness:** All policy in this area is formulated within the framework of the Lisbon Agenda to make Europe the world's leading knowledge economy. This policy field comprises work in a wide range of areas: infrastructure and transport, telecommunications and energy, research and innovation, labour policy. Competitiveness is seen as result of improving conditions in all these constituent fields.
- **Policy in commerce:** The policy in this area proposes that Catalonia has its own particular model of business which is based on a very dense SME population and is based on an equilibrium between the interests of all parties which reflects the cohesion of its peoples, towns and neighbourhoods. Business development must take place in this context and observe the need to maintain cohesion and equality of opportunity and ensuring conditions for open economic competition and consumer rights. Activities in this area include the regulation of business opening hours, the promotion of Catalonia as a location for international trade fairs to promote its international image and the develop laws to recognise and promote the importance of traditional artisan products and producers.
- **Policy in promoting use of ICTs and developing the information society:** The objective here is to welcome in the benefits offered by the knowledge society while defending citizens against risk and the increasing inequality of the digital divide. The policy documents recognise that Catalonia has low levels of take up of ICTs at home and in business compared with other EU countries. A new law has been passed 'The Knowledge Society Law' and a new Council for the Knowledge Society reporting directly to parliament has been created. Policy focuses on pushing the take up of broadband for all citizens, basic training for all, promoting e-government and open government, develop participative strategies for the development of knowledge society etc.
- **Education policy in the region:** The public education system is promoted as the backbone of the Catalan education system and a wide range of actions are in place to raise investment and quality. Policy objectives include: increasing the numbers of teachers, providing better continuing education for teachers, introducing performance related promotions and incentives. A rapid increase in quality and resources is needed and a very high priority is placed on improving this area to stem the outflow of children from wealthier more educated families to private schools
- **The objectives and priorities of regional development plans:** The region is criss-crossed with development plans at city and sub regional level. Perhaps the most important as an economic driver for the region is the Metropolitan Plan for Barcelona. This is an inclusive and interactive process of planning and review that has been underway since 1988 and includes representatives from private bodies, public and government institutions. The most spectacular results of which have been the '92 Olympics and the Forum in 2004, both of which have been property development led regeneration projects and have raised the profile of the town internationally. The Third Plan which started 1999 and is now under review adopted a very clear focus on the knowledge economy which had been part of but not the main thrust of the previous plans. Under the heading City of Knowledge the work

includes the creation of a new district @22 for new economy businesses built of the site of disused textile factories in the old industrial zone of town, this process is still underway and slowly buildings are opening and the first companies are taking up space; reinforcing universities towards the 'third way', focusing on technology transfer and spin offs, working in conjunction with the Generalitat who control university spending and policy; creating research infrastructures, science parks etc. again in collaboration with the Gencat as key policy makers and funders; promoting strategic sectors for the town in tourism, culture, logistics etc. The impacts of the work of the Third Plan are yet to be felt but it is significant that in the key metropolitan area of the region the city authorities are working in coordination with the innovation objectives of the regional government and perhaps even exceeding the regional government in terms of their focus on the links between research, knowledge business and city and regional prosperity.

Exhibit 2 in Annex 2 sets out regional policy areas and explores the impact of any complementary policies on the R&D and innovation capacity of the region.

Policy Instruments

To reach the policy objectives set out in the section above, the following instruments are deployed.

- **Fiscal law:** Spanish national fiscal law is recognised as being among the most generous in its treatment of R&D activity, partly to make up for the shortfall in available direct funds at national level. So, for example annual R&D expenditure qualifies for a tax credit of 30%, in addition an incremental tax credit of 30% is available if the R&D expenditure for the period is greater than the average for the R&D expenditure of the previous two years, system whereby credits are carried forward so that the firm has to improve overall longer term performance. Also a 10% tax credit is available for R&D expenses incurred in joint projects with academic, business or government partners. The ceiling for deductible amounts is 35%.
- However, laws in tax and business administration place burdens on small business and are a disincentive to start ups. Bureaucracy is a crushing burden as are the very high fixed costs which are levied from the very start of the business's life. Again, most of these frameworks are set nationally but it should be a priority matter for the regional administration to do whatever they can in the gaps left by any national legislation.
- **Labour law, labour flexibility:** The laws government is area of policy as set at national level and are not subject to regional policy making. Spanish labour market law is a long established problem for the Catalan innovation system and has various negative effects. The basic problem is that it is legal complexity and high severance payments to permanent staff which leads to a 'two stream' working culture of permanent employees very well protected with few incentives to innovate and a large number of temporary workers with few incentives to contribute to company development, raise productivity and who are not generally offered professional training. This environment is not conducive to investment in new technology based business where flexibility, commitment, high levels of motivation and willingness to take risks are shared by all at all levels of the organisation.
- This situation is compounded by a working culture that continues to be 'top-down' in most of the family owned SMEs and the public administration compounded by a system of promotions which is at times not entirely based on merit that can lead to frustration among talented employees – in R&D this has the well documented effect of hastening the 'brain drain'⁶⁰. There are programmes specifically targeted at employing researchers⁶¹ from overseas and improving the take up of doctorates by companies but in related policy areas a mountain still needs to be climbed regarding creating a modern employment market and it will prove very tough do as so many things conspire against it, for example, very high house price rises matched by low salaries and unstable contracts

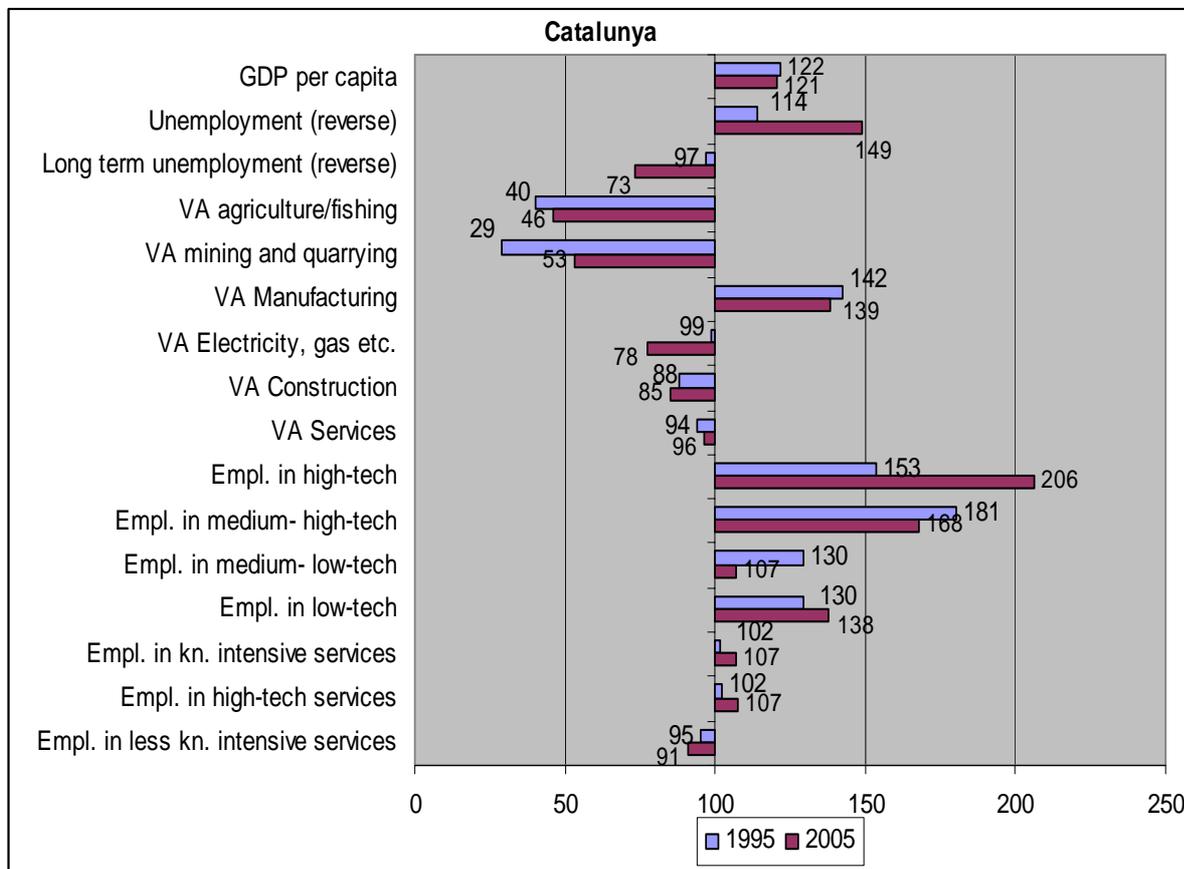
⁶⁰ See, for example, the article in Nature, 414, 22 November 2001 which describes the non-merit based system that was found, and remains, widely across Europe but especially in Spain and Italy. The article quotes Enric Banda a leading figure in the Catalan and European research system 'The typical way to make your career is to be next to a professor who is active. You are in his or her shadow, and if you wait long enough, eventually you will get a position. As we say in Spain, 'you have to keep your seat warmed'.

⁶¹ The national programmes in this field are the Ramón y Cajal and Torres Quevedo programmes. The Catalan attempt to do this for themselves is the ambitious and entirely sensible 'Serra i Hunter' which allows leading researchers to be employed on regular labour contracts rather than as civil servants. Government figures for 2005 indicate that 275 such contracts have been let to date, the original plan was for thousands and this policy is still unfolding.

mean that many workers are unable to move to find work currently and are not incentivised by the salary benefits over the inherent risk.

- **Access to capital:** The capital market is growing rapidly in the region as described at 3.1.4. For information about regional policy instruments for increasing access to capital please see Annex 1, 1.12.
- **Investment decisions of firms, especially with respect to risk and innovative projects:** CIDEM is the investment agency for Catalonia, assisting both Catalan, national and international business in their day-to-day work and decision making regarding relocation and innovation and risk among many other things. They provide a range of support instruments most of which are described at Annex 2, Exhibit 1 below.
- **Competition policy:** The Catalan Tribunal for the Defence of Competition is the key policy instrument for the creation of a positive competitive environment for business in the region. It was established in 2002 it is a pioneering and independent body to ensure objective adjudication in matters of competition to prevent restrictive or false practice, the creation of monopolies and to defend the public interest in matter of business.
- **Policies affecting (de)regulation and liberalisation of markets and creation of lead markets:** Negotiation continues at national level between government and workers representatives on the issue of labour market liberalisation to increase flexibility and reduce cost of employment. Energy market liberalisation is progressing slowly at national level with the recent government intervention in the purchase of a Spanish energy company by a German company being challenged by the EC. Other liberalisation proposals for utilities markets and the financial services sector are national level issues and are progressing slowly. Lead markets in the sense of the use of public procurement at the pre-commercial and commercial stage as a means for regional and local authorities to create markets in key growth areas are not a policy instrument used in Catalonia.
- **Initiatives directed to cluster development and SMEs:** Cluster development is covered in an earlier section and in the Annex 1. The Catalan investment agency provides a full range of services to SMEs and is the main policy instrument for SME development in the region. Services include funding for research projects in the key fields identified in the regional research plan and other innovation activities, business capital funds, advice on technology transfer, help with business planning, advice and assistance with accessing EU funding etc. The work of CIDEM is very closely integrated now with the work of the other ministries involved with the development of the research and innovation, mainly the ministry for education and research.
- **Balance of instruments, coordination of instruments:** The coordination of all relevant policy areas is undertaken by CIRIT, the inter-ministerial research and innovation coordination body. This organism is tasked with ensuring that policies related to research and innovation are agreed by consensus, that all views are taken into account in the development of policy and that synergies are exploited. There is no evidence of major conflict or dilemma in the policy choices that have been made.
- **Contribution of the Community Support Framework:** Catalonia has benefited from the various rounds of CSF funding in areas relevant to this study. For example, in the period 1996-1999 as an Objective 2 region support for research, technology and innovation comprised: the construction and equipping of research units and technology centres in five universities (ECU 45.1 million); the construction and equipping of eight centres of technology and innovation run by local authorities (ECU 9 million); co-financing public sector research and technology projects and equipping three CSIC centres (ECU 5 million) as well as supporting funding in related policy areas, including ECU 95.5 million to help SMEs integrate new technologies and contributions towards sector support centres and business parks (ECU 42.1 million). Under the current spending round (2000-2006) Catalonia has received 212 EUR million to support employment creation and consolidation with the greatest emphasis on the integration of the unemployed, the promotion of stability and adaptability with much less emphasis on vocational training, entrepreneurship and promotion of human capital in research, science and technology. A further 411 413 535 EUR of EU contribution from the ERDF has been dedicated to creating the knowledge based society, promoting innovation, R&D and the information society among the most visible results have which have been a new network of research centres built and equipped since 2000. In conclusion, the Community Support Framework has been a key source of funding in all the major infrastructure developments in the public sector over the last decade at least as well as funding 'soft' measures to improve to move Catalan culture forward into the post industrial age.

3.3 Conclusions regarding regional economic structure



Remarks: GDP data 1995-2003, unemployment data 1995-2001 and VA data 1995-2003.

Catalonia has a large and diverse economic base with a long standing tradition of entrepreneurialism, openness and flexibility that have seen it thrive for hundreds of years and have ensured its resurgence since the restoration of democracy to Spain. There are some strong points many of which are picked up in the table above: the market for finance is improving quickly, although it needs to be oriented more towards new sectors and start ups; the national fiscal framework is positive for R&D; the region is attracting significant amounts of FDI and is very highly rated as a destination for major international investments; there is high participation and low unemployment by national standards; high tech sector employment is growing, slowly but progressively over the last ten years.

However, the regional economy is facing, like all EU regions, new categories of challenges in the globalised knowledge economy and there are reasons to wonder whether it will be able to take a lead in the new economic paradigm that is emerging as effectively as it did in the industrial revolution in the nineteenth century when it led Spain into industrialisation. Over the last decade, despite investment and effort in research and technology transfer there is no growth in medium-high and high technology industrial sectors as a proportion of the economy, industrial economic composition has been static and remains rooted in low and medium technology sectors. *Basically, the danger is that the Catalan economy becomes stuck in the medium and low technology areas which currently provide the basis of its industrial strength.* These sectors are likely to be the ones that are most vulnerable to cheap production in developing countries. Also, as it becomes clear that developing countries are also capable of developing knowledge intensive sectors too and that the only solution to this challenge is for

EU regions to focus on continuous innovation to stay 'ahead of the game', the low rates of innovation in Catalan business is also a serious cause for concern. Clearly, also, the power of construction and tourism cannot be relied upon to drive sustainable growth in the very long term as they are very vulnerable to regulatory changes and altering fashions. It should also be expected that the relatively small amounts of EC money coming to region to help develop infrastructure will also end in the near future. In some respects, therefore, the regional economy is not yet geared up to be competitive in the changing market place, as demonstrated by some evidence of weak linkages between knowledge producers and business, lower than EU averages for knowledge intensity and innovation, and a reduced policy focus on creating innovative clusters.

Research does in theory have an important role to play in creating a competitive and sustainable future for the region but currently and over the last decade since the first regional research and innovation plans were made public sector research has made no impact on basic economic indicators in medium high and high technology industrial sectors. Therefore, it is likely that the current research and transfer system needs to be fundamentally reconfigured if it is to reach the objective of promoting regional innovation and entrepreneurialism and it is likely that there will be far greater emphasis on technology diffusion and take-up than on research if this objective is to be met. This will present a major organisational change challenge to the system of knowledge production in the region if the objective of developing the industrial sector is to be taken seriously.

4 Conclusions

4.1 Assessment of the RIS

Systematic characteristics, what kind of an innovation system is it?: There appears to be some uncertainty in this innovation system about the weight to be given to focusing on academic research or working on behalf of the needs of regional industry. The industrial focus is there, and it is slowly increasing but it still has much less import than academic research agendas⁶². In the longer term, a key challenge will be to decide to which type of system Catalonia wants to aim for and to dedicate itself single mindedly to developing either an outstanding research base or targeting the research base at the needs of the regional economy.

Systematic characteristics, to what extent is it a system?: In general it is difficult to assess the level of systematicity in the Catalan system as this has not really been a specific topic for detailed research activity based on a clear theory or hypothesis. However, there is one study that looks at the innovation system in the region at system level and finds that *Catalonia cannot be considered as a knowledge based innovation system*. The reasons given for this are that relational linkages are between stakeholders in the knowledge base are extremely scarce and that no mechanism existed then for integration at a regional level⁶³. Other indicators would also suggest low levels of regional systematicity, such as the poor rates of employment of doctorates in the business sector and the low levels of reported university spin-offs, suggest that people and knowledge are not moving through the different parts of the regional innovation system, doctorates and not transferring to businesses and high rates, academics are not trying to become entrepreneurs. Therefore, the suspicion captured in policy documents that regional system is not working systematically enough is probably true.

Does the knowledge specialisation match the economic specialisation of the region?:

This question as posed by the report template has two aspects. On the one hand the knowledge specialisation and economic specialisation go hand in hand in the private sector in some respects, for example, if the value added as presented in the graphic at Annex 1, 1. 24 and compared to the private sector research and innovation input (Section 2.1.1) clear correlations can be seen. So, the highest spending sector on innovation in 2000 was 'machinery and transport materials' and this sector accounted for over 17% of total regional value added in 2004 making it the highest regional value added sector. In chemicals in 2000 Catalonia invested the second highest total in innovation expenses and this sector returned the second highest rating of value added 15% of total value added in 2004. The other highest spending sectors were 'food products and beverages' which returned 13% and 'textiles, dressmaking, leather and footwear' which produced 7% of regional added value in 2004. So, the highest value added sectors are also the biggest investors in knowledge and innovation.

However, currently the economy is increasingly reliant on tourism and construction to drive growth and these sectors are accounting for most new jobs, perhaps up to fifty percent of all jobs and probably more than 25% of the economic activity in the region. There are no research input figures for these sectors but it should be expected that the figures are low and certainly not matched by the strength of these sectors in the regional economy as these are low research, low skill and low wage sectors. Therefore, the major economic drivers currently are not high users of research and innovation.

⁶² In fact, the first attempts at regional policy making in this field (the first regional plan was 1993-1996) were done in much closer collaboration with business and organised interdepartmentally, in fact, it appeared that research was to be put at the service of economic development. However, academic interests were able to change the direction of policy making and orient it firmly towards academic interests. These events are set out in 'Explaining the science and technology policies of regional governments', Luis Sanz-Menéndez and Laura Cruz-Castro, CSCIC, September 2005.

⁶³ Riba, Marta and Leydesdorff, Loet (2001) Why Catalonia cannot be considered as a Regional Innovation System? *Scientometrics* 50(2):pp. 215-240.

In terms of the public sector, the situation is harder to assess. A major economic sector in Catalonia is the chemical and pharmaceutical industry. It accounts for 26% of the value added in high and medium technology sectors and is a key sector for the region. The public sector knowledge specialisation does not follow this economic specialisation in an obvious way as the dominant area for publication and citation is in biomedicine - this is clearly a potentially related field but without greater detail it is impossible to know if there is a close correlation. Unfortunately, knowledge production indicators are not presented at fine enough resolution (publications are categorised 'biomedicine', 'other sciences' 'engineering') to assess if they follow economic specialisation in recognisable patterns. But, given the academic focus built into policy making and the pervasive sense of and some evidence for poor linkages between knowledge users and producers (see page 21) it is probably fair to assume that there is not a close relationship between academic and industry specialisation. In Annex 2, Exhibit 3 the key knowledge production fields identified in current policy documents (PRI) are set out to assess whether future orientation of knowledge production matches the economic specialisation of the region.

Strengths and weaknesses (see Annex 2, Exhibit 4 for more details): The strengths of the regional innovation system are:

- Catalonia, Barcelona in particular is very highly ranked as a place for international business location and comes out close or top of European cities for quality of life⁶⁴.
- It is connected by air worldwide and the communications networks are improving all the time. The weather, culture and food are all major factors in making Catalonia an attractive place for people to come to and stay.
- The innovation support network is another (latent) strength in terms of its sheer size and reach, all fields are covered, all services available.
- The universities have grown rapidly over the past two decades and overall provide a stable and consistent flow of new knowledge
- The new research centres are also potentially a great strength with new staff, often overseas staff, employed on new flexible contracts.
- Large number of established companies which have survived successive waves of technological change - strong entrepreneurial tradition in the region
- Large international companies in automotive and pharmaceuticals and chemicals bring with them international expertise and experience and may lead to spin out effects in the longer term.
- At national level, which applies to the regions too, a tax regime very to R&D is a strength and steps are now being taken to ensure that it can be properly accessed.
- @22 is a Barcelona city level initiative in process to create a knowledge based services zone close to the centre of town. At this early stage it show some potential to help contribute to raising the numbers of high tech sectors companies in the region.

Some weaknesses are:

- Majority of businesses are small, medium tech business with no specialist in house research capacity which makes absorption of new knowledge more difficult
- Educational levels are a real cause for concern being very low by EU standards as are levels of continuing education
- 49.7% of workers in Catalonia take home 1000 EUR or less a month⁶⁵, around 50% of all workers are in construction and tourism in low skill, unstable jobs which require few skills or qualifications, sex discrimination in wages very high. This is a low skill, low wage economy.

⁶⁴ For example, the European Cities Monitor of 2001 (a survey of 500 business executives) put Barcelona well ahead of any other EU city in terms of quality of life.

⁶⁵ Quoted in La Vanguardia newspaper 29.10.06 as on Agencia Tributaria data.

- Research resources in universities spread too thinly across all domains, no objective, qualitative, regular research evaluation system to help allocate resources
- University system does not instil questioning and challenging attitudes in the graduates it produces.
- Difficulties with employment law and high numbers of grants and temporary contracts means that often even quite senior researchers are in unstable positions.

Overall assessment of the contribution to R&D investments to economic growth and to regional prosperity of the potential of the region to increase R&D investment that would contribute to economic development.

Private sector R&D expenditure and its contribution to regional prosperity: The problem with addressing this question in Catalonia is the almost complete absence of evaluation data and interpretation which makes it very difficult to assess the impact of projects, programmes and policies. However, going from the data alone it is possible to see that since research investment has grown over the last decade, all other science output indicators have grown steadily while GDP has risen quicker than the rest of Spain to just exceed the EU 25 average and offer citizens a quality of life that is very highly rated internationally. Are these two things related? The answer is highly uncertain. In terms of private sector research, it should be assumed that the growth in the private sector has been facilitated, at least in part, by their own research effort and the returns on this investment (66.4% of investments were private sector in 2004 and most studies show gross rates of return for R&D investments at between 25-50% depending on contextual factors) although detailed analyses of key sector research spending is outside of the broad scope of this study. We also assume that as these key sectors are often by nature internationalised (cars and pharma and chemicals in particular) they can draw as necessary on international research and market knowledge and don't rely on the local knowledge infrastructure.

Public sector R&D expenditure and its contribution to regional prosperity: Drawing on Government planning documents we can see that linking public sector R&D very closely is not a priority: 'In relation to making general progress in the science and technology areas, the underlying goal of the Plan is to foster all areas of science and technology...progress in both general knowledge acquisition and in economic competitiveness requires a science and technology policy that is broad in scope, to foster the generation of knowledge in the long term without interference in the form of short-term market or productivity demands'. The emphasis here is on a wide academic research portfolio and not in the first instance on the capacity of public R&D to contribute to prosperity. It should not be expected, therefore, that public research contributes significantly to economic development in the region. In fact, this approach might possibly be one contributory factors explaining why, despite a decade of research plans and public investment in research and technology transfer the medium to high and high technology sectors of the regional industrial economy have not shown any significant growth, as Section 3.1.1. above demonstrates.

Other factors explain economic growth in the region: Other aspects of the socioeconomic structure are vastly more important than the investments in research when it comes to regional economic growth. Tourism accounts for 11% of all economic activity in Spain at a conservative estimate and is a vital sector in the region and doesn't feature in innovation planning, although it should. In fact, it is not uncommon to hear policy makers and economists express the opinion, off the record, that the only viable future for Catalonia is through tourism which should be managed better and more sustainably and that research policy making is relatively unimportant in the face of this. Construction⁶⁶ is the other key economic driver that has propelled the economy in the last two decades and is entirely free from research investment and policy making. 85% home ownership rates (highest in OECD), rapidly increasing foreign and second

⁶⁶ For an overview of the construction market see The Economist, September 14th 2006 and Time Europe Magazine June 19th 2006.

home ownership, 12% of all jobs, a high proportion of all new employment up to 70% of all municipal taxes to pay for local services depend on construction which draws investment away from other areas and has caused productivity gains in the economy and wages to remain static but has made giants of the Spanish financial and service sector leaders. Besides the monster drivers of tourism and construction research investment, particularly public sector investment is insignificant in socioeconomic development over the last decades. Opinions are divided as to whether this is a sustainable pathway but while tourism and construction account for so much of wealth generation those who try to argue that the regional economy needs to be based on knowledge driven by research will continue to have a very difficult job, in particular while the research policy is made by and mostly for academics.

4.2 Assessment of policies

Filling in gaps left by national programmes: It seems fair to say that policy is 'coherent' in the sense that there is a fairly clear logic behind the policy making. Basically, RTDI policy planning in Catalonia currently is clear and uncontroversial. It represents mainstream thinking about underpinning innovative regional cultures, doesn't focus overly on particular sectors leaving this job to the main national funds and basically doing what it can to improve the framework conditions in which the regional economy might prosper. There are no major conflicts thrown up by doing what the government is planning to do at the moment, it represents fairly good practice in a new regional economics/learning region/RIS/RITTS influenced fashion. Essentially, it fills in the gaps left at national and this is a sensible role for it to assume. RTDI is generally given good priority in the region and is viewed as an integrated part of socio-economic development although it is impossible to assess its standing vis a vis other socio-economic challenges, such as unemployment, income inequalities and poverty etc.

Need for prioritisation: Perhaps one weakness with policy as it currently stands is that there appears to be a certain reluctance to focus on excellence and set clear priorities and target resources on the achievement of specific and measurable objectives. The approach is, rather, to spread resources widely and, as a consequence, thinly across all disciplines. It is likely that, therefore, too much 'average' research is carried out (although in the absence of research assessments and evaluations it is difficult to tell this precisely) which is neither significant on the international re-search scene nor related to the needs of regional industry. It is probable that in the future a decision will need to be taken to pursue either excellence (and to measure and set resources against achieving it) or to orient the knowledge production system toward the needs of the regional economy.

Re-assess the dominance of academia: Perhaps more importantly, it might be said that the regional planning focuses far too much on academia and high tech and science and technology in general as the solution to the continued prosperity of the region in the longer term. In this they follow the orthodoxy that only high tech will enable EU regions to compete in the world economies. However, this is a fairly limited idea of what innovation is and where it can take place and ignores examples of different types of innovation that are very close to home. The example of the Zara empire is a good one. Based in Galicia and using traditional local skills this clothing empire has brought prosperity back to an ailing region. The innovations behind the success are not 'high tech' in the sense captured in the regional innovation planning documents but are innovations fundamentally in supply chain management which are also the result of research, although mostly not lab based research. These business process innovations have had a very powerful effect very quickly in a regional economy. Innovation in a wide range of non-technology intensive sectors needs to be better highlighted as an issue and the same can be said for the whole topic of innovation in the service sector which is mostly overlooked.

4.3 Challenges and trends of the knowledge economy

Some challenges are well addressed:

- The PRI addresses a number of global trends in the knowledge economy. It recognises that regions must compete on knowledge intensive business and not simply on price as used to be the case in Spain, this is a major move forward in recent planning.
- The PRI also recognises the need for highly qualified citizens and for continuing education and, although these are issues for general education reform and outside of the scope of the plan, although the plan should make stronger calls for creating a more dynamic and demanding educational system at all levels
- The PRI proposes that a key to success is better links between business and research performers in public institutions and the improving the transfer agencies that facilitate this and this issue is clearly addressed in the text at many points and at all levels
- PRI recognises too, the need to improve business start up rates in key new tech areas and suggests some actions to help facilitate this and create a culture supportive or risk, although, once again, this may be a question of the wider culture that is beyond the scope of a government planning document, but at least they are gesturing in the right direction.
- IPR questions also play a key role in promoting the setting up of new knowledge intensive businesses and, again, the PRI refers to this as a key areas and responsibility of its transfer networks and innovation support facilities but cannot actually do very much more than clarify issues and support companies through the maze, but it shows excellent awareness of the role of IPR.

Others issues need better attention:

- Increasing the flexibility and mobility in the labour market increasing levels of trust and security for employees to encourage innovative ideas and make training possible. However, employment legislation is outside of the scope of the plan and, in fact, is beyond the scope of the Generalitat to control as it is a national level issues.
- The plan also doesn't focus enough on excellence and international benchmarking, it is too comfortable with local solutions and with perpetuating the *status quo* in the way research is carried out
- Aspects which are not covered in RTDI planning and probably should be bear on issues around what might be called the 'information infrastructure' i.e., issues such as computers per capita and penetration of internet connections into the home. Until earlier this year such issues were the responsibility of the Department of Universities, Research and the Information Society, but responsibility for the information society has now passed to the President's Office as part of horizontal policy making and it remains to be seen what profile it will have
- Knowledge based services are mostly overlooked, the paradigm is founded on ideas targeted at research based industry or manufacturing
- E-government is another of the aspects of policy that might have been more closely integrated in policy making for RTDI as the government is a key role model and can push development through procurement practices. There are policies in E-government as there are in information society issues but the RTDI policy is not welllinked to them.

Annex 1 Data and further illustrations of main points of text.

1.1 Evolution of business sector R&D spending by autonomous region

(Thousands of EUR, no data for 2002, source Spanish National Statistics Institute, INE)

Region	1997		1998		1999		2000		2001		2003		2004	
	R+D Spend	%												
Andalusia	94.076	4,77	150.869	6,14	137.476	5,29	177.431	5,78	149.510	4,58	344.246	7,75	312.062	6,41
Aragó	41.003	2,08	65.720	2,67	77.112	2,97	75.725	2,47	74.627	2,29	97.610	2,20	102.611	2,11
Astúries	19.590	0,99	29.488	1,20	31.266	1,20	56.352	1,84	41.525	1,27	46.415	1,04	50.854	1,05
Balears	853	0,04	7.815	0,32	5.219	0,20	4.274	0,14	4.058	0,12	6.903	0,16	11.458	0,24
Canàries	11.163	0,57	12.065	0,49	15.486	0,60	25.594	0,83	31.456	0,96	27.328	0,62	42.781	0,88
Cantàbria	8.665	0,44	29.832	1,21	15.847	0,61	8.993	0,29	18.376	0,56	16.615	0,37	17.584	0,36
Castella i Lleó	46.694	2,37	48.073	1,96	76.759	2,96	92.347	3,01	157.727	4,84	193.599	4,36	228.128	4,69
Castella La Manxa	61.778	3,13	53.916	2,19	33.605	1,29	76.478	2,49	26.678	0,82	46.980	1,06	51.846	1,07
Catalunya	553.615	28,09	687.627	27,98	755.927	29,11	850.192	27,70	891.458	27,34	1.243.740	27,99	1.393.324	28,64
Extremadura	1.550	0,08	6.002	0,24	7.412	0,29	14.946	0,49	6.443	0,20	10.121	0,23	18.246	0,38
Galícia	36.677	1,86	48.456	1,97	50.168	1,93	67.230	2,19	65.996	2,02	135.478	3,05	137.619	2,83
Madrid	679.513	34,48	776.242	31,59	850.867	32,76	954.488	31,10	1.095.530	33,59	1.332.604	29,99	1.383.217	28,43
Múrcia	23.384	1,19	25.685	1,05	35.333	1,36	45.165	1,47	47.558	1,46	58.815	1,32	52.184	1,07
Navarra	34.122	1,73	47.390	1,93	58.192	2,24	61.814	2,01	79.936	2,45	128.268	2,89	166.778	3,43
País Basc	279.320	14,17	332.288	13,52	324.496	12,49	359.375	11,71	434.301	13,32	511.872	11,52	616.035	12,66
País Valencià	72.426	3,67	123.882	5,04	111.097	4,28	181.831	5,92	122.060	3,74	219.419	4,94	253.166	5,20
Rioja	6.425	0,33	11.831	0,48	10.836	0,42	16.761	0,55	13.793	0,42	23.355	0,53	26.901	0,55
Ceuta i Melilla	-	-	-	-	-	-	-	-	-	-	71	0,00	136	0,00
TOTAL	1.970.852	100	2.457.181	100	2.597.097	100	3.068.994	100	3.261.031	100	4.443.438	100	4.864.930	100

1.2 Evolution of higher education sector R&D spending by autonomous region

(Thousands of EUR, no data for 2002, source Spanish National Statistics Institute, INE)

Region	1997		1998		1999		2000		2001		2003		2004	
	Spend on R+D	%												
Andalusia	228.351	17,27	227.241	15,80	240.497	15,98	259.897	15,34	269.030	13,97	403.997	16,21	390.418	14,78
Aragó	29.263	2,21	30.840	2,14	32.674	2,17	36.555	2,16	37.486	1,95	46.932	1,88	40.823	1,55
Astúries	30.351	2,30	28.194	1,96	30.476	2,03	40.320	2,38	40.735	2,12	49.321	1,98	46.055	1,74
Balears	17.608	1,33	19.748	1,37	20.000	1,33	22.897	1,35	26.462	1,37	31.318	1,26	32.190	1,22
Canàries	51.087	3,86	67.764	4,71	62.633	4,16	65.931	3,89	74.197	3,85	98.800	3,96	107.648	4,08
Cantàbria	16.320	1,23	14.575	1,01	15.209	1,01	16.067	0,95	16.375	0,85	16.127	0,65	17.534	0,66
Castella i Lleó	85.869	6,50	92.060	6,40	101.655	6,76	110.911	6,55	116.785	6,07	139.881	5,61	159.231	6,03
Castella La Manxa	19.112	1,45	28.222	1,96	24.015	1,60	31.355	1,85	34.164	1,77	46.771	1,88	47.979	1,82
Catalunya	213.351	16,14	279.611	19,44	264.638	17,59	304.412	17,97	331.241	17,20	456.387	18,31	511.232	19,35
Extremadura	24.556	1,86	25.078	1,74	23.900	1,59	28.318	1,67	46.141	2,40	55.285	2,22	23.800	0,90
Galícia	74.979	5,67	75.138	5,22	83.736	5,57	105.145	6,21	135.965	7,06	161.874	6,50	170.014	6,44
Madrid	252.085	19,07	259.422	18,03	278.126	18,49	301.160	17,78	343.839	17,86	412.445	16,55	419.220	15,87
Múrcia	23.818	1,80	27.714	1,93	29.367	1,95	42.146	2,49	38.280	1,99	55.101	2,21	59.349	2,25
Navarra	26.625	2,01	27.085	1,88	31.304	2,08	30.648	1,81	33.072	1,72	41.534	1,67	77.210	2,92
País Basc	67.578	5,11	71.994	5,00	76.133	5,06	84.718	5,00	100.581	5,22	129.487	5,20	132.345	5,01
País Valencià	155.101	11,73	157.498	10,95	182.609	12,14	204.840	12,09	273.379	14,20	336.374	13,50	394.893	14,95
Rioja	5.878	0,44	6.485	0,45	7.629	0,51	8.561	0,51	7.627	0,40	8.774	0,35	9.507	0,36
Ceuta i Melilla	-	-	-	-	-	-	-	-	-	-	1.553	0,06	2.205	0,08
TOTAL	1.321.931	100	1.438.667	100	1.504.601	100	1.693.882	100	1.925.357	100	2.491.959	100	2.641.653	100

1.3 The Catalan Universities (source: Catalan Statistics Institute IDESCAT)

The Catalan Universities	Full time academic staff numbers 04-05	Students enrolled (not doctoral) 04-05
University of Barcelona (UB)	4.230	56.111
Autonomous University of Barcelona (UAB)	2.908	38.117
Polytechnic University of Catalonia (UPC)	2.525	33.242
University Pompeu Fabra (UPF)	841	10.213
University of Girona (UdG)	959	12.680
University of Lleida (UdL)	732	8.425
University Rovira i Virgili (URV)	1.098	11.962
Open University of Catalonia (public/private)	134	33.996
Ramon Llull University (private) (URL)	1.190	13.140
University of Vic (private) (UVIC)	474	5.113
International University of Catalonia (private) (UIC)	331	2.406
Abat Oliba University (private) (UAO)	67	564

1.4 The Growth of the Catalan University System 1985-2003 (source DURSI)

Number of Universities	1986	2003
	3	12
Courses Offered	1986/7	2002/3
	35	160
Floor space (area) of university buildings (m²)	1985	2001
	580,983	1,636,544
Funds transferred to public universities (1000EUR)	1995	2002
	367,351	517,108
Total number of students	1982/3	2002/3
	105,706	221,417
R&D funding in public universities (1000EUR)	1993	2000
	82,909	150,331

1.5 The Spanish National Research Centres in Catalonia

(source Plan for Innovation and Research 2005-2008 PRI)

National Research Centres in Catalonia
Mediterranean Centre for Maritime and Environment
National Microelectronics Centre
Centre for Advanced Studies of Blanes
Milà i Fontanals Institution
Institute for Economic Analysis
Institute for Space Studies of Catalonia
Institute for Biomedical Research of Barcelona
Josep Pascual Vila Institute for Chemical and Environmental Research of Barcelona
Artificial Intelligence Research Institute
Institute for Molecular Biology of Barcelona
Botanical Institute of Barcelona
Institute for Materials Science of Barcelona
Jaumen Almera Institute of Earth Sciences
Institute of Robotics and Industrial Informatics
Ebro Observatory

1.5 Student Numbers (source: Catalan Statistics Institute IDESCAT)

2004/05	Catalonia	Spain	% Cat/Spain
University Students (1000)	221	1 463	15.1
Humanities	22	134	16.8
Social Science	107	720	14.9
Science	16	106	15.5
Health	18	117	15.8
Engineering and architecture	57	386	14.7

1.6 Knowledge Production: Doctorates (source: Catalan Statistics Institute IDESCAT)

Doctorates awarded '04-'05	Sciences	Health Sciences	Social Sciences	Humanities	Engineering & architecture	Total
University of Barcelona (UB)	145	151	114	89	2	501
Autonomous University of Barcelona (UAB)	80	97	83	31	19	310
Politechnic University of Catalonia (UPC)	24	0	8	0	165	197
University Pompeu Fabra (UPF)	0	16	28	21	5	70
University of Girona (UdG)	24	0	5	3	8	40
University of Lleida (UdL)	4	3	8	6	16	37
University Rovira i Virgili (URV)	22	10	10	12	8	62
Open University of Catalonia (public/private)	0	0	1	0	0	1
Ramon Llull University (private) (URL)	5	1	26	2	6	40
University of Vic (private) (UVIC)	0	0	0	0	0	0
International University of Catalonia (private) (UIC)	0	5	0	8	0	11
Abat Oliba University (private) (UAO)	00	0	0	0	0	0
Total	304	283	283	170	229	1.269

1.7 Knowledge Production: Doctorates (Time Series) (Source: DURSI, 2004)

	1995/6	1996/7	1997/8	1998/9	1999/2000	2000/01	2001/02	2002/03
Humanities	177	131	167	164	171	161	155	167
Sciences	286	328	335	271	258	299	303	300
Health Science	246	223	254	188	265	261	232	258
Social Sciences	116	145	154	159	198	203	263	242
Engineering and Architecture	79	114	146	121	168	168	205	233
Total	904	941	1.056	903	1.060	1.092	1.158	1.200

('Sciences' are physics, geology, maths, chemistry, statistics)

1.8 Biocat, the Catalan bioregion network

There are 200 research group on life sciences, approximately 32.000 students in these fields and a network of hospitals which are among the leading research hospitals in Spain. There is a network of research centres in the key fields, (genomics, chemistry, nanobioengineering etc.), a network of support services, 11 science parks and 40 biotech companies as well as over 60% of Spanish chemicals production. In biomedicine and life sciences the University of Barcelona is the leader in Spain in terms of publications with 6.872 documents produced between 1994 and 2002 with 66.084 citations. In the same period, the closest rival the University Complutense in Madrid published 5.221 articles in this field and achieved 41.676 citations. During the same period Catalan hospitals took the top three places in terms of publications in biomedicine and life sciences with the Hospital Clínic Provincial of Barcelona dominating the field with twice as many publications as its nearest rival (4.070 publications with 42.564 citations). However, despite this sustained growth in the number of publications, the ratio of citations per document remains below the international average and, in fact, the number of publications itself, while impressive remains below the European countries average⁶⁷ In terms of companies in this field, 46% of Spanish pharmaceutical companies are located in Catalonia accounting for 60% of national production. There are 163 pharma labs with 17 national and 10 multinational R&D centres. In fine chemistry there are 32 companies (21 national and 11 multinationals) accounting for two thirds of the Spanish total production of pharmaceutical raw materials, 80% of which goes for export. Biotech is a small but growing sector here with 40 of the 150 companies in Spain. Regarding patents, in 2001 at the European Patent Office, in the field of pharma/biotech there were 128 patents in Spain with 37 coming from the cluster in the Barcelona area Therefore, the pharma/chemical/bio sectors in the Biocat cluster is one of the very few areas in which all the forces in the innovation system come together in a coherent whole with a clear agenda to build on real regional advantages and concentrate effort.

⁶⁷ See, for this opinion on publications 'Bibliometric map of Spain 1994-2002: biomedicine and health sciences' Cami J et al Medicina Clinica 2005 Jan 29, 124 (3): 93-101

1.9 Publication data for Catalonia in sciences, absolute and relative figures 1996-2002.

Source: J. CAMÍ, E. SUÑÉN i R. MÉNDEZ-VÁSQUEZ, *Estudi bibliomètric de la producció científica a Catalunya, distribució per àrees temàtiques (Catalunya, 1981-2002)*, Barcelona, Institut Municipal d'Investigació Mèdica i Universitat Pompeu Fabra, 2004

	Indicat or	1996	1997	1998	1999	2000	2001	2002
Biomedicine and Health Sciences	DOC	2.128	2.263	2.419	2.479	2.706	2.687	2.505
	CIT	8.829*	10.265*	13.133*	14.003*	15.155	6.234	933
	%NC	29	26	25	23	23	39	80
	%INT	26.5	23.4	27.8	27.6	29.3	29.4	31.3
	CD	4.15	4.54	5.43	5.65	5.60	2.32	0.37
Sciences	IC	1.04	1.14	1.37	1.42	1.41	0.58	0.09
	DOC	1.983	2.232	2.236	2.415	2.424	2.595	2.390
	CIT	7.338*	7.769*	9.106*	9.705*	9.546*	4.165	838
	%NC	26	27	25	27	26	45	81
	%NIT	37.0	38.8	41.3	41.5	43.7	41.8	46.0
Engineering, computing, technology	CD	3.70	3.48	4.07	4.02	3.94	1.61	0.35
	IC	1.12	1.05	1.23	1.21	1.19	0.48	0.11
	DOC	522	639	733	813	913	823	756
	CIT	1.082*	1.337*	1.453*	1.717*	1.654*	627	106
	%NC	43	40	46	45	49	66	90
	%NIT	28.9	28.3	31.0	33.9	31.7	36.6	41.9
	CD	2.07	2.09	1.98	2.11	1.81	0.76	0.14
	IC	1.08	1.09	1.03	1.10	0.94	0.40	0.07

(DOC: number of citable documents (articles, notes, conference papers and revisions); CIT: number of citations *(window of citation of three years between '96 and 2000, only citations made in year of publication and two years previously); %NC: percentage of documents not cited; %INT: percentage of documents in international collaboration; CD: quotient of citations per document (average citation); IC (index of citation); CD actual/CD total for field.)

1.10 Educational Levels (source: PRI, Generalitat de Catalunya)

Educational level of population between ages 25 and 64	Percentage of population at each level		
	Low	Intermediate	High
Catalonia	58	18	24
Germany	17	60	23
Korea	32	44	24
Unites States	12	51	37
Finland	26	42	32
Ireland	42	22	36
Japan	17	49	34
United Kingdom	37	37	26

1.11 The Action Lines and Priority Areas of the National Plan for Scientific Research, Development and Technological Innovation 2004-2007

The plan sets out a number of action lines including: fiscal incentives including larger direct deductions for RDTI efforts and increased deductions for patent and license applications; stimulate the creation of new technology based companies by strengthening the network of business incubators and venture capital; strengthening the role of science parks and technology transfer offices, with a particular emphasis on new expertise in IPR; human resources, increase the ratio of researchers to five for every thousand economically active citizens, in particular through the doctoral placement and support programmes Ramón y Cajal and Torres Quevedo and through new programmes aimed at new and established researchers and bring the numbers of private sector researchers up above the current level of 29% of the total; improve employment contracts and prospects for researchers; horizontal actions in basic research underpinning work in all scientific fields such as building new major facilities, creating new international programmes and promoting scientific culture.

There are a number of focused priority areas which are implemented through national programmes and sub-programmes and from which the various actors (universities, technology centres, companies etc.) can draw funding for activities in the different modalities such as RDTI projects, human resources actions, complementary actions etc. These are funded differently, sometimes competitively by open call, sometimes under targeted programmes, sometimes by building new facilities, depending on stakeholder and activity type.

The plan also sets out a number of priority thematic areas in which combine different fields of basic research to solve key problems at national level, they are: Caring for Health and Well-Being – carried out through the national biomedicine, national health technology, national agro-food, national biodiversity, earth science and global change programmes; Sustainable Use of Natural Resources – through the national biodiversity, earth science and global change programme; Seeing More to Know More – work in optics, satellites, synchrotron through the national programme for facilities and infrastructure; Information society for everyone – through the national programmes for electronics and communications technologies, for IT and for information society services; Discovering More about the Origin of Humankind and the Universe – through the national programmes on fundamental biology, biodiversity, earth science and global change and the national astronomy and astrophysics programme; Technologies for Today and the Future – through the national materials programme, the national energy programme, the electronics and communications programme, the nanoscience and nanotechnology action and the tourism technology action; Personal and Collective Safety.

1.12 The Ten Objectives, Transversal and Complementary Actions of the PRI

The Ten Objectives of the PRI	
1	To expand the research and development base by attracting new talent and facilitating the entry of young researchers into the system
2	To build up universities, educational centres and infrastructures to the level required for advanced, high quality research and development activities
3	To continue fostering improvements in the quality of research conducted in Catalonia as a prerequisite for attaining full integration in the European Research Area
4	To foster the entrepreneurial spirit and the creation of technology based enterprises by increasing the number of joint programmes between universities, research centres and businesses and by promoting the transfer of technology and knowledge
5	To promote the entry of researchers and qualified human capital in to the private enterprise sector
6	To consolidate and unify the system of research, technology transfer and innovation in Catalonia
7	To augment the innovation capacities of businesses established in Catalonia and to foster internationalisation projects
8	To draw up specific sector based and technological strategies that will drive both the development of the economy and structural modifications in production related activities
9	To improve coordination between Catalan research and development policies and economic and cultural policies thereby making Catalonia a reference as far as policies on coordinated research and innovation support are concerned
10	To promote communication and publicise developments in science and technology so that society as a whole becomes fully aware of the importance of research, development and innovation

The Transversal Activities of the PRI	
1	Research support programme
2	Research staff programme
3	Research centres and infrastructure programme
4	Support programme for technology and knowledge transfer
5	Innovation promotion programme
6	Financial support programme

The Complementary Activities of the PRI	
1	Mobility, cooperation and internationalisation programme
2	Programme to promote and share scientific and technological culture
3	Programme to boost entrepreneurship
4	Initiative to encourage innovation in government
5	Programme to coordinate and attract state and European funds

1.13 Funding priorities for Generalitat Directorate for Research, CIRIT (Interdepartmental Council for Research and Technological Innovation) and AGAUR (Agency for the Management Assistance to Universities and Research). (Source DURSI. Millions of EUR)

	1997	1998	1999	2000	2001	2002	2003
1. Human Resources Programme	14.501	12.375	17.590	16.798	32.733	21.762	27.825
2. Programme for Research Centres	4.305	5.029	6.381	8.632	10.746	13.546	20.560
3. Infrastructure Programme	4.387	8.564	5.049	4.556	5.724	2.149	9.889
4. International Cooperation Programme	0.972	1.028	1.493	1.481	1.497	1.976	2.138
5. Technology Transfer Programme	1.114	1.393	2.157	1.571	0.121	0.536	0.485
6. Other Actions	2.153	2.894	2.993	5.985	5.401	11.786	11.477
<i>Total</i>	27.432	31.283	35.663	39.023	56.222	51.755	72.374

1.14 Economic Performance in detail for 2003 (source 'Catalonia in Figures', Generalitat de Catalunya)

Agriculture (2003)	Catalonia	Spain	EU-25
Agricultural output (million EUR)	3.679	39.009	294.826
crop (%)	38.5	61.4	56.6
animal(%)	58.2	34.6	43.4
Milk production (1.000 t)	653	6.632	147.758
	Catalonia	Spain	%Cat/Spain
Meat production	1.653	5.596	29.5
bovines (%)	8.1	12.6	19
pigs (%)	67.0	57.0	34.7
sheep and goats (%)	1.7	4.5	11.0
poultry (%)	21.6	23.8	26.7
Industry (2003)			
Turnover (million EUR)	115.707	460.250	25.1
energy and water (%)	6.5	13.8	11.9
mining (%)	12.7	17.4	18.4
chemicals (%)	15.9	8.5	46.9
machinery (%)	25.9	24.0	27.2
food products (%)	15.4	16.8	23.0
leather and textile (%)	7.3	4.8	38.0
paper and publishing (%)	7.7	5.8	33.3
others (%)	8.4	8.8	24.0

1.15 The History of cluster policy in Catalonia

Cluster policy has a long history in Catalonia. In the mid-nineties clusters studies were performed in many sectors part funded by public money. Part of the popularity of this policy was due to the close contacts between the then minister for industry and Michael Porter's team in the USA who were then developing this analytical technique. Between the mid nineties peak period of activity and until very recently 'clusters' were continually in the background of policy thinking and often referred to but it has been difficult to trace exactly what was done in term of policy making and activities in relation to the clusters identified. There seems to be a shortage of public information about the cluster

work and it appears as if lots of the data may now reside with the consulting firm that carried out the studies in the sectors initially in the mid-nineties and over the years since then. However, recently (2005), the government (Industry Ministry of the Generalitat) has founded a new institute, the Observatory of Industrial Foresight, which is once again beginning to focusing its energies on the question of clusters and sub-clusters. According to a recent Observatory publication, Catalonia is home to 42 industrial clusters. According to this publication, these clusters account for 10% of the Catalan GDP and 26% of Catalan industrial establishments and employ 235.000 people. Another study 'Strategic Change and Clusters in Catalonia' identifies new microclusters which are grouped into five large skill clusters (health, tourism etc.) These microclusters include wooden toys in Osona, jewellery in Barcelona, meat industries in Girona etc.⁶⁸ The Observatory has started some practical work in at least one regional cluster (the metal sector around Ripoll) and some background studies have been undertaken. Additionally, there have been at least two very detailed analyses of regional clusters undertaken by the Industry Ministry. However, these very detailed documents do not form part of a clear policy platform, certainly not of one related to research. The motivation behind drawing up these elaborate studies is explained in the introduction to one of them: it is to provide further information about the Catalan economy to interested parties; to respond to EC demands that regions have better and more detailed understandings of their economies; it is done in the hope that it might help policy makers define actions to be taken in this area of policy. The introduction also acknowledges the partiality of its methods and accepts that had a different framework been placed over the data the different clusters and relationships would have been observed. This work is done as an input to learning and as a research project rather than as the foundation for policy making⁶⁹

1.16 FDI in Catalonia

In 2003 Barcelona attracted 90% of the FDI for the region, a total of 1.299 million EUR out of a total of 1.444 million EUR. 26% of the total investment comes from North America (USA and Canada), the rest, apart from 6% from 'other countries' and 1% from 'tax havens' comes from EU, with The Netherlands leading the way with 15% of the total, Italy with 13% and Germany with 11%. In terms of numbers of firms, 29% were German owned, 18% French and 12% from the USA, making a total of 59% from these three countries. Catalonia has established itself as a very favourable location for new international investments and in 2003 was second in Europe for the number of major international investments with 82, only Greater London has a greater number with 112. The principle areas of activity for foreign firms in Catalonia is automotive technology (13%), metalwork and machinery (13%), food and drink (11%) and the petrochemical and chemicals sector (10%). Overall, 22% of foreign companies are concentrated in high tech sectors. By activity types, 47% of foreign firms are carry out or are focused on marketing and commercialisation, 38% on production and 37% on logistics. Of the firms focused on production, 63% produce high tech products. Of all the firms in the region, only 13% carry out RDTI activities, and 14% design and/or engineering. In terms of turnover, there is a large number of companies below 6 million EUR per year (40%), while 32% turnover between 6 and 30 million EUR and 28% exceed 30 million EUR per year. Most (65%) employ fewer than 50 workers, in total 88% employ fewer than 250 (are SMEs) and 12% employ over 250. This is a change in the make up of foreign firms which up to now have tended to be multinational conglomerates rather than SMEs. Most RTDI takes place in firms with over 250 employees. 46.6% of these larger firms employ more than ten RTDI staff and they are mostly found in the pharmaceutical sector (where over 30% of firms employ more than ten RTDI staff), the automotive sector, chemicals and ICT sectors. However, when asked about the future, firms stated that they were least likely of all activities to establish RTDI or manufacturing units in Catalonia while they were most likely to most likely to set up logistics centres. Most foreign companies in Catalonia (65.7%) state that the principal market for their products and services are Spain and Catalonia while 19.2% say their main market is the rest of Europe and 13.7% the rest of the world⁷⁰.

1.17 Finance Market: Government support actions

Capital Gènesi is a CIDEM fund of 900.000 EUR (2005) to facilitate the creation of technology-based firms at pre-seed stage and funds such activities as business plans, financial analyses, market reports etc to a maximum of 20.000 EUR per firm at a rate of 100% of cost; Capital Concepte is a fund aimed at creating spin-offs from Catalan universities offering participatory loans to companies less than two years old of up to 100.000 EUR at market conditions but with no guarantees or collaterals, no commission and a four year repayment grace period, by 2004 69 new companies had been supported with over 6 million EUR; XIP is a network of private investors and business angels to offer a range of services to the suppliers and users of business finance through 12 sub-regional networks involving 137 entrepreneurs and 108 business angels (April 2005) with the aim of generating 40 million EUR of business angel investment by 2008 and 2000 firms assisted; there is a business angels school to encourage investors organised by the universities and; there are CIDEM's own venture funds, for example 'Invernova' which is a privately managed fund which made 7 investments for a total of over 4 million EUR in 2003. Additionally, there are now a wide range of financing options to consider for businesses at all stages of their development in the open market. For example there are 18 venture capital funds now active in the region.

1.18 Governance responsibilities at regional level

Catalonia has a degree of decentralisation from central government. In some areas it has complete control while in others it shares responsibility with central government in Madrid. In the following areas it has exclusive competence: organisation of institutions of the Generalitat; Catalan civil law; culture; research; heritage; town planning; tourism; transport; local administration etc. In all other areas it shares responsibility in varying degrees with the Spanish state government. The financial resources of the Generalitat come from three main sources: firstly, the part that comes directly from different percentages of the general taxes in Spain shared with central government, such as a 40% share of tax on tobacco in the region, 40% of the tax on alcohol, 35% of VAT, 33% of income tax; secondly, a transfer from the state to the region that is the difference between the necessary resources and the income provided by the income from the taxes mentioned in the previous point; thirdly, funds from the inter-territorial compensation fund, health system cohesion fund and the basic public services guarantee fund.

1.19 The question of 'systematicity' in Catalonia

'Systematicity' has become a watchword, almost a fetish in current thinking about regional innovation and it is clearly in the minds of those who drafted the PRI although no measure of systematicity is given or the lack of it nor any estimation made of what Catalonia might look like if it were more linked up. It is difficult to say simply because the region does not produce much leading edge university research or that the industry and university knowledge systems are not necessarily in strict harmony that this is *per se* a problem rather than, for example, a

⁶⁸ During the preparation of this report these studies have not been found and reference to them comes through the Catalan report of the E-Teams Interreg III project, 2005.

⁶⁹ Map of Local Industrial Production Systems in Catalonia, Generalitat of Catalonia, Department of Work and Industry, Secretariat of Industry, October 2005.

⁷⁰ Deloitte, Generalitat de Catalunya, Ajuntament de Barcelona 'Foreign Investment in the Barcelona Area', Barcelona, 2004.

characteristic of this system which, we must remember, is helping to produce EU average incomes and life quality for its citizens. Catalonia has always been a provincial place with hotspots of excellence and quality of life for its citizens at or just below European averages. For hundreds of years it has been powerful in Spain, but relatively unimportant in Europe and it will probably remain so for (in the absence of the thoroughgoing national overhaul of business and personal tax regimes, a revolution in the Spanish model of capitalism and its role to reorientate it towards a public rather than a purely personal or family process of wealth accumulation, a revolution in management, in the role of women at work etc.) a wide range of complex reasons regardless of government attempts to facilitate better linkages in the innovation system. In fact, it might be said that rather than being concerned about linking up the many and varied components of the system as it exists more attention should be paid to focusing effort on excellence in certain areas to create leadership in key fields and participate in international level activities, to 'raise the game' in areas where the region can excel, breaking away from local links to underperforming centres rather than reinforcing them in the same that it has been demonstrated that the worst way to for an unemployed person to find a job is to attend local support centres where they meet, unsurprisingly - other people without jobs (in fact, statistics show that the local bar is a better place for the unemployed person to spend their time although this will never be enshrined in policy). But linkage is currently seen as a dominant good thing in itself and absence of them problematised at regional level across Europe, as it is here in the PRI where its role should be seen more as an example of the dominance of this idea, of fashion in research governance, rather than as an example of a customised response to problems after all possible solutions, including no researched based ones, have been assessed. In fact, while the regional innovation systems (RIS) approach to regional development economics is quite dominant now in European regions, it remains a series of interesting propositions, perhaps less well founded theoretically than other more traditions economics approaches. While its application here in Catalonia is not by any means negative, far more research would have to be carried out on what specific problems current strategies are addressing, how they relate at system level and what a better system would like and what it would produce and how sustain itself, none of this basic work has been done and if the government were really thinking in systems terms it would have to devise systems planning methods, systems strategies and system level evaluations to make sure it was working towards systems objectives – it would be a fundamentally different paradigm of planning: it is not in place.

1.20 Number of People Employed by Company Size (Source: IDESCAT based on INE data) Figures are thousands of employees

Size (employees)	less than 20	20-49	50-99	100 +	Catalonia	Spain	%Cat/Esp
Food, drink and tobacco	15.8	13.2	8.8	39.4	77.3	376.4	20.5
Textiles, clothing, leather, shoes	26.2	16.3	10.8	19.3	72.6	244.7	29.7
Paper, graphic arts, publishing	19.5	12.6	7.3	19.1	58.4	194.7	30.0
Chemical industries	4.6	8.0	8.1	41.0	61.7	135.3	45.6
Metalwork and metal products	40.8	21.3	10.3	17.9	90.2	422.7	21.3
Machinery & mechanical equipment	13.8	13.8	8.1	14.1	49.8	190.2	26.2
Electrical machinery and devices	4.6	4.8	3.3	22.9	35.6	144.9	31.3
Transport materials	3.5	3.5	2.6	41.6	51.2	217.9	23.5

1.21 Percentage of Internet users among the total population independent of periodicity of use – comparison Catalonia and EU 15. (EU data from Eurobarometer, Catalan data from study 'The Network Society in Catalonia', Open University of Catalonia, 2003)

Country	Percentage of Users	
	2001	2006
Catalonia	34.6	
Denmark	70.3	75
Holland	68.6	85
Sweden	67.9	82
Finland	63.5	71
Austria	62.1	51
UK	56.9	56
Ireland	56	49
Germany	52.8	54
Luxembourg	46.4	63
Belgium	45.8	59
France	44.8	53
Spain	36.8	41
Italy	36.5	40
Portugal	33	27
Greece	16.8	24
Total EU 15	47.9	

Total EU 25		49
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1.22 The data collection grid for conclusions Section 2 graphic.

	1995 (or closest possible)	2004 (or closest possible)
Total intramural R&D expenditure as a percentage of GDP (Index; Country = 100)		
GERD		
BERD		
GOVERD		
HERD		
PNPERD		
R&D personnel as a percentage of total employment (Index, Country = 100)		
Total		
Business		
Government		
Higher education		
Private non-profit		
Human Resources in S&T as a percentage of labour force		
Total		
Patent applications at EPO per million inhabitants (Index, Country = 100)		
Total		
Students in tertiary education (ISCED 5+6) per thousand inhabitants (Index, Country = 100)		
Total		
Life Long Learning: Participation of adults aged 25-64 in education and training as a percentage of population (Index, Country = 100)		
Total		

1.23 Knowledge diffusion networks in Catalonia.

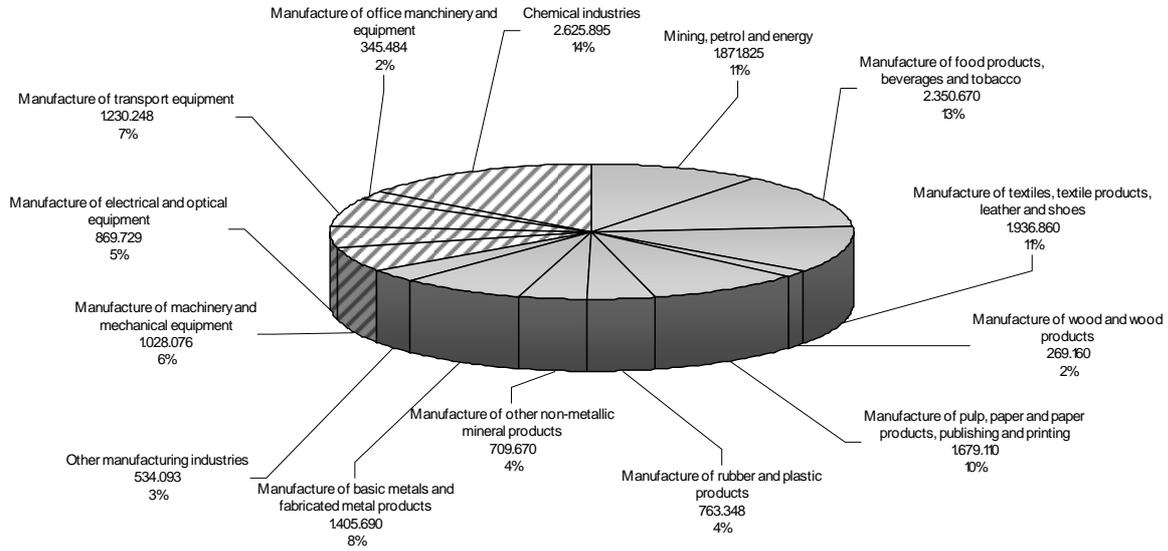
- The 'Network of Centres of Support to Technological Innovation' (Xarxa IT) is formed by units and groups of researchers with the capacity to offer innovation services to Catalan companies. It offers the services of researchers who are most experienced in working with companies and who recognise the need to respond quickly to market opportunities. All the universities and relevant government units (it is mostly an initiative of CIDEM, the Catalan Investment Agency) are involved as providers and managers and over 900 companies have contracted with the network for assistance as of 2003 with 600.000 EUR of subcontracting, training and research taking place in 2003.⁷¹

⁷¹ Source, CIDEM, Generalitat de Catalunya.

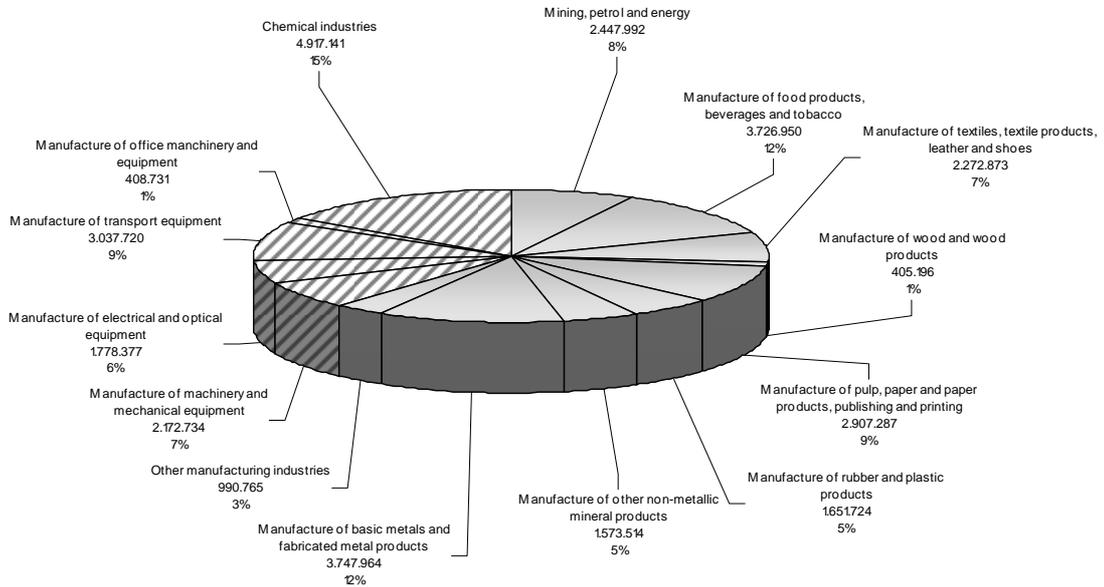
- The objective of the '**Technology Trampolines Network**' (XTT) is to create a network of units located in universities and business schools across the region to encourage the establishment of knowledge based companies from within the universities. Network staff help identify projects that could be exploited as companies, give courses on entrepreneurialism and hold competitions for the development of business plans etc. No data is available about the impact of this network.
- The '**Information Centres Network**' (PIC) of CIDEM is composed of a group of strategic allies focused on providing SMEs with essential information needed for carrying out their businesses and responds to user demand with programmes to help development links and supply chains. The services of the network are: help with innovation plans, catalysing and motivating clusters; piloting new management tools; piloting emerging technologies; promoting entrepreneurship; raising awareness of issues related to innovation and technology
- The '**Technology Advisor Network**' (XAT) is focused on the management of technological innovation in companies. The network is organised into 13 sectoral nodes and is delivered by chambers of commerce, specialist foundations, technology centres providing specialist advice to companies in project definition, information searches, partners searches.
- The '**Private Investors Network**' (XIP) is a programme designed by CIDEM to promote the growth of high potential innovative companies. It is a network of different existing investors networks which share a common code of good practice and work together to finance, advise and work with newly created companies during their early phase growth.
- The Ministry of Employment and Industry promotes the '**Technology Centres Network**' (XCT). There already exist a range of technology centres in the region and the objective of this network is to map and rationalise the existing offer and block any gaps that might be found to exist in existing provision. The participating centres will focus on applied research, precompetitive development and services and will be grouped according to their specialisation and national or international level of excellence so that depending on their size, level of knowledge and specialisation they are able to supply continuous support to their customers' innovation activities. Currently, there are seven major technology private and public not for profit centres involved in this network.
- XCDT is the '**Technology Dissemination Centres' Network**' created by the Ministry of Employment and Industry to promote technology transfer to help overcome an infrastructure deficit and overcome organisational problems in the Catalan innovation system. This network is based around a Registry which brings knowledge about all the science and technology organisations, their services and objectives, located in Catalonia into one place. The network is a not-for-profit organisation created on the back of demand from businesses in the region. It is aimed at improving company competitiveness by disseminating technology and providing technology services rather than carrying out research. The XCDT centres are characterised by their geographical proximity to their client base. Services include: promotion and dissemination of technology; information and assistance with innovation; training; advanced technology services. There are six centres in the network and they are dedicated to local business activities such as wine making, textiles, furniture making, and are located where these activities take place in the region.

1.24 Added value in Catalan industries.

Gross Value Added 1993
Thousands of Euros (Source: IDESCAT)
Patterned segments High-technology and medium-high technology industries

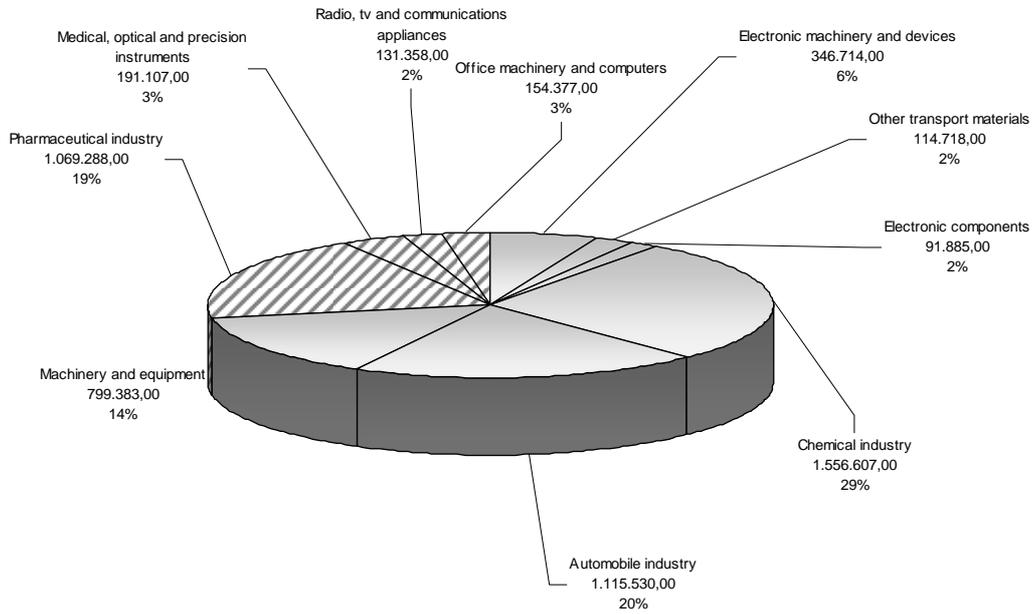


Gross Value Added 2004
Thousands of Euros (Source: IDESCAT)
Patterned segments High-technology and medium-high technology industries



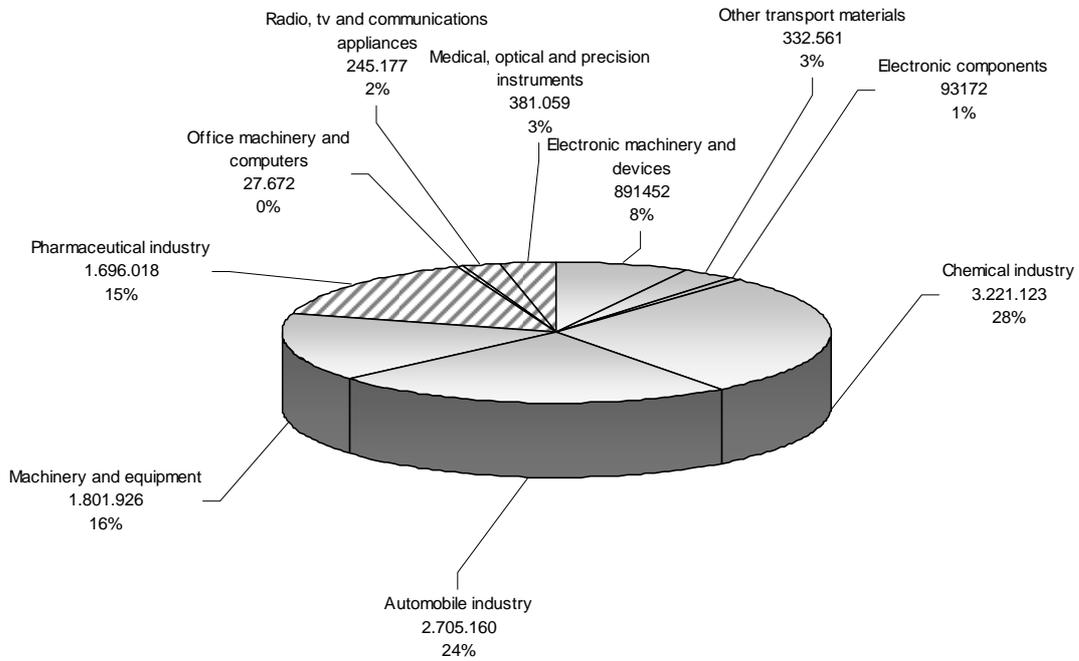
Added Value in Catalan medium-high and high tech industries in 1993

Thousands of Euros (Source: IDESCAT)
 Patterned segments High-technology Industries, remainder Medium-high -technology industries

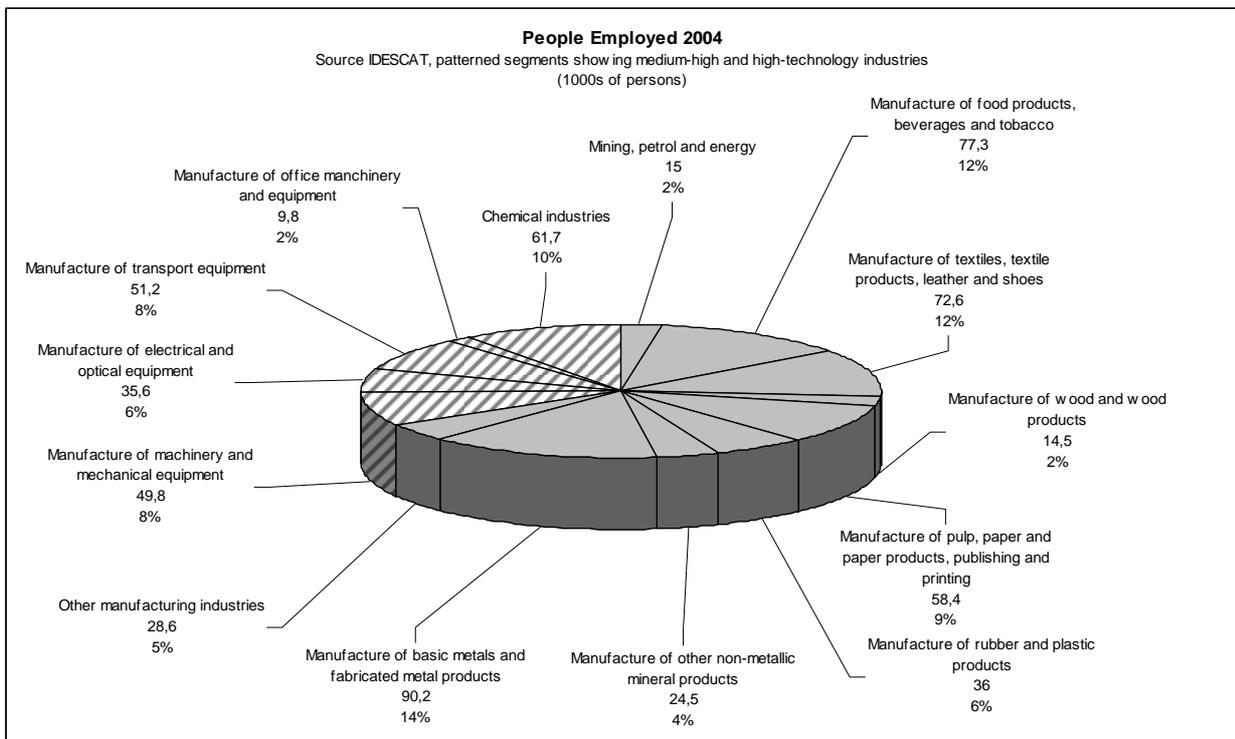
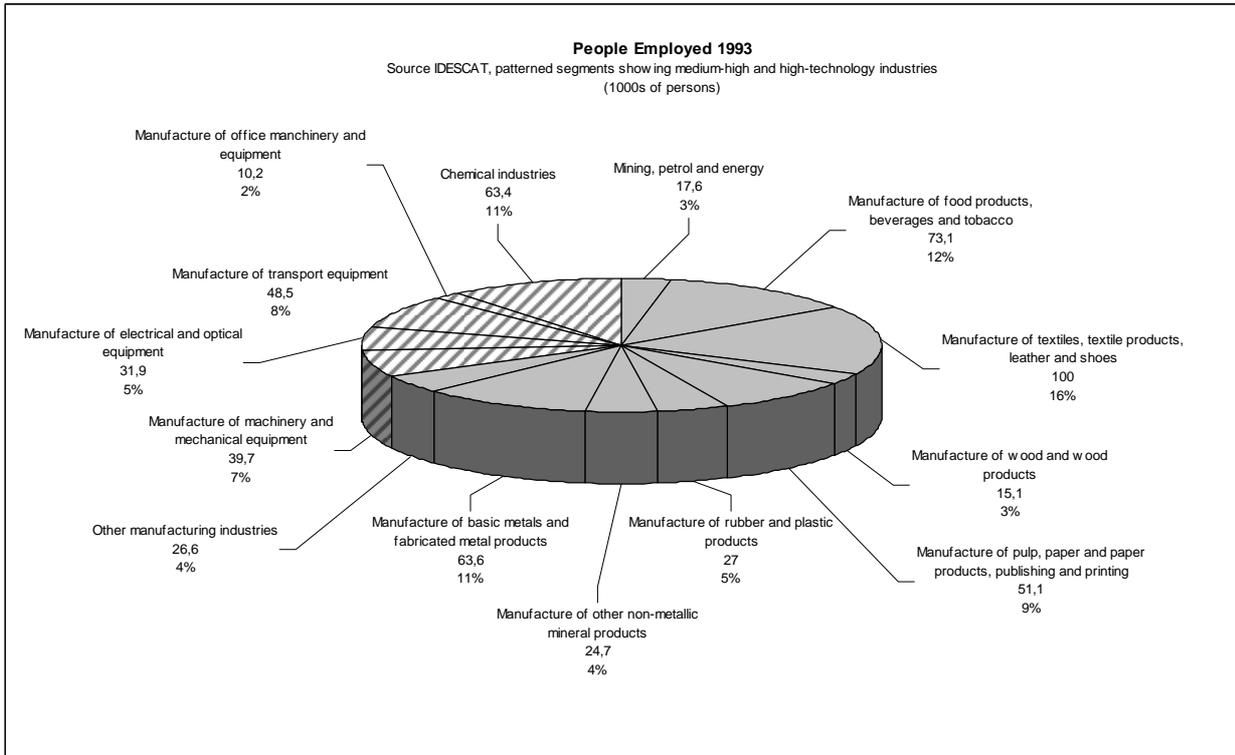


Added Value in Catalan medium-high and high tech industries in 2004

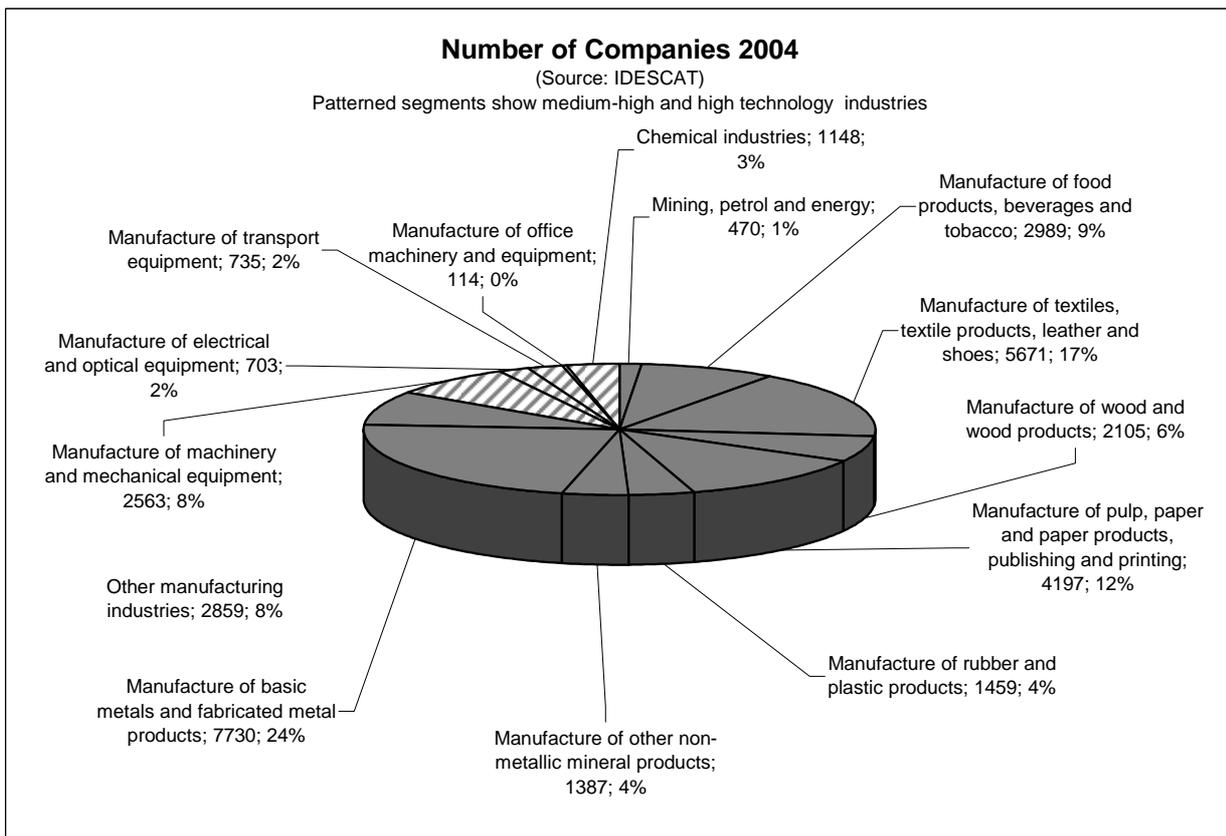
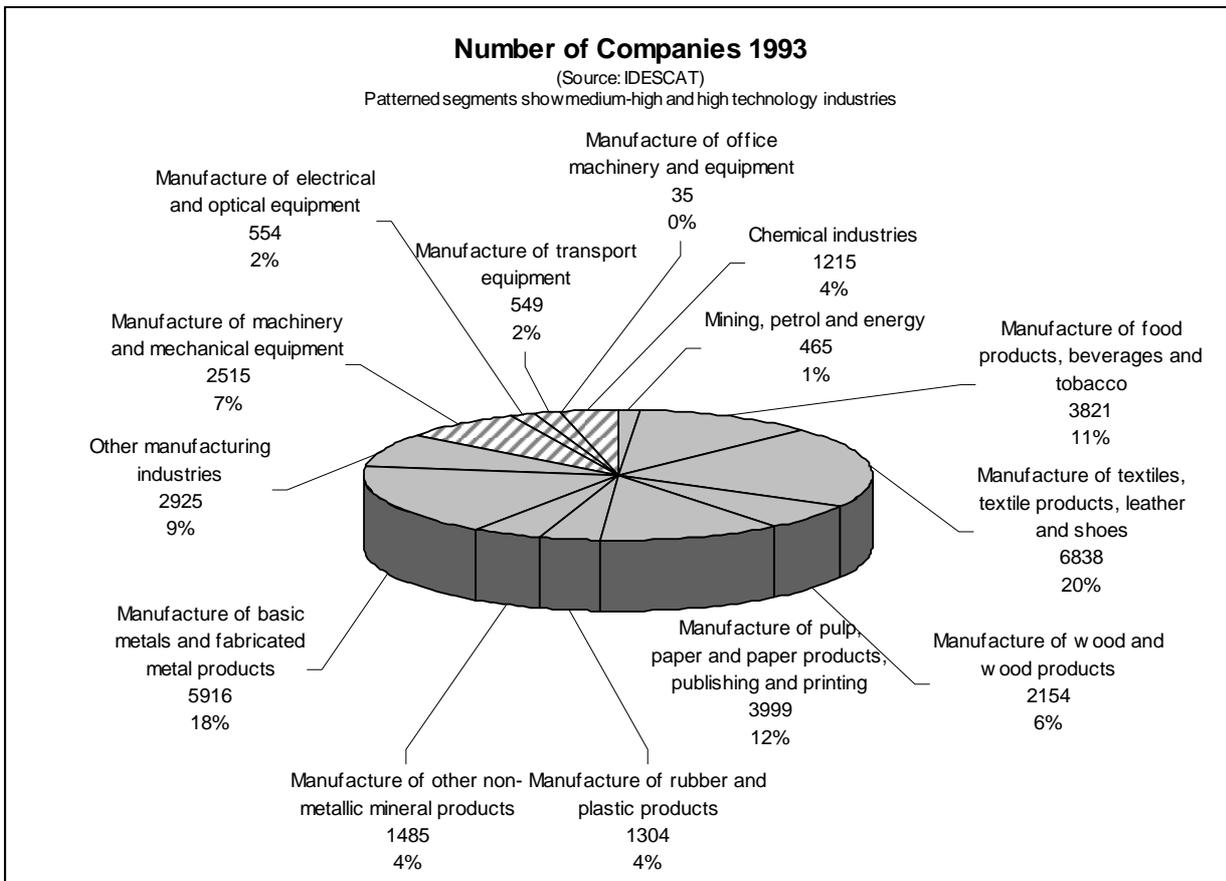
Thousands of Euros (Source: IDESCAT)
 Patterned segments High-technology Industries, remainder Medium-high -technology industries



1.25 People Employed



1.26 Number of Companies



**1.27 Investment by the Generalitat of Catalonia in R&D infrastructure (2001-2006):
eighteen examples.** (Source: Institut d'Estudis Catalans, 2004)

<i>Centres/Facilities</i>	<i>Investments either projected or executed 2001–2006 period</i>				
	<i>Completed 2001–02</i>	<i>Projected 2003–04</i>	<i>Sub-total 2001–04</i>	<i>Projected 2005–06</i>	<i>TOTAL 2001–06</i>
Research Centre for International Economics (<i>CREI</i>)	0.00	1.86	1.89	0.12	1.98
UdL – Agri-Food Centre (<i>UdL-IRTA</i>)	0.07	2.34	2.42	1.79	4.21
Animal Health Research Centre (<i>CReSA</i>)	4.33	9.95	14.28	0.84	15.12
Gene Regulation Centre (<i>CRG</i>)	5.93	2.23	8.16	4.47	12.62
Meat Technology Centre (<i>CTC</i>)	0.59	5.35	5.94	2.98	8.93
Telecommunications Technology Centre of Catalonia (<i>CTTC</i>)	0.62	8.80	9.42	4.90	14.32
Synchrotron Light Source	0.00	24.43	24.43	58.72	83.15
Catalan Institute for Classical Archaeology (<i>ICAC</i>)	0.06	1.69	1.75	1.00	2.75
Catalan Institute for Cardiovascular Sciences (<i>ICCC</i>)	1.97	7.30	9.28	0.66	9.94
Catalan Institute for Chemical Research (<i>ICIQ</i>)	3.78	20.54	24.32	3.84	28.16
Trias i Pujol Health Science Research Institute*	0.00	4.90	4.90	0.00	4.90
August Pi i Sunyer Biomedical Research Institute (<i>IDIBAPS</i>)	6.69	12.07	18.76	7.77	26.53
Photonic Science Institute (<i>ICFO</i>)	1.10	9.12	10.22	7.52	17.73
Geomatics Institute (<i>IG</i>)	0.53	1.91	2.44	0.21	2.64
Vall d'Hebron University Hospital Research Institute	2.14	2.27	4.40	0.00	4.40
Internet Interdisciplinary Institute (<i>IN3</i>)	1.73	7.48	9.21	1.20	10.41
Montsec Observatory-Universe Observation Centre (<i>OAM-COU</i>)	0.50	4.00	4.50	0.00	4.50
Barcelona Science Park (<i>PCB</i>)	31.77	2.94	34.71	0.00	34.71
<i>Total investment in building work and scientific equipment</i>	<i>61.82</i>	<i>129.18</i>	<i>191.00</i>	<i>96.02</i>	<i>287.01</i>
Subtotal investment in building work (including equipment and facilities)	36.28	77.33	113.61	30.41	144.02
Subtotal investment in scientific equipment	25.54	51.85	77.39	65.61	142.99
<i>Total investment in building work and scientific equipment</i>	<i>61.82</i>	<i>129.18</i>	<i>191.00</i>	<i>96.02</i>	<i>287.01</i>

* Investments allocated in 2003-2004 period correspond to years 2002-2004

Annex 2 Exhibits

Exhibit 1: RTDI policy mix affecting the region

Policy Areas	Policy objectives and instruments at National level affecting the region	Policy objectives and instruments at Regional* level
Improve innovation and R&D governance	National Plan weak on anything but <i>ex ante</i> evaluations of proposals. New 'Ingenio 2010' plan much stronger on new initiatives to embed evaluation at all stages of programme life cycle. Foresight carried out at national level and more recently in key sectors although no clear impact on policy making.	Regional plan (PRI) refers to evaluation but mostly as monitoring and management of implementation. Foresight not used at regional level. This area of policy, in general not well enough emphasised or recognised as key facilitator of regional system
Creation of an innovation and entrepreneurial friendly environment	The National Programme to Foster Business Competitiveness is a programme to strengthen the innovation system by funding initiatives that motivate the business sector to embark on new RDTI activities and to apply the results of basic research more effectively. This action will encourage more business RTDI actions by: improving access to the already very positive tax framework for research through a system of simple, binding certificates recognised by the tax authorities; raise the level of public procurement of knowledge intensive products to stimulate leading firms; industrial property scheme and the generation of Spanish patents, a range of actions to clarify IPR for public researchers who are involved in collaborations with industry and mechanisms for fostering a greater number of Spanish patents.	Complementary measure called the Entrepreneurial Support Programme which promotes direct action aimed at the creation of new knowledge based companies which will intervene at the earliest possible phase of business development This programme will reach its objectives by: strengthening the network of business incubators, centralising the management and coordinating the network of all such units across the region; enlarging and professionalizing the network of existing platforms (e.g., the Technology Trampolines, see above) improvement in concept stage capital funding, making it easier to access and making loans more freely available; the creation of seed funding instruments for implementation prior to concept capital as soon as the business is established, creation of a network of experienced business coaches; training in entrepreneurship reaching right down to secondary schools etc.
Development of human capital	Relevant programme is the National Programme on the Development of Human Resources. This programme works at three levels: to improve the take up of doctoral programmes in universities; to ensure the placement of doctorates in university research groups and that they continue to develop their careers; thirdly to vastly increase the numbers of doctorates employed in industry where the qualification has a very low profile and where research skills and knowledge are not highly valued. Activities in this programme include: ensuring more security and stability for doctoral students while they complete their research; to increase inter-institutional mobility of researchers; to spark demand for doctorates in business and the public sector by offering support to employers. A new emphasis has been given to this area under the Ingenio 2010 programme's CÉNIT sub-programme where new resources will be aimed at the Torres-Quevedo programme aimed at increasing the numbers of doctor employed in industry and in the CONSOLIDER sub-programme where the I3 action will integrate more qualified researchers into the public research centres	Human capital is highlighted in the PRI as a transverse measure which has objectives structured in the same way as at national level – promoting research and training of researchers, enabling more to start research careers and making them more stable and long term, encouraging the integration of doctorates into the innovation system at all levels but in particular in the private sector. The priority actions in this field are: instruments for the provision of employment and the consolidation of employment in both the public and private sectors; training for research support staff, in particular research technicians to facilitate the research process; ensuring equal opportunities for men and women. The instruments are: grants or funding for the employment of pre-docs as trainee researchers for up to four years in either public or private sector; contracts for post doctoral training in Catalonia for two years in the private sector or in a university other than the one where the candidate's thesis was presented; increasing the number of contracts at ICREA (Catalan Institute for Research and Advanced Studies) for both junior and senior researchers. The budget for this line over the four years of the plan will be 138. million EUR.
Networking, co-location and clustering measures	At national level activities under this heading take place mostly under the National Programme for Scientific and Technological Research Equipment and Infrastructure where science parks are promoted as a form of technological infrastructure alongside large scale scientific facilities.	At regional level there is much greater focus on networking and clustering measures. In fact, Catalonia, for many years in the mid-nineties cluster policies dominated the industrial policy making and more than twenty clusters were identified and to some extent supported by the regional government. Times have changed considerably since then and clusters are no longer the main thrust of policy making but are seen rather as very useful tools to be used in certain instances. Few clusters are now promoted by the government but the ones that are receive great attention. The most important recent example by a long margin is the Biocat cluster discussed above. This cluster builds on strengths in the Catalan research capacity in both the public and private sector and brings together all relevant ministries, universities, science parks and business to foster the development new business, promote existing companies, raise the standards of basic research and attract inward investment to the region in this key future area. Regarding networks, there are various initiatives for example, science parks and the Catalan Science and Technology Network (XACIT) will be promoted primarily through the transverse measure the Research Centres and Infrastructure Programme which has a total budget of 213 million EUR over four years, although it is not clear exactly how much of that will be dedicated to networking and clustering.

Knowledge and technology transfer to enterprises	<p>The Support for Business Competitiveness programme comprises activities to: create and foster new technology based companies, including new venture capital initiatives; support for the creation of new interface units that will provide assistance for recruitment of skilled professionals, standardisation and the certification of companies and the development of patents in both the public and private sectors; support for the creation of RDTI units in the private sector and support for the creation of joint centres involving companies and public sector research performers; support for the creation of a culture of innovation through studies, analyses and working groups to speed up the dissemination of an innovation culture in Spain.</p>	<p>Transverse Measure called Technology and Knowledge Transfer Support Programme. The main objective of this programme is to create technology transfer interfaces to facilitate technology transfer to the market and the subcontracting of technology by private sector enterprises from research centres. The activities in this programme are particularly aimed at SMEs which make up such a large proportion of the Catalan economy and have difficulties initiating and managing innovation activities. The ambitious objective of this programme is to design, coordinate and manage a systematic technology transfer model for Catalonia linking ministries, research performers with businesses and to overcome the currently fragmented offer of services in this field. Success will be measured by indicators such as the increase in business expenditure on R&D of GDP, the number of patents registered per million inhabitants, invoicing by university technology transfer centres to companies, new business creation from public research institutions etc. A new Technology Exploitation Centre will also be established to help identify emerging ideas and new technological opportunities into viable products and services.</p>
Research collaboration of public research organisations with private sector	<p>Programme: Support for Business Competitiveness where support for the creation of joint centres involving companies and scientific and technological agents is foreseen; and in the programme for Scientific and Technological Research Equipment and Infrastructure where science parks are proposed as a key shared collaborative activity alongside the construction of large-scale as well as medium sized facilities and technological platforms providing more and better scientific and technological research in priority areas and contributing to industrial and business development</p>	<p>A number of new medium to large scale research infrastructures have been build over the last decade and especially in since the year 2000 in a wide range of scientific fields. Some are the result of very close collaborations with industry, for example the Catalan Institute of Chemical Research (ICIQ) was opened in 2003 and has twenty three state of the art labs and is a not for profit foundation affiliated with a public university to award degrees. However, ICIQ was developed in very close partnership with a number of with the big multinational chemical firms present in the region and its stated aim is both to increase the quality of chemicals science in the region but also to facilitate innovation and increase the competitiveness of this key sector in the Catalan economy. The involvement of industry is clear in the make up of the Executive Board where four of the six members are senior industrialists. Other centres, for example the Genomic Regulation Centre (CRG) with less immediate industry relevance have a separate business consultancy board but are run largely by researchers.</p>
Support of public research	<p>There are nine high level priority areas ('life sciences', 'agro-food and environment', 'space, maths and physics', 'energy', 'chemicals, materials, design and industrial production', 'security and defence', 'information society technologies', 'transport and construction' 'humanities, social sciences and economics') and a number of sub-programmes under each main heading. The resources are allocated by the funding of large scale facilities, public calls, tendering for R&D services and joint applications from public/private consortia. The bulk of the 4792 thousand million euro was allocated in this way in 2005. While there are a range of initiatives to help stimulate commercialisation of research results, for example, new transfer centres and more staff, there appear to have been no regulatory changes to encourage this activity.</p>	<p>Infrastructure and centres and networks of excellence are funded through the Research Centres and Infrastructure programme funded with 213.276 over the four years of the PRI. Grants for R&D projects are allocated against the priority areas set out in the PRI (biomedicine and health sciences, ICT engineering, agro-food, social and cultural development, sustainable development and environment) and are administered by the programme management teams as block grants and competitive calls. But in general basic public research is mostly funded by central government resources and all the priority areas and also sectoral strategies for business will be funded with 122. million of Generalitat funding over the four years of the PRI.</p>
Financial R&D measures for the private sector	<p>In research to be undertaken in the National Plan priority areas there are three types of project. Research projects – mostly to be undertaken by public sector research institutions; technological development projects – to be undertaken by mixed teams of public and private researchers which can go as far as the creation of a non-commercial prototype; Technological innovation projects aimed at innovation in products, processes and services. Companies take part in the second and third type of project for which they make be funded with: conditional grants and credits covering the financial costs associated with a business action project together with the application of different types of credit facilities; repayable credit with low or zero interests and grace periods and a repayment obligation only if the activity funded is a technical success; equity stakes. Indirect actions include simplifying access to the already favourable regime of tax deductions for R&D work based around standardised reporting of research performed and accounting to make the laws simpler to understand and apply for users and tax authorities alike. Catalytic financial measures for the private sector at national level include: loan guarantee facilities thorough financial institutions and mutual guarantee societies to cover the loan requirements of technology innovation projects undertaken by the private sector stakeholders in activities across the priority areas.</p>	<p>At regional level private sector direct R&D measures are a key part of the PRI and priority areas for innovation in the private sector have been identified (production technologies, new materials, nanotechnology, ICTs, energy technologies, biotechnology) as these underpin the competitiveness of key regional sectors such as aerospace, biotechnology, pharmaceuticals, processed foods and renewable energies. Each priority area has a management committee comprising government, research and business stakeholders who allocate funding to projects with a priority on projects that go across technology disciplines and include a wide range of stakeholders. In fact, this list is not exclusive and all stakeholders are invited to bid in for funding. The funding to the private sector takes the form of direct grant funding to boost the level of research performance. The regional administration is also very active in the area of catalytic measures, specifically in the development of regional venture capital markets with the Financial Support Programme which aims to increase the participation of pension funds in capital risk markets, to increase the numbers of active private investors and network them making them more visible to customers. Catalytic actions in this area include the use of mutual guarantee companies and loan guarantee funds and participative loans to encourage growth in SMEs as an alternative to sourcing additional finance from a new partner). In this field, as in other, the Generalitat acts at local level to fill in the gaps that appear in the provisions of national plans and national legislation and provide focused solutions which are appropriate to the local economic context.</p>

Exhibit 2: Effects of policies complementary to RTDI instruments on R&D and innovation capacity of the region

Policy Areas	Policies complementary to RTDI instruments affecting policy area*	Effects on R&D and innovation capacity of the region
Improve innovation and R&D governance	No complementary policies beyond those described directed related to innovation system	No evidence
Creation of an innovation and entrepreneurial friendly environment	Fiscal policy very favourable to R&D investment	In principle these policies should facilitate greater spending on R&D. There is no evidence available about this topic.
Development of human capital	Education policy. Employment policy.	Recent OECD works finds Spanish investments at all levels of education significantly below OECD averages. Report from Jaume Bofill Foundation finds Catalan spending on education at 2.8% against OECD average of 5.9% GDP. Basic problems with supply of well educated citizens for knowledge economy. Employment law still rigid, difficult to be rapidly responsive to changing market opportunities/conditions. Workforce still have 'industrial age' expectations of long term employment, in particular in the large public sector. Hierarchical, family owned business structures stifle team work and initiative.
Networking, co-location and clustering measures	Active encouragement of FDI by industry ministry is key part of industry policy	See Annex 1, 1.6 for discussion of FDI in Catalonia, although there are no clear data on R&D and innovation capacity of the region
Knowledge and technology transfer to enterprises	No complementary policies beyond those described directly related to innovation system	No evidence
Research collaboration of public research organisations with private sector	No complementary policies beyond those described directly related to innovation system	No evidence
Support of public research	No complementary policies beyond those described directly related to research policy	No evidence
Financial R&D measures for the private sector	Fiscal incentives for R&D	No evidence

*[*Examples of such policies are the fiscal, industrial, regional, educational, labour, trade and competition policies.]*

Exhibit 3: Matching of knowledge and economic specialisation

Knowledge production in the region	Related economic sectors	Specialisation of the Regions' economy	Conclusions
Life sciences and biomedicine	Pharma Chemicals	Pharma, Chemicals	Life sciences and biomedicine capabilities knowledge users and producers well linked and will be increasingly in Biocat cluster/network initiative currently underway.
ICT Engineering	Services e-business	Services Tourism Aerospace	Underpinning research with few strong links between research and problem solving in industry
Agro alimentary sciences and technology	Agro-industry	Stockbreeding Fishing	IRTA is the Catalan gov't's own agriculture research institute and works closely with industry stakeholders
Social and cultural development	Underpinning action in all sectors of economy	Economics, tourism, educational research, governance	Lots of general activity in this area but not brought to bear on problem solving in structured way. Great potential here for work in process re-engineering, new governance structures, new management methods etc. These 'softer sciences' are much under utilised in planning and linking up the innovation system and should be highlighted more as they are key facilitators to reaching the other objectives in the regional plans.
Research in Sustainable development and Environment	Energy, construction, waste management and underpinning for all regional sectors	Renewable energy, house building and construction	Construction is a key economic driver with significant impact on the quality of life and environment in Catalonia, however, links between industry and research are unclear. Renewable energy, in particular wind power, is an important sector in Spain and Catalonia and the government plans to build better links between research and the companies in this field.
Organisational sciences	Cross cutting for all sectors		The PRI recognises that this area of research is key to improving the competitiveness of regional economy. However, no clear lines of research and transfer activity are outlined to get businesses to take up these new ideas and practices.
Nanotechnology	All sectors in future	All sectors in future	Set as a priority underpinning future technology area but not in relation to current needs or knowledge creation capacity.
Production Technologies	Underpinning all sectors	Underpinning all sectors	Set as a priority underpinning future technology area but not in relation to current needs or knowledge creation capacity.

Exhibit 4: Summary of strengths and weaknesses of the regional innovation system

	Strengths	Weaknesses
<i>Knowledge creation capacity</i>	<ul style="list-style-type: none"> Strongly endowed regional knowledge creation system, region well covered with science performing universities and non-university research centres, growing number of new specialised research institutes with international outlook Some 'hotspots' of excellence at international level, e.g., in biomedicine where researchers are highly productive Presence of large, internationally important industrial sectors such as pharmaceuticals and chemicals and car manufacture performing research has potential to spill over to local innovation system, although extent of this unknown 	<ul style="list-style-type: none"> Policy is to encourage work, of whatever quality, in as many fields as possible by spreading resources rather than focusing, in a certain light this means resources are spread too thinly Policy is academic, made mostly for and by academics, industry relevance is not a key driver and there are no incentives or rewards for most academics on bullet proof civil service 'tenure' to do it The universities are developing the reputation of being 'degree factories' creating civil servants, middle managers and consumers of high value goods not questioning, creative entrepreneurs 'Brain drain', many of the best researchers leave to find more opportunities elsewhere as institutions are often poorly funded very rigid and hierarchical. Small presence of high tech business, low rates of high tech innovation
<i>Knowledge diffusion capacity</i>	<ul style="list-style-type: none"> Region well supplied with TT offices in universities which are part of national network, with networks to encourage university spin-offs, with science parks, with sectoral technology centres, with international technology transfer offices in USA and Japan (COPCA and CIDEM offices) Strong publishing achievement in some key areas, biomedicine in particular, fair all-round publishing performance 	<ul style="list-style-type: none"> Diffusion not treated as specialised profession, staff are generally ill equipped for this role and come from the academic or administrative rather than business or consulting side Low degree of 'pull' from business side because of low levels of innovation and high tech business reduces demand for diffusion
<i>Knowledge absorption capacity</i>	<ul style="list-style-type: none"> Good production of doctorates, increasing levels of university education among workforce growing from a low base Promoting information society is on policy agenda to help with take up of knowledge intensive products and services New international businesses locating in Catalonia bring with them new ideas and business and managerial practice and access to international knowledge networks 	<ul style="list-style-type: none"> Weaknesses and under funding in basic education, high proportion of citizens educated only to basic levels compared with leading EU regions Increasing 'ghettoisation' of public schools system as immigration increases risk of marginalisation of incomers creating knowledge 'have nots' Poor take up of highly trained researchers in industry, it is believed that the status of doctorates outside of medicine is not highly valued

	<ul style="list-style-type: none"> • Strong traditional business networking in many sectors of family owned SMEs with generations of experience of dealing with technology change are a strong business foundation 	<ul style="list-style-type: none"> • 'Brain drain' of most talented researchers forced to seek opportunities elsewhere, discouraged by rigid institutions, insecure contracts and low salaries makes it difficult to incorporate leading edge international research ideas into ongoing work in universities and institutions in the region • Low levels of internet use retard development of and demand for knowledge based services and products at all levels of society⁷² • High levels of precarious temporary employment in all sectors, low salaries in all sectors, high degree of discrimination against women in the workplace, very low levels of workplace training and continuing education all lead to a demotivated, low productivity working culture that views constructive change and innovation as irrelevant
<p><i>Interactions of main actors</i></p>	<ul style="list-style-type: none"> • Regional research and innovation policy sets out to supplement and fill the gaps left at national level with flexible and appropriate regional programming focusing on human resources and relevant infrastructure development to maximise the impact of the larger research funding sources from national government • While still confusing and overlapping the relation between central government and the regional administration is a topic for urgent clarification on the research agenda on both sides • Ministries responsible for universities/research and innovation have linked up to set current research/innovation agenda • National, regional and local plans (particularly the planning for Barcelona) all stress the same priorities for the development of the knowledge based society and in principle have the potential to facilitate movement of ideas and activities from macro to micro level coherently • The potential for a highly linked and interactive system does exist here in latent form as there are nodes of a very wide range of disciplines in both research and intermediaries, there is the critical mass of actors and institutions to make it well connected and dense network. 	<ul style="list-style-type: none"> • There is a widespread perception that the system has a low level of interactions between the participants and this presupposition drives policy making to a large extent and is supported by the preponderance of public sector researchers over private sector which reflects the low levels of qualified researchers employed in business • The degree and extent of this weakness of interaction of the regional system is not well understood, there is no quantitative study of the extent of this problem, or even if it is in fact a problem and what benefits a solution might bring • Policy organised along ministerial lines of responsibility rather than aimed at addressing innovation as an issue affecting and influenced by a wide range of policies and responsibilities in the field of innovation should be shared between all ministries involved not kept as a research or industry issue
<p><i>RTDI governance capacity</i></p>	<ul style="list-style-type: none"> • The competencies at regional level, giving a regional minister some space for manoeuvre and the power structure at regional level, placing considerable discretion in the hands of the minister mean that a good minister can get things done quickly and implement an imaginative agenda and even enact new laws • There are outstanding researchers (often those with extensive international professional experience) in control of some research units and institutions • Long standing tradition now of making policy for research at regional level, process well embedded and document well recognised and widely used in government • The current iteration of the plan is the first combined effort for research and innovation linking two main ministries concerned • Ambitious plans to make Catalonia a leading innovative country, international reference points used although perhaps not always appropriate (e.g. Finland) • Some exposure to international ideas and policy practice through international networking. The current plan incorporates many features of the RIS/RITTS style of work e.g., the emphasis on internal linkages etc. • Intention to serve as wide a community of researchers as possible by providing an infrastructure of support open to all, a fair and equitable approach • The relationship between the region and the central government in this policy area is under active review and will be clarified and simplified in the coming years 	<ul style="list-style-type: none"> • The fact that ministries are very hierarchical places means that a minister who is not a strong leader and expert in the field brings the whole policy making edifice to a standstill causing widespread demotivation • Policy making is highly politicised, all senior policy makers are political appointees, even senior civil servants are shifted in or out of positions depending on political affiliation as ministers change, a change of minister means a massive change of personnel and a change of policy making long term policy and tacit skill development in policy teams very difficult • Some weakness in the levels professional expertise in research and innovation policy theory and practice, certainly in middle management and often right up to senior policy making level depending on minister in control • Some weakness in the levels of general managerial skills: improvements could be made in objective setting, resource planning, coordination of related units, search and selection practices, encouraging flexible project based team working, helping to overcome rigid pyramid organisational forms • Persistent tendency to see innovation through the lens of science and technology rather than widening the definition and including, for example, the role of dynamic consumer demand or services or traditional sectors, very much a 'white coat' modernist idea of the role of R&D in economic development • No widespread use of systematic problem identification, planning and management tools, so that it is at times difficult to identify the precise problems government is trying to solve, what good outcomes would be like and what quantifiable difference the activities are intended to make • Significant weakness in the use of systematic evaluation at ex ante, in term or ex post, almost impossible to say exactly what has worked, is working or what strategic objectives are in policy, no fit of policy to problems • Almost no understanding of technology assessment and foresight methods, Catalonia has been left behind in the use of this new paradigm of strategic tool

⁷² See Annex 1, 1.21

Exhibit 5: Identification of policy challenges

In the table below are the 'specific strategic lines of research for the productive sectors' identified in the PRI which, in the wide and general research base of Catalan knowledge producers are most clearly related to the concerns of industry. However, it does not appear that the areas have been identified as the result of detailed strengths, weaknesses, opportunities and threats analysis or on the basis specific regional problems to be solved which makes the completion of the following table rather difficult as no specific targeting of links between the different columns of the table underpin regional planning and nor, in general, are research capacities linked to economic sectors.

Policy challenge	Corroborating indicator	Inducement mechanisms	Effective approaches
<ul style="list-style-type: none"> Expand R&D base by attracting new talent and facilitating entry of young researchers into system 	<ul style="list-style-type: none"> Difficulty employing new staff flexibly Predominance of temporary contracts for research staff 	<ul style="list-style-type: none"> Serra i Hunter plan Focusing more funds on employing research staff 	Serra i Hunter plan to employ non-civil service staff on flexible regular labour contacts with performance based reviews and meritocratic career progress is very promising way forward.
<ul style="list-style-type: none"> Improve the R&D base by improving infrastructures 	<ul style="list-style-type: none"> Ensure region has the correct range of high quality infrastructure to meet strategic objectives 	<ul style="list-style-type: none"> Since 2000 have seen major new round of infrastructure building in key future technology areas 	New centres, linked with the new employment structures and outward looking employment policy, often working in English are a very promising dynamic aspect of the research and innovation system here. The new science and technology network (XACIT) will structure and link the existing components of the system.
<ul style="list-style-type: none"> Improve quality of research at all institutions 	<ul style="list-style-type: none"> Low level of patenting from universities Low level of citation impact of published papers Preponderance of biomedicine in publications and citations relative weakness elsewhere 	<ul style="list-style-type: none"> Attempts to put some loose priorities in place in the regional plan But prioritisation conflicts with the 'coffee for all' approach 	Must be a much more determined reduction in low quality research and focus on the better or more promising areas based on external evaluation of institutions, fields or departments. There needs to be a research evaluation exercise of some kind and it needs to be backed up by funding re-targeting.
<ul style="list-style-type: none"> Foster entrepreneurial spirit and creation of tech-based businesses 	<ul style="list-style-type: none"> Not enough new tech-based business start ups Too few spin-offs from research institutes 	<ul style="list-style-type: none"> Wide range of transfer mechanisms exist in particular the OTRI network Science parks are numerous and well networked 	No effective mechanisms have been found to engender this new spirit in Catalonia, the tradition of the 'entrepreneurial academic' does not exist here and will take a long time to foster. Improvements in general business conditions, bureaucracy and start up costs will need to be addressed but difficult to see how regional plans can address this national legal issue.
<ul style="list-style-type: none"> Get more researchers and highly qualified people into companies 	<ul style="list-style-type: none"> Low numbers of researchers in companies Dominance of public sector research compared with competitors Low level of respect for doctorates in private sector 	<ul style="list-style-type: none"> National schemes exist to subsidise salaries of researchers in companies (Torres Quevedo) New initiatives in the PRI to facilitate this objective. 	National schemes are considered to be success in terms of number of placements. Regionally there are now grants for study/work visits of two years outside Catalonia and a joint programme between the gov't. and business community in Catalonia to enable doctoral students to complete their thesis inside a company on a business relevant topic. However, no data about success of these regional measures to date.
<ul style="list-style-type: none"> Consolidate and unify the research, technology transfer and innovation system 	<ul style="list-style-type: none"> Perception that the various system stakeholders do not interact sufficiently or well 	<ul style="list-style-type: none"> Networks of research performers (XARXA IT and XARXA CT) Networks of technology transfer actors Network of intellectual property promoters 	All these initiatives are new or are yet to be kicked off, therefore, no data exist as to the efficacy or impact of this new work.
<ul style="list-style-type: none"> Augment business innovation and foster international projects 	<ul style="list-style-type: none"> Low levels of business innovation against EU average Perception that companies insufficiently internationalised 	<ul style="list-style-type: none"> Funding to business for ICT integration plans, innovation benchmarking, logistics and production, industrial research, R&D capacity building projects etc. 	Very significant funding is administered through CIDEM to business for RTDI projects, for example, in 2006 to date almost 21 million EUR has been dedicated to 443 ranging from 9 to 900 thousand EUR as of September '06. Preliminary, unofficial academic econometric studies of this funding up to 2000 suggest 'that most of the programmes have a positive and significant impact on the growth of value added value of the firms...' ⁷³
<ul style="list-style-type: none"> Develop specific sectoral and technological strategies in key sectors 	<ul style="list-style-type: none"> Key sectors underperforming Innovation systems in key sectors not integrated No strategic vision in key sectors 	<ul style="list-style-type: none"> Programmes to encourage strategic thinking, systematisation of innovation, incorporation of state of the art management tools. 	All these initiatives are new or are yet to be kicked off, therefore, no data exist as to the efficacy or impact of this new work
<ul style="list-style-type: none"> Coordinate R&D and social and cultural policies in government 	<ul style="list-style-type: none"> Poor integration between relevant policies and policy bodies 	<ul style="list-style-type: none"> Activities to improve coordination of all innovation related policy making 	No actions described specifically for this area of work, but the PRI plan itself is an example of innovative linking of previously separate ministries – universities and research with industry. So this approach is likely to be informal, internal but successful
<ul style="list-style-type: none"> Public understanding of science 	<ul style="list-style-type: none"> Low levels of public understanding of scientific issues Science and research and researchers not respected 	<ul style="list-style-type: none"> 'Science Week' is run annually by the FCRI (Catalan Foundation for Research and Innovation) Placement schemes for doctoral students and post docs in business 	The Science Week is a pioneering action in Spain and has now taken place for the last ten years. In 2005 there were over 360 events aimed at raising science awareness

⁷³ 'Evaluation of public subsidies oriented to firms' performance: a quasi-experimental approach'. Néstor Duch et al, 2004