ESPON

AMCER

ADVANCED MONITORING AND COORDINATION OF EU R&D POLICIES AT REGIONAL LEVEL

Targeted Analysis 2013/2/18

Synthesis of the territorial and R&D systems
of the nine case study regions involved in the project

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List of Abbreviations

AMCER	Advanced Monitoring and Coordination of EU R&D Policies at Regional Level
b	billion
BERD	Business Expenditures on R&D
BES	Business Enterprise Sector
EC	European Commission
EDP	Electronic Data Processing
EPO	European Patent Office
EU	European Union
FTE	Full Time Equivalent
GDP	Gross Domestic Product
GERD	Goss Expenditures on R&D
GOV	Government Sector
HES	Higher Education Sector
HRSTC	Human Resources in Science and Technology Core Stock
ICT	Information and Communication Technology
IS	Innovation System
ISCED	International Standard Classification of Education
m	million
MCS	Measurement, Control, and Steering
NIS	National Innovation System
NUTS	Nomenclature of Territorial Statistical Units
p.a.	per anno
PNP	Private Non Profit Sector
R&D	Research and Development
RIS	Regional Innovation System
RTDI	Research, Technological Development, and Innovation
SME	Small and medium-sized Enterprise
STI	Science, Technology, and Innovation

Executive Summary

The present report constitutes the result of component 1 of the project: ESPON Targeted Analysis Based on User Demand 2013/2/18: Advanced Monitoring and Coordination of EU R&D Policies at Regional Level (AMCER).

The **aim** of the AMCER project is to provide a framework for the analysis and monitoring of the impact of EU R&D policies at regional level, for creating strategic knowledge and building better synergies between regional and EU R&D policies.

The **overall objective** for the ESPON AMCER project is to study the participation of nine European regions in European R&D and innovation support programmes.

These **regions** are Lower Saxony, Tuscany, Andalusia, Catalonia, Brittany, Provence-Alpes Côte d'Azur (PACA), Ostrobothnia, Flanders, and East of England.

Within the AMCER project, the first component´s main goal is to provide general insights into the RTDI systems of the regions, by compiling a synthesis of the R&D systems and territorial challenges at the regional level for each of the nine case-study regions involved.

The component provides an overview of the situation in the nine regions and forms the basis for further analyses in the following components of the project which aim at consolidating relevant data on EU R&D Programmes in the regions involved in the project; developing a harmonised methodology for this purpose; analyse the impact of such programmes in the nine regions; and carry out inter-regional comparison of the results, at horizontal level (all R&D sectors taken together), and at the level of specific R&D sectors to be defined.

For its preparation, a comparative approach has been applied to the extent possible, while taking into account regional and national specificities. It is based on secondary data, reports, and expert information.

The report provides **overall findings** for each of the sectors reviewed, namely general socio-economic characteristics, the situation concerning RTDI, including human capital and the potential for innovation; RTDI governance and policies; public and private actors as well as the overall trends and challenges affecting the regional R&D systems.

It also provides **conclusions on the Regional Innovation System (RIS)** for each of the nine regions.

Main findings:

Regarding ***economic output***, the strongest regions are Flanders and Ostrobothnia, followed by Tuscany, PACA, East of England, Catalonia, Lower Saxony, Brittany, and Andalusia. Except for Andalusia, all regions are above the EU-27 per capita GDP average (see App. Tab. 3).

The regional ***economic structures*** and their specialisations vary. Although all regions are shaped by service activities, in some cases industrial sectors or industry-related services play a more significant role. This is the case for Catalonia, Ostrobothnia, Tuscany, Lower Saxony, Flanders and the East of England. Other regions are focussed rather on agriculture, tourism and related activities, and have little industrial tradition (e.g. Andalusia, Brittany, PACA) (see App. Tab. 4).

Except of Lower Saxony, all regions suffer from the rise of ***unemployment*** rates due to the ongoing economic and financial crisis. However, even though much of this increase arose from effects of the crisis, more specific unemployment figures such as long-term and youth unemployment suggest that in most regions there would be an urgent need to apply structural reforms (see App. Tab. 5).

R&D-related indicators indicate that East of England currently is the region where the R&D activity is most intensive among the AMCER regions. Other regions that are relatively active and above, or at least in line with, the EU average are Ostrobothnia, Lower Saxony, Flanders, and PACA. These regions already put a relatively strong emphasis on knowledge-driven development, at least in some key sectors. Brittany and Catalonia increasingly trying to foster their regional potentials, but suffer from structural weaknesses. Tuscany and Andalusia are the regions with the lowest R&D performance; even though also these regions have existing potentials (see App. Tab. 6). Moreover, East of England is by far the most *technologically sophisticated* region, followed by Flanders. Catalonia, Ostrobothnia, Brittany, PACA, and Lower Saxony are relatively medium-high to high-tech oriented. Tuscany and Andalusia have few technologically exposed sectors; however, most activities are in low-tech fields.

The education of the ***human capital*** forms the basis for productive and innovative activities. In general, there is not much difference in the relative numbers of tertiary level students. However, Ostrobothnia has a very marked advantage regarding the number of higher education students, whereas Lower Saxony has by far the lowest figures. Despite East of England´s rather average values in terms of human capital, the region benefits i.a. from the presence of an excellent HES (i.e. Cambridge University). The figures for early leavers generally show positive development. The Spanish regions have by far the highest share. Flanders and Brittany have the lowest figures. In addition, the further education of adults plays an important role. In this area, most regions have values below the European mean. The French regions PACA and Brittany have the lowest figures; whereas Ostrobothnia and East of England show by far the highest participation share (see App. Tab. 7).

Potentials for innovation are very unevenly distributed between the regions. The highest relative values are held by Ostrobothnia, Lower Saxony, Flanders, and East of England. Andalusia´s figures are very low, reflecting the region´s weaknesses in knowledge and technology creation, although some significant efforts have been undertaken. However, the productivity of R&D shows a more mixed picture: Brittany and Lower Saxony seem to have the most effective R&D system, whereas East of England´s and Andalusia´s R&D systems are relatively ineffective (see App. Tab. 8).

The regions show 3 main types of ***governance structures***, with some being more centrally-led (e.g. Ostrobothnia, East of England, Brittany, PACA), others with federal characteristics (Lower Saxony, Flanders) or a mixture of both (Andalusia, Catalonia, Tuscany). By depend-

ence on these structures, all regions follow some kind of RTDI policy support programmes. However, in general, the different structures are accompanied by different RIS approaches, with specific characteristics as well as related trends and challenges.

The share of ***public and private actors*** participation within the R&D systems varies, generally reflecting different economic or research setups (see App. Tab. 6). With regard to the innovation system approach, the proportion of R&D performed by the business sector (BERD) is an indicator of the overall innovative capacity of a region. The regions Ostrobothnia, East of England, Lower Saxony, Flanders, Brittany, Catalonia, and PACA are dominated by the business sphere. Nonetheless, also there the public sphere plays an important, often complementary role. Tuscany and Andalusia are much more shaped by the public sphere, as the business sector there is sufficient initiate and carry out RTDI activities by itself.

Within the business sector, ***large foreign and national companies*** often play a major role in the RTDI processes, although all the regional economies are ***greatly characterised by SMEs***. This is mainly due to underdeveloped business innovation cultures, limited absorptive capacities, and low emphases on technological aspects as well as other barriers limiting the efforts of SMEs to conduct R&D. This gap is problematic since SMEs are significant providers of employment and their RTDI activities can have a sustainable impact on regional competitiveness and wealth. In turn, in regions that are highly dependent on RTDI activities of MNEs and large national players (e.g. PACA, East of England, Lower Saxony, Ostrobothnia, Brittany, Flanders), this situation could lead to regional dependencies on location decisions of often globally (re-)acting companies. Additionally, some regions such as Brittany, PACA, Catalonia, and Andalusia are likely to suffer more from *headquarter bias* because big companies and research organisation often do not have their headquarters in these regions.

Trends and challenges: despite the current economic and financial crisis, the regions which have already managed to build up a knowledge-driven regional economy (at least to a certain degree) are likely to have better, more sustainable, and less volatile growth perspectives (e.g. Ostrobothnia, East of England, etc).
A further challenge is the rise of general unemployment and the long-term and youth unemployment figures that remain high in most of the regions (e.g. Catalonia, Andalusia, etc.). The population development and the Demographic Change are challenging all the regions studied. The regions are facing lower population growth, demographic ageing, and outmigration. The availability of human capital (secondary and tertiary education) is often satisfactory. However most regions are confronted with high numbers of early leavers and a low participation rate of adults in further education (e.g. Tuscany, PACA).
Furthermore, except East of England, all regions need to increase their R&D capabilities (some most urgently, such as Andalusia, Tuscany, Catalonia, and Brittany). Additional spending and personnel will help to strengthen the competitiveness of the regions in terms of knowledge and technology production. Moreover, in some regions (e.g. Andalusia, Tuscany, Lower Saxony) the structural change towards a more diversified and knowledge based economy has to be fostered. Existing potentials in high-tech sectors have to be strengthened. For this, SMEs play a crucial role. But so far, SMEs in the AMCER regions are not so strongly involved in innovation activities. Additionally, the link between businesses and research institutions is in some cases rather weak (e.g. Tuscany, Catalonia, Brittany, PACA, and Andalusia). More support is needed to support and encourage SMEs to conduct R&D.

Introduction

It is a well-established principle of the economic theory that in the long-term only *innovations* as well as the resulting technological progress ensure *sustainable, inclusive and smart growth*. From a theoretical perspective, the success of generating innovations depends on factors and framework conditions constituting territorial research and development (R&D) systems. As discovered by several ESPON studies, European Union (EU) R&D policies seem to have a substantial impact on regional R&D systems and territorial cohesion, both at a European level and in the regions.

Against the backdrop of the aims of Europe´s 2020 strategy, the European Commission (EC) aims to improve the impact of its funding programmes on more competitive R&D systems in regions.

The ESPON AMCER project can provide a significant contribution in this context by providing a model for a comprehensive analysis of the regional participation in EU R&D programme. The *high level objective* of the ESPON AMCER project is to study the participation of Lower Saxony, Tuscany, Andalusia, Catalonia, Brittany, Provence-Alpes Côte d'Azur (PACA), Ostrobothnia, Flanders, and East of England in European R&D and innovation support programmes in order to provide a *framework for the analysis and monitoring* of impacts of EU R&D policies at the regional level and its current coordination for the purpose of creating strategic knowledge for building better synergies between individual regional R&D policies and EU ones.

Within the AMCER project the *first component´s main goal* is to provide general insights into the RTDI systems in regions by compiling a synthesis of the R&D systems and territorial challenges at the regional level for each of the nine case-study regions involved.

Based on secondary data, reports, and expert information Component 1 therewith *gives an overview* about the regions and thus serves as a *basis for further analyses and interpretations* with respect to headquarter effects, regional clusters and specialisation, relations and cooperations (within the regions and among the actors) as well as with regard to the final impact assessments of R&D support programmes in the following components. Ultimately, complementary to the other components this report specifies the need of the EU and the regions to enhance monitoring of R&D funding, its outcomes as well as thereof resulting regional structures.

For the purpose to better understand the respective regions' features in a national and European context as well as to illustrate the heterogeneity among the AMCER regions, if possible, a comparative approach is applied. However, since the regions are showing great differences e.g. in size and population, direct comparisons would lead to reasonability and reliability distortions. On this account comparisons between the regions have always been put in these contexts.

To better understand the description of the regional R&D systems, the regions' socio-economic framework conditions have been outlined, showing that the regional economic areas with respect to their structures and performances are very heterogeneous. These differences can also be found for the regions' R&D systems.

Background:

a. Acknowledgement of the Relevance of Research & Development

EU R&D policies seem to have a substantial impact on regional R&D systems and territorial cohesion, both at a European level and inside regions. Several projects such as INTERREG projects (i.e. ERIK, RAPIDE, IMPACTSCAN, and INNOWATCH) and the PRO INNO

Europe® project INNO Appraisal have focused on regions and the innovation and knowledge economy and how policy can support this. Similarly, the Green Paper on the European Research Area (SEC (2007) 412) advocates addressing R&D investments from a wider economic and territorial development perspective.

The EC through its 2020 strategy (cf. EC 2011) for smart, sustainable and inclusive growth a vision of Europe's social market economy for the 21st century and the Innovation Unioninitiative, wishes to enhance the impact of its funding programmes' on more competitive R&D systems in regions. Similarly, the recent EC Communication "Regional Policy contributing to smart growth in Europe 2020" calls for effective action in this regard. The timing of the *Advanced Monitoring and Coordination of EU R&D Policies at the Regional Level* (AMCER) project is therefore very well chosen in order and may also constitute a significant contribution to the preparation of the Operational Programmes in the participating regions from 2014 onwards.

b. Request from the Regional Level

On behalf of the regions, there is often only a fragmented vision of the territorial impact of EU programmes such as the FP6/FP7 and the CIP on their territories. To monitor these issues, the regions are using generic national or European assessments and local empirical data.

Moreover, and despite the fact that regions often shelter multiple actors that are active in the R&D field, frequently regions lack strategic knowledge for building better synergies between their own policies and EU R&D support programmes (cf. ESPON 2006 thematic project 2.1.2, and the EATIA targeted analysis starting late 2010), on the one hand, and for developing effective regional innovation strategies that are able to get support from and serve the conjoint of available regional R&D and innovation actors, on the other. The latter has for instance been an item that the ESPON FOCI project looked into, and the ongoing KIT ESPON project (2010-2012) studies the territorial dimension of the innovation and knowledge economy.

At the same time, there is the issue of attributing R&D capacities, participations and benefits on behalf of regions (or Member States) to incorrect locations. This is the so-called 'headquarters effect'. This effect is partially a consequence of the political structures in Member States and the use of subsidiaries and dépendances (without their own legal seat) on behalf of the main research stakeholders in countries (e.g. large research organisms, large companies).

As a consequence, there is a growing need for reliable indicators to measure the impact of regional, national and European programmes on regional RTDI systems and economies. This need is further fuelled by the fact that:

- Regions are trying to perform their own European programme assessments by collecting information from local stakeholders.
- Such assessments are difficult to compare across regions since no common rules, terminologies and definitions have previously been defined for such evaluations.

It is clearly in the interest of regions that the available EU funds for R&D are well spent in order to create regional economic growth and employment as well as long term sustainable development on their territory. In this perspective, it is important for them to be able to coordinate their R&D policies with national and European ones. In parallel, it is also important for European and national authorities to set-up efficient coordination with the regions and to monitor their effects.

c. Problem Definition

While FP6/FP7 and the CIP are managed by the EC, the EU Regional policy is managed at national or regional levels, and most of the Operational Programmes of the EU Regional policy are implemented at the level of the regions.

Therefore, accurate knowledge about the current results and the impact of FP6/FP7 and CIP at regional level is useful, if not a sine qua non condition, for the coordination of the Operational Programmes of the EU Regional policy with the FP6/FP7 and CIP. It is also useful for the coordination between the EU Regional policy, FP6/FP7 and CIP, and R&D policies implemented by the regions and by national authorities.

However, data on the results and the impact of FP6/FP7 and CIP at regional level are today considerably lacking. Indeed, European databases about FP6/FP7 and CIP participants are generally not easily accessible by the regions, and are suffering from reliability problems in terms of actual geographical location of participants. Therefore, a large number of participants are artificially located in regions where headquarters of their organisations are located, and not in the regions where teams actually involved in the projects are working. Work done by some regions involved in the AMCER project showed that such mismatches could even concern more than 50% of projects in a given region.

Consequently, regions, but also national and European authorities, only have a fragmented overview of the increasing impact of FP6/FP7 and CIP at regional level, and lack the right tools to assess and monitor EU R&D investments in the regions. As a result, synergies between EU, national and regional policies are more difficult.

At their own initiative, several of the regions involved in the AMCER project have developed specific data on the results of FP6/FP7 and CIP on their territories, gaining thereby a key methodological experience useful to the project. The data they developed needs to be further developed and consolidated in the framework of the project. Such work should also enable the building of a harmonised methodology for the development of regionalised data on the results of FP6/FP7 and CIP projects at regional level. It should also enable the development of analysis on the impact of these EU funding sources for R&D in each of the regions involved in the project. Since previous ESPON studies, which worked on the topic of the territorial impact of R&D policies (cf. EATIA, FOCI, KIT, PROJECT 2.1.2), did not have the same regional focus as the AMCER project, and different methodological approaches have been applied as well as the impacts of EU R&D policies were grounded on rather qualitative assessments "where impacts were being felt and the level of significance of each of these" (PROJECT 2.1.2:165), the AMCER project has the potential to contribute both to the creation of a new *framework for the analysis and monitoring* of impacts of EU R&D policies at the regional level in a quantitative way, and to the *enhancement of the effectiveness* of funding programmes' impact on more competitive R&D systems in European regions. Moreover, regions, as well as national authorities can build better synergies between their policies and EU policies for R&D.

d. Objectives

In this context, the AMCER project will study the participation of Lower Saxony, Tuscany, Andalusia, Catalonia, Brittany, Provence-Alpes Côte d'Azur (PACA), Ostrobothnia, Flanders, and East of England in European R&D and innovation support programmes, in order to develop assessment tools to control for the headquarters effect of contracts data of the European Commission and measure the impact of EU R&D support programmes in a more correct way. Therewith the creation of strategic knowledge for building better synergies between individual regional R&D policies and EU ones will be accelerated.

The present report constitutes the results of component 1 of the AMCER project (2013/2/18 – part-financed by the EC through the ESPON programme). The overall objective of the first component within the AMCER project is to synthesise data about the territorial and R&D systems of the nine regions involved (see App. Fig. 1; Component Task 2.1.6). Thus, the first component gives an overview about the regions and forms the basis for further analyses. On the one side, it outlines the elaboration of the theoretical and analytical framework as well as the research approach of Component 1, and on the other side, presents the analyses of the AMCER regions. In the course of the analysis, there is also important to point

out the region-specific strengths and weaknesses as well as the existing diversity. In the meantime, the report gives a review of the main literature and data sources.

Methodological Framework

a. Theoretical Background

While there is consensus now that in the long-term only innovations as well as the supporting technological progress ensure economic prosperity (cf. BUSWELLS 1983; MALECKI 1997; OECD 2007), the question how innovations are created and what conditions must be met is widely discussed (cf. MACKINNON et al. 2002; MOULAERT/SEKIA 2003). The Neo-Schumpeterian Innovation Research sees innovation processes integrated into innovation systems and networks. Starting point of a systemic view of innovation and the innovation process is the recognition that technological know-how constitutes an important basis for innovation success that this know-how will be established in the context of learning and experimentation processes and that this can be understood as interactive, science policy, economic policy and socially embedded processes (cf. LI 2005).

The innovation system approach is a widespread and well-known theoretical concept in the field of Innovation Research. The actual concept is rooted in Friedrich List´s "The National System of Political Economy" (cf. LIST 1841). The breakthrough of the innovation system (IS) approach in Innovation Research is due to Christopher Freeman´s (1987) work on the economic development of Japan after the Second World War and the associated catch-up. Thereby, FREEMAN (1987) particularly accentuates the nation-state level and assumes a systemic connection between the catching-up process of Japanese companies and the innovation processes, innovation diffusion and economic, legal and social institutions and organizations in the country. He coined the concept of national innovation system (NIS). In consequence of several criticisms, especially those concerning the observed scale, a variety of other innovation system approaches emerged (cf. COOKE 1998a; FISCHER et al. 2001; BRESCHI/MALERBA 1998; CARLSSON/STANKIEWICZ 1991; CARLSSON/JACOBSSON 1997; MALERBA 2002).

Since the mid-1990s, attention to regional systems of R&D and innovation has increased. COOKE (1992) is the pioneer in the field of regional Innovation Research. He has examined the influence of regional processes on learning institutions and economic development in Japan, Germany, France and Great Britain and in that context emphasized the importance of regional innovation systems (RIS). The theory of regional innovation or R&D systems is indebted to the evolutionary theory of technical change (MOULAERT/SEKIA 2003). RIS can be defined as "interacting knowledge generation and exploitation subsystems linked to global, national and other regional systems" (COOKE 2004:3) "in which firms and other organizations are systematically engaged in interactive learning through an institutional milieu characterized by embeddedness" (COOKE et al. 1998:1581) or as "a system of innovative networks and institutions located within a certain geographic area, with regular and strong internal interaction that promotes the innovativeness of the region's companies" (KOSTIAINEN 2002:80).

Among other reasons, because in today's industry, where a lot is outsourced and – consequently – must be achieved in a networked way, R&D and innovation are less and less individual processes. Instead, it is increasingly becoming a multiparty matter requiring inputs from multiple actors and fine-tuning between them. Therefore, the possibilities with which inter-organisational efforts can be coordinated and bundled in a synergetic way matter a lot. Therefore, the ability to articulate such interactions with partners within a reduced perimeter implies clear agglomeration advantages. This means that the relational environment that regions can offer is of vital importance for developing R&D activities. Consequently, the actors and facilities that underpin innovation efforts and the interaction dimension of R&D makes regions a highly relevant unit for policy action and impact assessment.

The RIS concept is a *normative and descriptive approach* aimed at capturing how techno-

logical development takes place within a territory. Its popularity reflects the heightened interest in the regional, i.e. sub-national, business environment for inter-active innovation processes (systemic innovation). It has since become a central paradigm for the analysis of regional potential and the design of policies to promote knowledge-based regional development (REVILLA DIEZ/KIESE 2006).

Even though there are differences in detail between the various innovation system approaches, generally speaking, an innovation system refers to the actors, organisations and institutions, whose actions and interactions influence and participate in innovation processes. DOLOREUX (2002) defines firms, institutions, knowledge structures and holistic innovation policies as the main elements comprising a regional innovation system. From the theoretical point of view, the territorial innovation performance depends crucially on the performance of the territorial innovation system and to which extend the different actors network with each other, but also on the extent with which they succeed to make productive use of (regional, national or European level) public projects that aim to contribute to capacity building or to develop research, technological development and innovation (RTDI) networks and linkages, through which RTDI actors can tap distant resources and set up cooperation with RTDI actors across (regional or national) borders.

Together with the companies, which are the key players in a market-oriented IS, universities and research institutions form the R&D system. Companies are considered as the key actors, because of their market-orientation they are always endeavoured to develop new or improved products through inventions and innovations, respectively, in order to maintain or increase their competitiveness. Universities and re-search institutions complete the R&D system. On the one hand, they are performing applied research in the context of e.g. contract research or collaborative research projects and, on the other hand, they are providing new insights through basic re-search, which in turn can be picked up by the enterprises and developed into marketable goods and services (cf. HENNEMANN 2006). Therewith, the R&D system involves the relevant actors of R&D processes, which perform the knowledge and technology production. Thus, the R&D system must be regarded as the central sub-system of the IS, wherefore the following analysis is limited solely to the consideration of the R&D system, while the other actors and subsystems are most widely omitted.

b. First Component´s Aim

Against the backdrop of results regarding the impact of R&D policies on regional R&D systems and territorial cohesion, the EC´s wish to enhance the efficiency of support programmes and the theoretical background of regional innovation and R&D systems, the main goal of the first component within the AMCER project is to provide general insights into the RTDI systems. Focusing on regions the insights will be developed by compiling a synthesis of the R&D systems and territorial challenges at the regional level for each of the nine case-study regions involved in the AMCER project. Based on secondary data, reports, and expert information the component will provide an analysis and assessment of the regional R&D systems (using traditional STI indicators) and their territorial trends and challenges.

c. Research Questions

From the above-explained aim of the first component, the following questions arise:

- What are the socio-economic framework conditions of every respective region? (Component Task 2.1.2)
- How are every region´s capability and performance constituted in respect to its RTDI characteristics? (Component Task 2.1.2)
- What are the main R&D performers in the respective regions? (Component Task 2.1.2)
- How is the R&D governance structured, and what are the main public and private organi-

sations providing funding for R&D in the regions involved in the project? (Component Task 2.1.2)

- What are the main innovation policy guidelines in the regions involved in the project? (Component Task 2.1.2)
- What are main territorial trends and challenges which are and which are not specific to the R&D sector? (Component Task 2.1.3 and 2.1.5)
- How can the analysed regional R&D systems be assessed? (Component Task 2.1.3 and 2.1.5)

d. Analytical Approach - Definitions

The description and analysis of the socio-economic framework conditions, the *RTDI capability and performance*, and the *main R&D performers* will be mainly based on indicators from secondary statistical data and descriptive analytical methods. In order to meet the aim to describe the governance structure, the innovation policy issues as well as the *main territorial trends and challenges* mostly qualitative data, i.e. reports and expert information from the respective region will be used.

The final *assessment of the regional R&D systems* is based on the information and cognitions found out in the course of the previous analyses. As suggested by COOKE (1992, 1998, 2004) RIS´ can be measured and identified along two central dimensions. First is the *governance dimension* (see App. Tab. 1), which comprises public policy, institutions and knowledge infrastructure as integrated part of regional innovation processes. The following dimensions are of main interest: primary source of initiative, primary source of funding, predominant competences, degree of coordination and the degree of specialization. "These dimensions cover the main management and organizational issues of power, resources, expertise, control and focus" (COOKE 1992:368). The key question is whether the organizational setting, e.g. regional administrative bodies, animates or facilitates the networking propensity among actors of the innovation system. Based on the governance dimension, this results in three different types of RIS: grassroots, network and dirigiste RIS.

Grassroots is the level where the innovation system is generated and organized locally, at town or district level. Financial support and research competences are diffused locally, with a very low amount of supra-local or national coordination. Local development agencies and local institutional actors play a predominant role (cf. COOKE 1998a, 2004).

A *network RIS* is more likely to occur when the institutional support encompasses local, regional, federal and supranational levels, and funding is often guided by agreements among banks, government agencies and firms. The research competence is likely to be mixed, with both pure and applied, blue-skies (exploration) and near-market (exploitation) activities geared to the needs of large and small firms. The level of coordination is assumed to be quite high, due to the existence of many stakeholders as well as associations, forums, industry clubs, etc. The degree of specialization is rather flexible than dedicated, because the system hosts various firm scales and types (cf. COOKE 1998a, 2004).

A *dirigiste RIS* is animated mainly from outside and above the region itself. Innovation often occurs as a product of central government policies. Funding is centrally determined, with decentralized units located in the region. Research competences are prevalently basic or fundamental and often linked to the needs of larger, state owned firms in or beyond the region. Since the system is state-run the coordination level is potentially very high and the degree of specialization is likely to be high, too (cf. COOKE 1998a, 2004).

The second important dimension is the *business innovation dimension* (see App. Tab. 2) (cf. COOKE 1998a, 2004). It is often linked to the industrial base characterized in terms of productive culture and systemic innovation. Of special interest are the role of lead firms (enterprise domination), the emphasis given to private or in-house, over public research (research

reach) and the kind of nature of the innovation milieu in which the firms operate (associationalism). There are three different forms of RIS resulting from this dimension: the localist, the interactive and the globalised RIS.

The *localist RIS* is not dominated by large indigenous firms and the business innovation culture is not very great, although there may be local research organizations capable of combining with industry clusters within the region. A localist set-up will probably have few major public innovation or R&D resources, but may have smaller private ones. Finally, there will be a reasonably high degree of association among entrepreneurs and between them and local or regional policymakers (cf. COOKE 1998a, 2004).

An *interactive RIS* is one in which there is a balance between large and small firms. The reach of this combination will vary between numerous instances of access to regional research resources and to foreign innovation sourcing as and when required. The mix of public and private research institutes and laboratories in the inter-active RIS is balanced, reflecting the presence of larger firms with regional headquarters and a regional government keen to promote the innovation base of the economy. The association in local and regional industry networks, forums and clubs is above-average (cf. COOKE 1998a, 2004).

In the third type of *RIS*, the *globalised* one, the innovation system is dominated by global corporations, often supported by clustered supply chains of rather dependent small and medium-sized enterprises (SMEs). The research reach is largely internal and private in nature rather than public, although a more public innovation structure aimed at helping SMEs may have developed. Associationalism is normally greatly influenced by the needs of large-sized enterprises, and conducted to a significant extent on their terms (cf. COOKE 1998a, 2004).

e. Procedure

In order to answer the above-derived research questions and the related intention to fulfil the formulated research aim, *every region* will be analysed separately as follows:

In the *first part*, we stress the region´s socio-economic characteristics. Herewith we want to gain insights into the regional economy and illustrate the framework conditions. The *second part* will deal with RTDI-related issues and thereby deliver information about R&D efforts and inputs into the process of knowledge generation, human capital endowment and innovation through- and output. For the purpose to understand better the respective region´s features in a national and European context as well as to illustrate the heterogeneity among the AMCER regions, if possible, in section 1 and 2 a comparative approach is applied. However, since the regions are showing great differences e.g. in size and population, direct comparisons would lead to reasonability and reliability distortions. On this account, comparisons between the regions have always been put in these contexts. The third *section* aims at epitomizing RTDI governance and innovation policy matters. The *fourth and final part*, on the one hand, constitutes trends and challenges resulting for the region in terms of both socio-economic and R&D matters. On the other hand, it aims on a short, final assessment of the respective regional R&D system based on the gained information and cognitions and against the backdrop of COOKE´s (1998a, 2004) RIS approach (see this section part d above).

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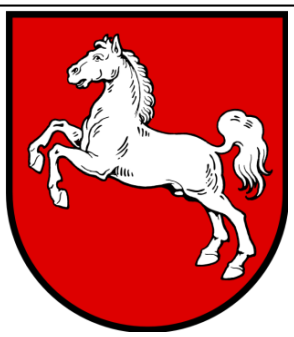
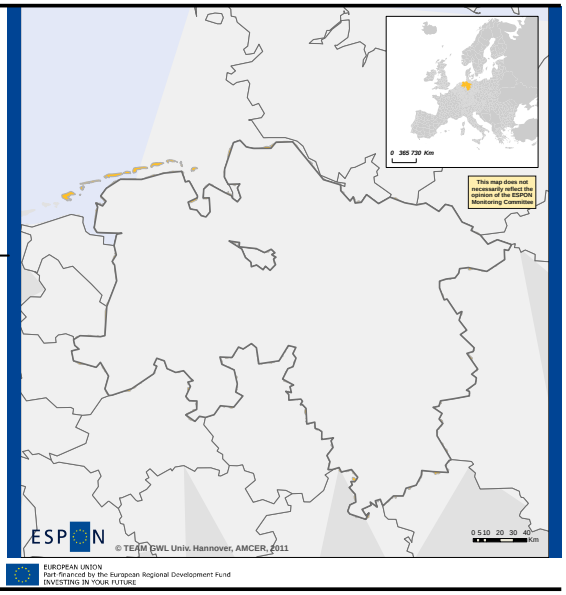
I. Region Lower Saxony

GERMANY

Region Lower Saxony

NUTS Code DE9 (NUTS-1-Level)





Introduction:

Lower Saxony is a German federal state (Land) in the north-western part of the country. It has borders with eight out of sixteen federal states, particularly with Bremen, Hamburg and Schleswig-Holstein to the north, Mecklenburg-Western Pomerania to the northeast, Brandenburg and Saxony-Anhalt to the east, and Thuringia, Hessen as well as North Rhine-Westphalia to the south. Lower Saxony also borders the Netherlands to the west and the North Sea to the north.

Lower Saxony has a surface of 47,641km² and a population of about 7.9m. Therefore the region has a population density of 167 per km², in 2008, which means that it is sparsely populated by German standards (230) and relatively dense populated compared to the EU-27 mean (116). The regional capital is Hanover with about 520,000 inhabitants in its core and 1.13m inhabitants in the metropolitan area (cf. EUROSTAT 2011; NLS 2011).

National/EU context:

Lower Saxony´s regional GDP per capita is below the German but above the European mean. The region has great socio-economic differences, a multifaceted sectoral structure and a relatively well-developed research infrastructure. However, in general, Lower Saxony is very much shaped by the automotive industry and therewith related low-medium- or medium-high-tech industries.

Overall, within Germany Lower Saxony's innovation system achieves average values. In comparison to the EU, the region´s RTDI characteristics are even above average.

The region´s main R&D sectors are engineering and manufacturing technology research, (new) material research, food industry research, and climate and maritime research. In addition, of particular seminal importance to the region´s R&D activities are energy research (e.g. renewable energies; surface mobility; fuel cell; electric mobility), life sciences research (especially the health industries), and ICT research. Furthermore, Lower Saxony has significant research competences in the area of aviation research. Overall, RTDI is mostly dominated by the business, although the public sphere is of great importance (cf. JERUSEL 2008; NIW 2008).

The region´s innovativeness in relation to the other federal states within Germany, measured by the number of patents applied at the European Patent Office (EPO), ranks in the upper midfield. However in European terms the region is a strong player with respect to patenting.

In 2007, the employment in R&D (FTE) was equivalent to 8.0% of the overall German R&D personnel. The R&D personnel (FTE) per 1,000 employees amount to 13.3. This figure almost corresponds with the German standard (13.5) and is above the EU-27 average (11.0). Regarding the business orientation of both the R&D expenditures and the R&D personnel (FTE) (69.0%, 61.9%), Lower Saxony is less business-oriented than the German (70.0%, 63.6%) and more business-oriented than the EU-27 (63.7%, 52.1%) average (cf. EUROSTAT 2011).

In 2007, Lower Saxony had the 7th-largest per capita spending on R&D among the German regions, and a R&D intensity of 2.48%, thus being broadly in line with the national average (2.53%) but vastly better than the EU-27 average (1.85%). The Lower Saxon R&D productivity amounts to 0.32, thus being below the German standard (0.42) but above the EU-27 average (0.27) (cf. EUROSTAT 2011).

1. Socio-economic Characteristics

In 2008, the regional gross domestic product (GDP) in Lower Saxony amounted to about €211.8b, accounting for a share of about 8.5% of the German GDP and therewith forming the 5th strongest regional economy after North Rhine-Westphalia (21.9%), Bavaria (17.8%), Baden-Wuerttemberg (14.6%), and Hesse (8.9%). The regional GDP per capita was €26,600, which represents 88.1% of the German and 106.0% of the EU-27 average, respectively. Between 1995 and 2008, the region´s economy grew by 1.8% p.a., which is both below-average regarding the national (2.0%) and the EU-27 (4.5%) (cf. EUROSTAT 2011). Comparing the economic performance of Lower Saxony with that of the other AMCER-regions, the region ranks in the lower third (see App. Tab. 3).

In 2009, the regional labour force amounted to 3.92m, representing 9.3% of Germany´s total labour force (42.02m). Meaning Lower Saxony has the 4th-largest labour force after North Rhine-Westphalia (20.8%), Bavaria (15.8%), and Baden-Wuerttemberg (13.5%). The regional employment rate of the 20-64 year-olds lies at 74.8%, which almost exactly corresponds with the national average of 74.9% (cf. EUROSTAT 2011). Furthermore, the regional employment rate nearly meets the employment rate target of 75% defined by the "Europe 2020 Strategy" (cf. EC 2011).

In 2008, 3.0 of the employees worked in the agricultural sector, 28.3% in industry, and 68.7% in the service sector. These figures almost correspond with the national figures (2.2%, 29.7%, 68.1%), whereas the share of the agricultural and service sectors are slightly more marked in Lower Saxony. Taking the EU-15 average (3.5%, 26.2%, 69.7%), where the more developed countries of the European Union are considered, some profound differences can be observed. The agricultural sector and especially the service sector appear to play a more important role in the EU-15 average, whereas the proportion of the industrial sector is less pronounced. This illustrates the relatively large overall relevance of the industrial sector and the comparable inferior importance of the service sector for Germany in general and Lower Saxony in particular (cf. EUROSTAT 2011). Comparing the economic structure of Lower Saxony with that of the other AMCER-regions, in terms of its industry sector share the region ranks in the upper midfield, regarding the service sector share it ranks in the lower midfield (see App. Tab. 4).

The average annual regional unemployment rate accounted for 6.5% in Lower Saxony in 2010, coming from 10.4% in 2005. The regional trend is thus following the national development, where the unemployment rate decreased from 11.1% (2005) to 7.1% (2010) (cf. EUROSTAT 2011). Both the Lower Saxon and the national unemployment figures are well below the EU-27 average of 9.6% in 2010. Even in the period when the financial crisis affected the real economy the most, the Lower Saxon unemployment rates still declined from 7.1%, in 2008, to 6.8%, in 2009. These developments illustrate the labour market persistence to crisis

evolved in the recent years. Reasons for that positive evolution are extensive labour market reforms (i.e. Agenda 2010) at the beginning of the last decade, growing international competitiveness of German enterprises, an overall positive development of the world economy till 2008 as well as policies introduced by the government in times of the world financial and economic crisis between 2007/2008 and 2010. Comparing the unemployment rate of Lower Saxony with that of the other AMCER-regions, the region ranks in the 4th place (see App. Tab. 5). Taking the youth unemployment (15-24 year-olds) Lower Saxony has the best result. Both figures hold a mirror up to the already discussed positive regional economic development as well as the mentioned political efforts. On the other hand, however, the relatively high long-term unemployment share must be considered critically. This reflects still existing inflexibilities in the labour market, which makes further reforms necessary.

The Lower Saxon economy is characterized by various intra-regional disparities as indicated through the coefficient of variation of several indicators stated in Tab. 1. In Lower Saxony relatively huge differences can be observed in terms of economic position, especially between the urban centres such as Hanover, Brunswick, Gottingen, Wolfsburg, Osnabruck, Oldenburg, the surroundings of Hamburg and the far less dynamic north-eastern or southern rural regions. Particularly weak in the south is the Harz region and in the northeast the Region Lüchow-Dannenberg. These regions have comparatively low growth rates, high unemployment figures, and a rapidly aging population. On the other hand, additionally to the urban centres, for several years, the rural western regions such as Vechta and Cloppenburg have managed to develop a considerable economic dynamic with high growth rates and decreasing unemployment rates. Furthermore, in contrary to the Lower Saxon and the overall population aging trend, these regions have also relatively high population growth and a comparatively young population. In many cases, the western rural areas have better population development figures than even the urban areas, although many urban areas are still growing (cf. NIW 2010b).

Table 1: Intra-regional socio-economic Disparities in Lower Saxony (selected Indicators)

Coefficient of variation of GDP per capita 2008 (in %)	Coefficient of variation of the yearly average GDP per capita growth rate 1998-08 (in %)	Coefficient of variation of the unemployment rate 2009 (in %)	Coefficient of variation of the population dynamics 2005-09 (in %)
38.99	41.51	28.13	74.64

Remark: disparity calculations based on NUTS-3 level data

(Source: own creation and calculations; based on data from EUROSTAT 2011)

The Lower Saxon economy employed about 3.6m people, in 2010, and is dominated mostly by the automotive sector (136,644 employees, in 2009). In addition to it, other fields of activity are the food industry (82,098), metal production industry (73,008), rubber and plastics industry (58,223), mechanical engineering (56,908), wood and paper product, and printing industry (37,272), chemical industry (23,429), computer, electronic and optical products industry (21,881) and electrical equipment industry (19,594). Overall, the automotive sector and its supplier industries represent about 30 percent of all jobs in Lower Saxony. World-famous companies in these industries are Volkswagen and Continental. Within the manufacturing sector, the above-mentioned food industry is both in terms of turnover and in terms of labour market the second most important industry after the automotive sector in Lower Saxony. A further important sector is the maritime industry clustered in particular in the north-western parts of Lower Saxony but also in the region of Hanover and in the surroundings of Bremen and Hamburg. The Lower Saxon maritime industry accounts for about 39,000 employees. Only in the Free and Hanseatic City of Hamburg, more people work in the maritime industries. Moreover, in the fields of biotechnology and life sciences nearly 20,000 are employed. A location advantage is the region´s research environment; there are 18 universities and universities of applied sciences in the fields of life sciences and further 80 research institutions in

the fields of biotechnology research. In the service sector important fields of activity are the financial and insurance sectors (76,947), particularly in and around of the regional capital city of Hanover. Further weighty fields of activity are the ICT sectors (45,906). Moreover, the federal armed forces are an important employer in otherwise less developed (rural) areas (ca. 50,000) (cf. MELTLS 2009; NGLOBAL 2011; NLS 2011; RIM 2011a).

Overall, the Lower Saxon economy is rather characterized by SMEs. Employment in firms with less than 250 employees (SME) accounted for about 62% of total employment (2006) and is therewith broadly corresponding with the German average (61%, in 2005). Nonetheless, comparing the region´s employment share of SME´s with that of the EU-27 average (67%, in 2005), it can be determined that Lower Saxony is somewhat more characterized by large-scale enterprises. Differentiating between the industry and service sector a sophisticated picture comes to light. In the industry sector, only 52% of the employees work in SME´s, whereas in the service sector, there are 67% (cf. EUROSTAT 2011; NLS 2011; SCHMIEMANN 2008). That elucidates that particularly the Lower Saxon industry sector is shaped by larger enterprises.

In 2010, the overall scope of exports was €66.2b (6.9% of national total), the scope of imports came to €73.5b (9.1% of national total). The traded commodity patterns are in line with the dominating industrial sectors. Main export goods were passenger cars and recreational vehicles (€12.4b), chassis, car bodies, engines, parts/accessories (€5.4b), equipment for electricity generation and distribution (€3.1b), machinery (€2.2b), meat and meat products (€2.1b), and chemical preproducts (€1.9b). Main import commodities were petroleum and natural gas (€13.4b), chassis, car bodies, engines, parts/accessories (€5.0b), passenger cars and recreational vehicles (€4.5b), watercrafts (€3.1b), and equipment for electricity generation and distribution (€1.9b). In 2009, the primary target markets were Europe (75.5%), the USA (6.8%) and Asia (8.1%). In Europe, the highest proportions have France (9.1%), the Netherlands (8.5%), the UK (7.1%), and Italy (6.3%). In Asia, the most important export market is China (3.0). Although, Lower Saxony traditionally was a net exporting region, since 2009, due to the economic crisis, Lower Saxony became a net importing region. Between 2000 and 2010, the Lower Saxon exports grew by 7.3% p.a., which is below the national average (9.1%). On the other hand, the imports grew by 10.2% p.a., which is above-average (8.6%). Altogether, the economic crisis hit the former export-oriented Lower Saxon economy hard, with the result that the exports are still below the imports and the recovering phase is still proceeding (cf. NIW 2010a; NLS 2011).

2. Research, Technological Development and Innovation (RTDI) Characteristics

2.1 R&D Efforts and Input into the Process of Knowledge Generation

Lower Saxony´s gross expenditures on R&D (GERD) amount to €5.15b in 2007, thus contributing 8.4% to the German total. The R&D expenditures per capita amounted to €645. Therewith, the region has the 7th-largest per capita spending on R&D after Baden-Wuerttemberg (€1,459), Bavaria (€976), Hamburg (€947), Hessen (€934), Bremen (€880), and Berlin (€839). When expressed as a percentage of GDP, the GERD is used to indicate the overall R&D intensity of a country or region. This measure unfolds the emphasis placed on R&D activities within a given economy. In 2007, R&D expenditures per GDP are 2.48%, thus broadly in line with the national average (2.53%) but vastly better than the EU-27 average (1.85%) (cf. EUROSTAT 2011). Nonetheless, the regional R&D expenditure per GDP quota does not meet the target of 3% defined by the "Europe 2020 Strategy" (cf. EC 2011). Comparing both the R&D expenditures per capita and per GDP of Lower Saxony with that of the other AMCER-regions, the region ranks in the upper third (see App. Tab. 6).

In 2007, the full time equivalent (FTE) employment in R&D amounts to 40,315, which is 8.0% of the overall German R&D personnel. The R&D personnel (FTE) per 1,000 employees

amount to 13.3. This figure almost corresponds with the German standard (13.5). In Comparison with the EU-27 average (11.0), the Lower Saxon figure is far above-average. Regarding the R&D personnel per 1,000 employees in comparison to the other AMCER-regions, the region ranks in the lower midfield (see App. Tab. 6) (cf. EUROSTAT 2011).

The R&D sector can be sub-divided into the Business Enterprise Sector (BES), the Government Sector (GOV), the Higher Education Sector (HES), and the Private Non Profit Sector (PNP). Their relative importance varies greatly across regions, however, generally reflecting different economic or research structures and traditions, respectively. With regard to the innovation system approach, the proposition of R&D performed by the business sector (BERD) is considered as an indicator of the overall innovative capacity of a region. Although, this should not be over-interpreted, because the other sectors also provide important stimuli to the process of knowledge and technology production.

The RTDI sector in Lower Saxony is clearly business-oriented. The BERD amounts to 69.0% (€3.75b) of the overall GERD, in 2007. Moreover, the share of the BES in R&D employment (FTE) accounts for 61.9% (24,966 employees) of the overall R&D employment. Regarding the business orientation of both the R&D expenditures and the R&D personnel (FTE), Lower Saxony is less business-oriented than the German (70.0%, 63.6%) and more business-oriented than the EU-27 (63.7%, 52.1%) average. Comparing the same aspects between Lower Saxony and the other AMCER-regions, the region ranks in both cases in the upper third (see App. Tab. 6), thus having a more business-oriented RTDI sector than the most AMCER-regions (cf. EUROSTAT 2011). About 80% of the industrial R&D capacities are bundled by the automotive, the aeronautics, the shipbuilding and the railway-technology sector. Furthermore, more than the half of the national agricultural R&D personnel is currently based in Lower Saxony. Nevertheless, the potential in high-tech sectors is rather small, although some stand out, for instance the fields of instruments, navigation, and biotechnology (cf. RIM 2011a).

The HES as well as the GOV play a subordinated role in terms of R&D expenditures and personnel (FTE). In the HES the shares of R&D expenditures and personnel amount to 17.0 (€877.24m) and 20.6% (8,298 employees), respectively. Accordingly, the shares of R&D expenditures and personnel in the GOV are 13.6 (€698.1m) and 17.5% (7,051 employees), alternatively. Hence, after the BES the HES sector is the second most important R&D sector in Lower Saxony. On the other hand, the PNP does not seem to play any role (cf. EUROSTAT 2011).

Lower Saxony hosts a broad research landscape with 13 universities, two art academies, six public and seven state-recognised universities of applied sciences. Further, Lower Saxony has six Max Planck institutes, three Fraunhofer institutes, two Helmholtz facilities (i.e. the German Aerospace Centre (DLR), Helmholtz Centre for Infection Research (HZI)), six institutes of the Leibniz Association, seven federal institutes, and 17 regional research institutes. In addition, Lower Saxony has seven institutes which are closely related with, but legally independent from universities (cf. BMBF 2011; FHG 2011; MPG 2011; MSCLS 2011a, 2011b; WGL 2011).

The main Lower Saxon R&D sectors are largely corresponding with the dominating economic sectors (see above), meaning engineering and manufacturing technology research, (new) material research (e.g. nanotechnologies), food industry research, and climate and maritime research. In addition, of particular seminal importance to the region´s R&D activities are energy research (e.g. renewable energies; surface mobility; fuel cell; electric mobility), life sciences research (especially the health industries), and ICT research. Furthermore, Lower Saxony has significant research competences in the area of aviation research. In Brunswick and Gottingen are renowned research institutions of the DLR and the Technical University of Brunswick, with its Centre of Aeronautics and Astronautics (ZLR) being a constant in the

national and European air and space research landscape. Nevertheless, although SMEs are an important pillar of the Lower Saxon economy, the share of those which are performing R&D is often rather weak. Weaknesses in terms of R&D activities of SMEs can particularly be found in the rubber and plastics industries, the automotive sector, the engineering sector, the electronics industries, the electronic data processing (EDP), the media technologies, and the measurement, control and steering (MCS) technologies. With respect to employment and long-term development perspectives, this circumstance is of great disadvantage for the region. Surprisingly is the strong reduction of R&D activities of SMEs in the automotive and therewith related sectors. Obviously, a strong structural reorganization took place in the supplier sector (cf. JERUSEL 2008; NIW 2008).

The RTDI-related parameters are not uniform across regional areas within Lower Saxony as indicated through the coefficient of variation of several indicators stated in Tab. 2. There are substantial differences within the region in terms of both innovation capacity and performance, most notably in skills and education performance and the density of knowledge-intensive employment within the sub-regions. Some areas within Lower Saxony have especially weak levels of high-tech and R&D employment which may limit their capacity for innovation. Quantitative data indicates that the weaknesses are especially concentrated in the regions Luneburg and Weser-Ems, as well as in the rural areas in general. Particularly strong is the region Brunswick and with some limitations also the region Hanover. Within these regions, the RTDI activities are highly concentrated in agglomerations, e.g. Brunswick city, Hanover City or Gottingen. Nevertheless, compared to Hanover Brunswick has a superior position in terms of high-tech and R&D employment. On the other hand, however, regarding the regional patent output, the region Hanover is in a better position (cf. EUROSTAT 2011).

The distribution of industrial research capacity is in some ways even more supported by the locations of universities and para-university institutions. However, in Gottingen the gap between R&D capacities in the public sector and the economy is extremely marked. Here it must be assumed that the spillover effects of public (basic) research into applied research and experimental development in the economy are not very high. In Lower Saxony, however, spillover effects from public research into the economy are in general more limited than elsewhere in the western and southern parts of Germany, although there are notable exceptions and some dynamic science-industry co-operations. To the north, particularly the surrounding regions of Hamburg and Bremen, areas gain from spillover effects from the aviation industries. However, the sectoral spillover effects from R&D in the aviation and aerospace industry to the rest of the production sector are not assessed as particularly high. They are relatively isolated, due to that the production of knowledge and its application are largely limited to the sectoral borders. Regarding spillover effect, in the automotive sector one can find a different situation. In Lower Saxony, hardly any sector sets so many innovative impulses - in both the manufacturing and towards services. Its regional scope, however, seems to be limited to Lower Saxony (cf. EUROSTAT 2011; NIW 2004; RIM 2011a).

Table 2: Intra-regional RTDI Disparities in Lower Saxony (selected Indicators)

Coefficient of variation of hight-tech employment (hightech-employment as percentage of total employment) 2009 (in %)	Coefficient of variation of knowledge workers (HRSTC employment of the economically active population) 2009 (in %)	Coefficient of variation of R&D employment (R&D employment as a percentage of total employment) 2007 (in %)	Coefficient of variation of the persons with a tertiary education attainment (as percentage of total population) 2010 (in %)	Coefficient of variation of the patent applications at the EPO per million inhabitants 2004-2007 (in %)
37.56	23.20	104.10	11.14	23.90

Remark: disparity calculations based on NUTS-2 level data

(Source: own creation and calculations; based on data from EUROSTAT 2011)

2.2 Human Capital Endowment

In 2009, regional human resources in science and technology (core stock) (HRSTC) amounted to 0.562m, representing 7.7% of national total (7.308m) and 14.4% of the economically active

population. With this share of knowledge workers Lower Saxony ranks in the lower third in comparison with the other AMCER regions (see App. Tab. 7) (cf. EUROSTAT 2011).

Moreover, in 2009, Lower Saxony had a stock of 95,663 employees working in high-tech industries and knowledge-intensive services, i.e. 5.8% of national total and 2.6% of total employment in the region. Therewith, Lower Saxony´s share in total employment is far below-average in German standards (4.3%). In comparison with the other AMCER regions it is not very high, too, and thus Lower Saxony ranks in the lower third again (see App. Tab. 7) (cf. EUROSTAT 2011).

The education level of the human capital forms the basis for productive and innovative activities in developed countries and regions. In 2010, Lower Saxony had 875,312 students in the secondary education level (ISCED 2-4), i.e. 110.1 students per 1,000 inhabitants. Thus, regarding the German standard (101.4), this is above-average. Overall, 62.4% of the Lower Saxon population of working age (25-64 year-olds) has an upper secondary education attainment (ISCED 3), in 2010. This is compared to both the German (59.2%) and the EU-27 average (46.8%) well above-average. Considering the tertiary education level (ISCED 5-6), Lower Saxony had 180,827 students in that field, in 2010, i.e. 22.8 students per 1,000 inhabitants. Considering the German average (29.7), the Lower Saxon figure is below-average. Altogether, 22.3% of the population of working age has a tertiary education attainment (ISCED 5-6). This is compared to both the German (26.6%) and the EU-27 average (25.9%) below-average. Moreover, the share of the 30-34 year-olds with a tertiary education attainment amounts to only 25.1% (Germany: 29.8%; EU-27: 33.6%), thus the region does not meet the 40%-target defined by the "Europe 2020 Strategy" (cf. EC 2011; EUROSTAT 2011). Comparing the figures of secondary and tertiary level students per 1,000 inhabitant of Lower Saxony with those in the other eight AMCER regions, the region ranks in terms of secondary level students in the 2nd place and in terms of tertiary level students in the last place (see App. Tab. 7).

Regarding the early leavers from education and training, which can be interpreted as at least temporarily lost human capital, in the education vintage 2010, they account for 13.9%. This is a minus of 0.9 percentage points compared to the year 2000 and thus suggesting a slightly positive trend. Nonetheless, this result is far above the German average (11.9%) and slightly below the EU-27 standard (14.1%) (cf. EUROSTAT 2011). Apart from the fact that the Lower Saxon figure is generally rather high, the regional proportion of early school leavers does not meet the maximum target of 10% defined by the "Europe 2020 Strategy" (cf. EC 2011). Compared to the other AMCER regions, the Lower Saxon proportion still ranks in the upper midfield (see App. Tab. 7). Regardless of this positioning, against the backdrop of the aging Lower Saxon society (see 4.1 below), high reintegration costs, increasing pressure for innovation, productivity, and competitiveness, profound reforms are urgent.

Because the technological progress is increasingly challenging developed countries and regions and therewith requirements for education are steadily rising, further education of adults is playing an increasingly important role in knowledge and innovation driven economies in general, and for aging societies in particular. The Lower Saxon participation share of adults aged 25-64 in education and training amounts to 6.7%, in 2010, therefore being far behind the German (7.7%) and the EU-27 average (9.1%). The drawn picture is particularly disillusioning against the background that Lower Saxony ranks in the lower third compared to the other AMCER regions (see App. Tab. 7) (cf. EUROSTAT 2011).

2.3 Potential for Innovation

In the course of this work, the number of patent applications at the EPO is taken as an indicator for the potential for innovation, thus depicting the production of knowledge and technologies. Although in the innovation process patents are somewhere between inventions and innovation and therefore covering only a part of the whole innovation process, they are among the most widely used innovation indicators (cf. GRUPP 1997; FRIETSCH et al. 2008).

Between 2000 and 2003 in Lower Saxony, a number of 5,379 patents were applied at the EPO, accounting for 6.2% of the national total. Between 2004 and 2007 the number of patent applications amounted to only 4,957 (5.8% of national total), a decline of about -7.9%. At the same time, the patent applications per million inhabitants shrank from 677, in 2000-2003, to 620, in 2004-2007 (minus 7.8%). Among the German federal states Lower Saxony ranks in the upper midfield, regarding the overall patent output (cf. EUROSTAT 2011). In comparison to the other eight AMCER regions, regarding both the absolute and the relative patent application figures, the region ranks in the 2nd place after Ostrobothnia or Länsi-Suomi, respectively (see App. Tab. 8).

Since patents are in most cases the result of extensive R&D activities, it is possible to determine the R&D productivity (measured as EPO patent applications per million R&D expenditures in 2005). Moreover, this indicator unveils how effective the money spent on R&D is utilized in the process of knowledge generation. The Lower Saxon R&D productivity amounts to 0.32, thus being below-average compared to the German standard (0.42) (cf. EUROSTAT 2011). Despite apparently existing weaknesses in the national scope, compared to the other AMCER regions the Lower Saxon R&D productivity still ranks in the 2nd place (see App. Tab. 8), thus showing that the region already has a comparatively efficient R&D system.

Concerning the technically more challenging high-tech patents, Lower Saxony accounted for 708 applications at the EPO between 2004 and 2007. Nonetheless, between 2000 and 2003 the region´s high-tech patent applications still amounted to 930, thus baring a decline of -23.9% over time. The high-tech patent applications per million inhabitants come to 89 in the period of 2004-2007. For the same period, the proportion of high-tech patent applications to all patent applications amounted to 14.3%. Among the German federal states, Lower Saxony ranks in the upper midfield, regarding high-tech patent applications. Comparing the Lower Saxon figures with that of the eight other AMCER-regions, it ranks in the lower midfield (see App. Tab. 8). These results together with the figures concerning HRSTC and high-tech employment reflect the above-mentioned circumstances that Lower Saxony is with some exceptions to a lesser extent a high-tech region. However, the most Lower Saxon high-tech patent applications have been made in the fields of communication technologies (40.1%), computer and automated business (27.1%), and aviation (16.2%) (cf. EUROSTAT 2011).

Overall, Lower Saxony has a clear focus and specialization advantage in the field of mechanical engineering, especially for transport and traffic. These patents, however, are mostly medium- and low-tech oriented. Lastly, the Lower Saxon patent focus and its specialization reflect the overall importance of automotive-related industrial sectors (cf. NIW 2004).

3. RTDI Governance and Innovation Policy

3.1 Governance

As a federal state, Lower Saxony has a high degree of autonomy with regard to legislation and tax-raising powers as well as a say in various matters of federal policy. Particularly, the German Basic Law gives the federal states considerable autonomy in R&D policy. This is especially the case for higher education policy matters, where each state independently enacts its own legislative framework. At the regional level, RTDI policy is designed by the Lower Saxon Ministry of Science and Culture, and the Lower Saxon Ministry for Economic Affairs, Labour and Transport (cf. RIM 2011a). Further actors with whom the ministries closely cooperate are the following:

The Centre for Innovation (IZ, Innovationszentrum Niedersachsen) is a technical consultancy and think tank which supports the federal state's government in designing and implementing innovation policy. With the thereby set impulses, the IZ tries to stimulate the development and diffusion of new technologies in Lower Saxony. (cf. IZ 2011; RIM 2011a).

The NBank is the first point of contact for all potential beneficiaries of support and funding

programmes. The NBank is the support bank of the federal state of Lower Saxony and subordinated to the Lower Saxon Ministry of Finance. It assesses funding applications according to formal criteria. The NBank is supported by the Centre for Innovation by assessing funding applications with regard to their substance (cf. NBANK 2011; RIM 2011a).

Beyond that, the inter-ministerial approach applied involves some complementary actors, most notably the n.transfer GmbH, the Innovation Fund Lower Saxony (Innovationsfonds Niedersachsen), and the Lower Saxon Institute of Economic research (NIW, Niedersächsisches Institut für Wirtschaftsforschung).

The n.transfer GmbH is a joint platform aiming on the transfer of innovations into markets. It concentrates and coordinates application-oriented knowledge by systematically involving the universities as potential partners for development. The n.transfer GmbH was founded in 2002 on the instructions of the Ministry of Science and Culture. The Innovation Fund Lower Saxony is supporting projects carried out by local companies and/or scientific institutions. Moreover, the Innovation Fund is executing the entire sponsorship of certain projects. The Innovation Fund was set up in 2007 with a capital of €20m. In the course of the coming years, it is planned to raise the endowment to €100m through contributions by both the state government and the business sector. The Lower Saxon Institute of Economic Research, an important regional think tank in Lower Saxony, provides input in the form of locally tailored yet comprehensive studies and reports (cf. ITI 2011; IF 2011; NIW 2011; RIM 2011a).

Furthermore, at the local level a vast number of (municipal) business development organizations work in co-operation with both the above-mentioned and other local actors, thus often acting as the first contact point especially for SMEs. On the one hand, these organizations inform and advise enterprises. On the other hand, they directly provide assistance in the form of concrete support measures.

3.2 Policy

The main aim of the research and innovation policy of Lower Saxony is to strengthen the innovation and competitive potential of SMEs, particularly through collaborations between the academic area and the industry. Furthermore, the promotion of university research in its full scope is part of the funding portfolio of Lower Saxony. Technology funding and transfer involve all ministries in charge in order to develop and strengthen the region as a high-tech and innovation region. Meanwhile, the knowledge and technology transfer centres operate as an interface between academia and industry. Key political actors are both the Lower Saxon Ministry for Economic Affairs, Labour and Transport and the Lower Saxon Ministry of Sciences and Culture. In the manner of the inter-ministerial approach, a close collaboration consists between both ministries in the fields of science, research, technology and innovation policies.

In order to support and accelerate research and innovations in Lower Saxony, the Lower Saxon Ministry for Economic Affairs, Labour and Transport has formulated the following main innovation policy guidelines (cf. MELTLS 2011a):

- building up a research infrastructure which is highly relevant for the economy;
- providing support for innovation in future fields of activity in Lower Saxony;
- strengthening technology transfer;
- supporting the starting conditions for start-up entrepreneurs; and
- supporting the process of innovation in the socio-economic field.

Besides the main guidelines which are determining the innovation political behaviour, the Ministry for Economic Affairs, Labour and Transport has set up core technological state initiatives. These initiatives aim on supporting the technological development in particularly important and promising technology fields relevant to the economic development of Lower Saxony. Prerequisite for the establishment of a regional initiative are a discernible technological future trend or a concrete emerging market as well as already existing potentials. State

initiatives are created for a limited period, initially for three years. With the establishment of state initiatives, the intention is to combine the relevant scientific institutions and companies on a technology-or industry-specific topic in a network. The core regional networking initiatives which are comparable with cluster platforms and presently active are the Regional Initiative Health Industry and Life Sciences, Regional Initiative Fuel Cell and Electric Mobility, Regional Initiative Nanotechnology and Material Sciences, and the European Centre of Adaptive Systems (ECAS) e.V. (cf. MELTLS 2011b). A further important state initiative is the Lower Saxony Competence Centre for the Food Industry (NieKE). NieKE aims to secure and strengthen the economic position and the innovativeness of the food sector in Lower Saxony in the long-run. To meet this, actors from production, marketing and sales, science, education, finance and public administration cooperate in the network. Thereby, a core task is the chain-wide support of research and innovation processes (cf. NIEKE 2011). The regional networking initiatives are in line with the above-mentioned main R&D fields.

Additionally, the Lower Saxon Ministry of Science and Culture is conducting and supporting several science-related policies for the purpose of securing and enhancing sustainable employment, thus laying the basis for future prosperity. In order to fulfil these tasks the following broad objectives have been set by the ministry (cf. MSCLS 2011c; RIM 2011a):

- Safeguarding the breadth/scope

The development of sciences must be safeguarded across the whole spectrum from basic through to applied research. Although certain key technologies shall enjoy special support, sponsorship of the arts and social science shall be maintained.

- Focus and profile creation

As no single university or university of applied sciences can offer all subjects, research policy aims to coordinate the profiles of the respective institutions of higher education.

- Networking

Apart from networking with each other, universities shall also be encouraged to cooperate with the institutes of the Max Planck Society (MPG), the Fraunhofer Society (FhG), the Knowledge Community Gottfried Wilhelm Leibniz (WGL) and the Helmholtz Society (HGF) in order to concentrate their abilities in synergetic style with those of the extra-university organisations.

- Quality assurance

The ability of Lower Saxony to maintain its status as a centre of science is heavily dependent upon the quality of research which is undertaken there. To ensure this, in 1997, the state government set up an independent external committee, called the 'Scientific Commission Lower Saxony' (WKN, Wissenschaftliche Kommission Niedersachsen), to critically monitor the university and research system and develop new primary fields of research.

- Science and industry cooperation

In order to guarantee a better exploitation of research results from the universities and universities of applied sciences and to intensify technology transfer to industry, the state government has adopted a series of special measures.

The support of the region´s research and innovation community is ensured by various funding measures. Some of the main support measures are namely Start-up Campus Lower Saxony, Consultancy for Knowledge and Technology Transfer at Community Level, Measures to support Technology Transfer and New Models of Science-Industry Cooperation, Regional Technology Initiatives, Lower Saxon Programme for Innovation Support, Directive for Personnel Transfer (Assistant for Innovation), and Management for Innovation Networks (cf.

RIM 2011a). Ultimately, these measures provide funding for almost each part of the innovation chain, thus guaranteeing balanced political framework conditions.

4. Trends, Challenges, and Assessment

4.1 Trends and Challenges which are not specific to the R&D Sector

The long-term economic development of Lower Saxony in the period of 1995-2008 was below-average compared to both the national and the European average. Moreover, in the period 2000-2007, the growth was weaker in the rural areas and in the city regions than in the urban agglomerations. Exceptionally strong growths in the rural areas for that period were in Vechta and Cloppenburg as well as in the region Emsland-Bentheim. The growth was the weakest in the regions of the upper Weser, the Leine-Weser mountainous country as well as the central Weser region and the Heide region. Among the urban areas, especially Osnabruck and Oldenburg were very dynamic. Gottingen and Hildesheim were somewhat weaker. The growth of the densely populated regions of Hanover and Brunswick was generally slightly above average (cf. NIW 2010b).

The population development and especially the aging figures of a population are crucial for innovation related purposes, due to the fact that the youth and size of a population virtually determines its dynamism, innovativeness, and labour supply and therewith its future viability. With the decline in migration gains in recent years and the trend of a rising mortality rate, the population is steadily shrinking in Germany since 2003. In 2005, in Lower Saxony the population reached its maximum of nearly 8 million. Since then it is also declining. With a total of 7.95m inhabitants (2009) its share in national total is 9.7% and it ranks the 4th place among the German federal states. For quite some time, the Lower Saxon population development has a relatively stable spatial pattern that is characterized by an urban-rural gradient and a west-east divide. In recent years, the population development of metropolitan areas in Lower Saxony as a whole was slightly more favourable than compared to the national average. Among the metropolitan areas, the surroundings of Hamburg and the urban region of Oldenburg had the strongest population dynamics. A far distance behind followed the regions of Hanover, Osnabruck and the surroundings of Bremen. A below-average population growth can be observed in the urban regions of Gottingen, Hildesheim and Brunswick. Lower Saxony's rural areas have a highly diverse population development. At the head of the population development surplus are the rural areas of west Lower Saxony, namely the Emsland-Bentheim region and the Oldenburger Münsterland (Vechta and Cloppenburg). Behind followes the region of Ostfriesland and the Elbe-Weser region. All other rural areas developed significantly less favourable. The largest population losses in Lower Saxony have the Leine-Weser mountainous country and the Harz region (cf. NIW 2010b).

According to GIANNAKOURIS´s (2010) regional population projections (EUROPOP2008) for the period 2010-2030, the Lower Saxon population will grow with about 1.3% and thus amount to 8.095m. Against the backdrop that there are population losses in most of the Lower Saxon regions for that period, this development is at least surprising. Recent population projections by the NIW (2006) assume a more pessimistic future development, where the population will shrink to about 7.5m until 2025. However, in general, the basic findings are similar in both studies, especially those concerning the major regional growth and ageing trends. The only growing region will be the region Weser-Ems (+7.9%) in the west of Lower Saxony and, in addition, with respect to the findings above, also the urban centres will grow further. To the contrary, most of the rural area populations will shrink. Nevertheless, the Demographic Change will further sharpen everywhere in Lower Saxony. In 2009, 14.6% of the regional population was younger than 15 years, 64.8% were between 15 and 64 years, thus representing the population of working age, and about 20.6% were 65 years or older (retirement age). The age distribution depicts an ageing regional population where the cohort of the young and

adolescent people is markedly smaller than the cohort of the people of pensionable age. This finding is in line with the overall trend of the Demographic Change in Germany. However, in 2030, the share of people which are 65 years and older will regionally vary between 25 and 30% within Lower Saxony, underpinning the economic and social challenges the region is confronted in the future (cf. EUROSTAT 2011; GIANNAKOURIS 2010).

Because of the previously dominating economic structures in favour of cities and urban agglomerations and the ongoing Demographic Change and population development patterns especially in the rural areas the described trends are likely to continue in the future. In general, the main profiteers will be the cities and urban agglomerations. In terms of the still growing rural and peripheral Weser-Ems region in the west of Lower Saxony it is at least questionable to what extent the local young and regrowing workers are available, i.e. actually remain in the region.

4.2 Trends and Challenges which are specific to the R&D Sector

R&D activities have diminished with respect to the SMEs involved over time. In Lower Saxony, about 93% of the R&D activities are due to large-sized enterprises (Germany: 89%). This trend causes concerns, especially against the backdrop that in many other European countries and regions a contrary development takes place. However, SMEs play a special and increasingly important role in innovation processes. SMEs often concentrate their R&D activities on the development of high-tech goods. In addition, SMEs do often act comparatively flexible, unconventional, and risky, wherefore their R&D behaviour is mostly quite intensive. With the drastic drop of R&D activities of SMEs, an increasing abandonment of implementation of high-tech knowledge in inventions, innovations, value added and jobs in the breadth of industries and regions can be expected in the future. In many cases, this emerging development is a sign of the missing supply of fresh knowledge through young and new enterprises. It is assumed that especially young companies are more active in R&D, due to the reason that they are in particularly intense market competition and their existence thus often depends on new ideas. Another weakening factor is an increasingly shortage of (young) high-skilled people, but without them R&D and innovation are hardly feasible (cf. NIW 2008).

Concerning the concentration of R&D activities, in general, two major trends can be observed both in Germany as a whole and Lower Saxony in particular. High-tech is mostly generated in densely populated areas (urban agglomerations). In the more rural areas and such areas with low or starting agglomeration tendencies, predominately low, middle and advanced technologies are created. Accordingly, the technological competition between the urban agglomerations takes place on a higher level. Rural regions with lower density and less market-related industry linkages are hardly involved in high-technology competition. With regard to R&D employees and R&D intensities in the regions of Lower Saxony, especially Hanover and Brunswick dominate. This trend will probably continue, especially since Hanover is catching up steadily to the top region of Brunswick in recent years. A driver of this development is often especially the automotive sector or therewith closely related sectors. Other research-intensive fields that have been carriers of the developments in recent years were electrical engineering, production engineering and the electronics industry. However, in many ways, these sectors are closely linked with the automotive sector. In Lower Saxony and North Germany as a whole, there are missing broad innovation impulses due to the high sectoral concentration. Unlike in southern Germany, there is a lack of variety of technological lines and cores. Since in Lower Saxony technological spillover effects are mainly due to the automotive sector, they are also highly concentrated in the southeast (i.e. Hanover, Wolfsburg, Brunswick) and southwest (i.e. Osnabrück). Apart from the two regions Hanover and Brunswick, also Gottingen has high R&D intensities. This counts, however, especially for public basic research. Regional spillover effects are rather unlikely – as already mentioned – due to a lack of industrial structures. More likely is a continued strong increase in regional concentra-

tion of international basic research due to political fostered elite promotion of the location (Excellence Initiative) and an outstanding reputation (cf. NIW 2008).

The regional governance structure is likely to be further developed in the direction of an extension and strengthening of the inter-ministerial approach. Additionally, the policy will at least maintain if not deepen its cooperation with a broad basis of actors from the innovation and research system. Building on the above said and against the background of the European core objectives with regard to innovation capabilities (Europe 2020), on the one hand, a task should be to increasingly reintegrate SMEs into R&D and innovation processes and strengthen the foundation of R&D intensive SMEs. On the other hand, against the backdrop of the occurring Demographic Change, it is urgent to strengthen the training and education of human capital as well as to expand and intensify the further education of adults. It is assumed that in particular SME support and funding programmes, start-up promotion programmes as well as further education programmes will continue to form the central pillars of innovation policies in the future. A further challenge on which the region´s future depends on is, however, the mitigation of regional economic dependence on its automotive sector. As a long-term promising industry, the renewable energy sector could play an important role.

4.3 Assessment of the regional R&D System

4.3.1 Governance Dimension

Concerning the governance dimension, Lower Saxony is rather close to a *network R&D system*. RTDI support takes place on different levels, e.g. local, regional, or federal as appropriate. In the manner of a network system funding is guided and assessed by public and private regional banks (e.g. NBank), government, semi-state-owned, and private agencies or firms (e.g. Ministries, n.transfer, IZ, etc.) as well as regional research institutes (e.g. NIW). Lower Saxony´s research competences are quite broad in nature, thus covering basic, applied and experimental research. This is due to the extended Lower Saxon private and public research landscape. However, since the Lower Saxon R&D system is business-oriented and the private business sector contributes a major proportion of the overall research activities, it must be said that applied and experimental research are in the focus. Since numerous actors are involved in the entire Lower Saxon R&D systems, the degree of coordination can be assessed as quite high. The region´s degree of specialization with respect to its governance and policy characteristics is rather flexible. In general, Lower Saxony can be regarded as being specialized to a quite large extent in the automotive and thereof connected or associated sectors (e.g. metal production, plastics and rubber, chemical, and electronics industries, mechanical engineering). However, due to the awareness of the importance of SMEs for the regional development and the need for diversification in order to sustain long-term growth, the regional policy initiatives are often addressed to SMEs and high-tech sectors, such as the ICT industries, the biotechnology and life sciences, climate and maritime research, energy, and new materials.

4.3.2 Business Innovation Dimension

In general, regarding the business innovation dimension, the Lower Saxon R&D system is a mixture of *globalised* and *interactive R&D systems*. On the one side, the Lower Saxon R&D system is highly dominated by large, indigenous companies (e.g. Volkswagen AG, Continental AG, Salzgitter AG). Of those companies, most are active globally and supported by clustered supply chains of rather dependent SMEs. On the other side, regarding the research reach, the Lower Saxon R&D system can be classified somewhere between an interactive and a globalised system. Lower Saxony hosts a broad mix of public and private research institutes, regional headquarters of larger firms and a regional government keen to promote innovation. These aspects stand for an interactive R&D system. However, at the same time, the Lower Saxon R&D system is highly characterized by private rather than public research activities, which are mostly conducted by large-scale enterprises, although the public innovation struc-

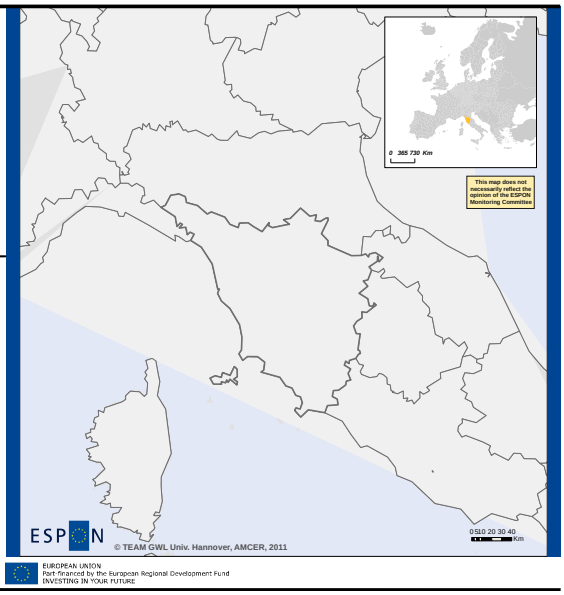
ture aims on the support of knowledge and technology production of SMEs. These aspects are more of a globalised R&D system. This ambivalent characteristic continues for associationalism. The overall degree of association can be assessed to be well engineered, especially in the central leading industries. However, the political actors accelerate actively the existence and foundation of network initiatives in smaller sectors and future fields of activity, in order to create new potentials, synergy effects, innovative impulses, and co-operation advantages.

II. Region Tuscany

ITALY

Region Tuscany

NUTS Code ITE1 (NUTS-2-Level)



Introduction:

Tuscany is a region in Central Italy, bordering on the regions Liguria and Emilia-Romagna to the north, Umbria to the east, Marche and Lazio to the southeast or south, respectively, and the Mediterranean Sea to the west.

Tuscany has a surface of 22,994 km² and a population of about 3.7m. The region has a population density of 164 per km² as of 2009, which means that it is sparsely populated by Italian standards (204) but relatively dense populated taking the EU-27 average (116, in 2008). The regional capital is Florence with about 370,000 inhabitants in its core and 1.5m inhabitants in the metropolitan area (cf. EUROSTAT 2011; DEMOISTAT 2010).

National/EU context:

Tuscany´s regional GDP per capita is above the Italian and the European mean. The region is shaped by small-scale businesses with little research capabilities, organised in industrial districts. However, there are sectoral changes occurring, with modern industries developing. Nevertheless, research activities are mostly due to the public sector. Indicators of the RDTI system show that Tuscany cannot achieve national and EU average values.

The main R&D sectors are in the fields of radar, space, and laser technologies, ICT research, as well as biotechnology and life sciences. These research fields are high-tech-oriented and mostly dominated by the public sphere. The business sector plays a rather subordinated role. Finally, the weaknesses of the private sector in terms of RTDI activities partly explain the steadily erosion of the region´s international competitiveness in its traditional industrial sectors (cf. COLETTI 2007).

The innovativeness of the Tuscany region, measured by the number of patents registered at the EPO, is below the national and European figures. In 2007, employment in R&D sector was equivalent to 6.7% of the overall Italian R&D personnel. The R&D personnel per 1,000 employees amounted to 9.2. This figure almost corresponds with the Italian standard (9.1), but it is below EU average (11.0). The number of R&D public employees is 17.7% of the total. The main differences with the national average are in the greatest number of people within the university, highlighting the role of universities in R&D, and small business involvement (cf. EUROSTAT 2011).

In 2007, Tuscany had the 8th largest per capita spending on R&D among the Italian regions, and a R&D intensity of 1.01%, thus being far below both the national (1.78%) and the EU-27 average (1.85%).compared to the rest of Italy. The Tuscan R&D productivity amounts to 0.26, thus being below-average compared to the Italian standard (0.31) and to EU average (0.27) (cf. EUROSTAT 2011).

1. Socio-economic Characteristics

In 2008, the regional GDP in Tuscany amounted to about €106.1b, accounting for a share of about 6.8% of the Italian GDP and therewith forming the 6th strongest regional economy after Lombardia (20.9%), Lazio (11.1%), Veneto (9.5%), Emilia-Romagna (8.8%), and Piemonte (8.1%). The regional GDP per capita was €28,700 which represents 109.5% of the Italian and 114.3% of the EU-27 average, respectively. Between 1995 and 2008, the Tuscan economy grew by 4.9% p.a. which is above-average regarding both the national (4.7%) and the EU-27 (4.5%) (cf. EUROSTAT 2011). Comparing the economic performance of Tuscany with that of the other AMCER-regions, the region ranks in the upper third (see App. Tab. 3).

In 2009, the regional labour force amounted to 1.67m, representing 6.7% of Italy´s total labour force (24.97m). Therewith, Tuscany´s labour force size ranks in the upper third in comparison with the other Italian regions. The largest proportion has the region Lombardia (18.2%). The regional employment rate of the 20-64 year-olds lies at 67.8%, which is far above-average compared to the national average of 61.1% (cf. EUROSTAT 2011). Nevertheless, taking the employment rate target of 75% defined by the "Europe 2020 Strategy", the Tuscan employment rate is still far too low (cf. EC 2011).

In 2008, 3.0% worked in the agricultural sector, 31.2% in industry, and 65.8% of the employees worked in the service sector. These figures are roughly in line with the national average (3.8%, 29.7%, 66.5%), whereas Tuscany´s agricultural and service sectors are less but in turn the industry sector is more accentuated. Taking the EU-15 average (3.5%, 26.2%, 69.7%), where the more developed countries of the European Union are considered, some profound differences can be observed. Particularly striking is that in the EU-15 average the agricultural sector and especially the service sector appear to play a more important role, whereas the proportion of the industrial sector is less pronounced. This illustrates the relatively large overall relevance of the industrial sector and the comparable less importance of the service sector for Italy in general, and Tuscany in particular (cf. EUROSTAT 2011). Nevertheless, the Tuscan economy shifted further towards the service sector in recent years, with tertiary activities growing faster in Tuscany than in the rest of Italy. Regarding the structural change, one can say that Tuscany is steadily losing its industrial basis for which the region has been noted since the middle of 20th century. The overall reduced relevance of the industry sector in Tuscany is mainly due to the reduction of manufacturing. While the added value of Tuscan manufacturing decreased by two points between 2000 and 2004, the Italian average only dropped by 0.4%. The decline in manufacturing was largely the result of the downsizing of the Tuscan fashion industry (cf. CRESCINI/PELA 2008). However, comparing the economic structure of Tuscany with that of the other AMCER-regions, in terms of its industry sector share the region ranks in the 3rd place, regarding the service sector share it ranks in the lower third (see App. Tab. 4).

The average annual regional unemployment rate accounted for 6.1% in Tuscany in 2010, coming from 5.3% in 2005. The regional trend is thus following the national development, where the unemployment rate increased from 7.7% (2005) to 8.4% (2010) (cf. EUROSTAT 2011). Nevertheless, both the Tuscan and the national unemployment figures are well below the EU-27 average of 9.6% in 2010. Although between 2005 and 2007, a recovery of the labour market seemed to occur with rates declining from 5.3 to 4.3%, in 2008 and 2009, in the period when the financial crisis affected the real economy the most, the Tuscan unemployment rates harshly increased again to 5.0% (2008) and 5.8% (2009). These developments il-

lustrate the regional labour market susceptibility. Comparing the unemployment rate of Tuscany with that of the other AMCER-regions, the region ranks in the 3rd place. Taking the youth unemployment (15-24 year-olds) Tuscany ranks in the midfield. Moreover, the relatively high long-term unemployment share must be considered critical (see App. Tab. 5). The discussed figures show that Tuscany still has some advantages, but that those fade over time, despite high economic prosperity during the last decade. In general, the negative evolution of the regional and national unemployment figures unveils existing inflexibilities in the labour market, which make structural reforms necessary. A result of delayed reforms is that the general unemployment is rising and the youth as well as the long-term unemployment persist on high levels.

Table 3: Intra-regional socio-economic Disparities in Tuscany (selected Indicators)

Coefficient of variation of GDP per capita 2008 (in %)	Coefficient of variation of the yearly average GDP per capita growth rate 1998-08 (in %)	Coefficient of variation of the unemployment rate 2009 (in %)	Coefficient of variation of the population dynamics 2002-10 (in %)
8.27	24.79	31.62	26.74

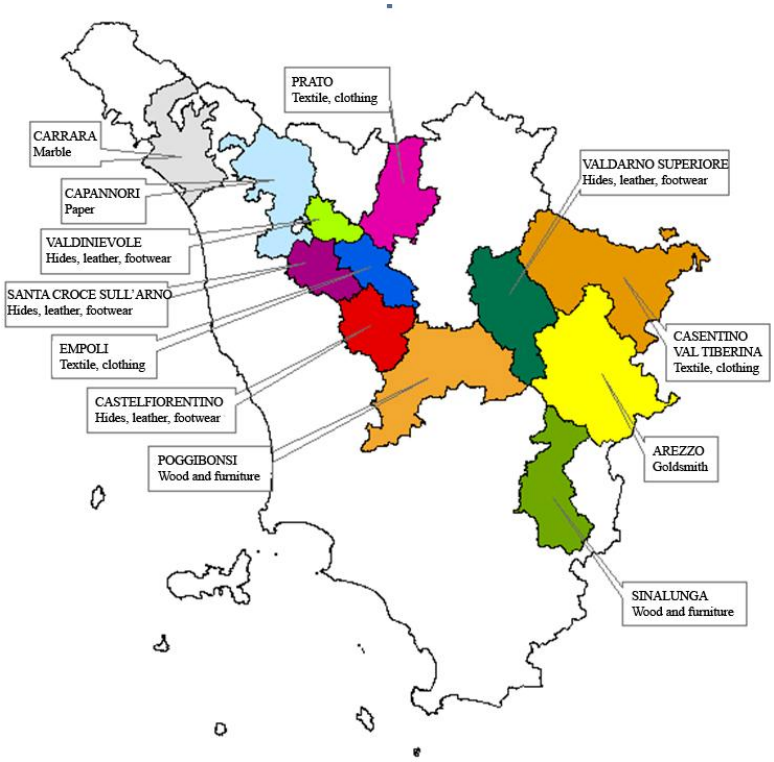
Remark: disparity calculations based on NUTS-3 level data

(Source: own creation and calculations; based on data from EUROSTAT 2011)

The Tuscan economy exhibits some intra-regional disparities as indicated through the coefficient of variation of several indicators stated in Tab. 3. The economically weaker regions which are below the Tuscan average are Massa-Carrara and Pistoia to the north and the northeast, respectively, Arezzo to the east, Grosseto to the south, and Livorno to the west. Particularly weak is the region Massa-Carrara. The stronger regions are all located around the economic centre Firenze (Florence). Except of the region Siena which is situated to the south of Florence, all economically powerful regions are located to the north or northwest of Florence. Nevertheless, in general, it is noticeable that the distribution of wealth does not vary excessively among the regions. Much more unevenly distributed are growth, unemployment and population dynamics. Surprisingly, the economically weaker regions show the highest growth figures. Here, most outstanding is the region Grosseto, followed by Massa-Carrara and Livorno. Regarding the unemployment among the regions, it could be observed that especially Massa-Carrara has a particularly high unemployment rate, followed by Prato and Lucca. All other regions have quite similar, low unemployment figures (around 5%). Although, the regional population development is in general negative, comparatively high growth figures can be found in the north-eastern regions; whereas the north-western regions have the lowest figures (cf. EUROSTAT 2011).

Despite an overall increasing importance of the service sector in Tuscany during the last two decades, the industry sector is still a main pillar and driver of development in the region. Tuscany is Italy´s third major manufacturing centre after Milan and Turin (cf. TOSPRO 2011). As in other regions of central and north-eastern Italy, the Tuscan production system is characterized by a dense network of small-sized enterprises and by self-employment, the so-called "industrial districts" (DEI OTTATI 1998:28). They have become internationally famous for their exceptional success and could be described as "an integrated industrial area, which produces economies external to the firm, and even to the industrial sector defined by technology, but internal to the 'sectoral-social-territorial' network" (BECATTINI 1978:114). Within these industrial districts, a great richness of local expertise and tacit knowledge is accumulated. Based on the networks, over time, "a wide and multi-layered variety of production systems has developed, on which to a large degree the regional industry´s level of competitiveness rests" (COLETTI 2007:3).

Figure 1: Industrial Districts in Tuscany



(Source: CRESCINI/PELA 2008:25)

A dominance of industrial districts is notably visible in highly traditional sectors (mostly fashion-related) (see Fig. 1), such as clothing, silk, wool, leather products, footwear, furniture, chairs, leather sofas, spectacle frames, gold jewellery, sportswear (including ski boots), stockings, tiles and household products: cutlery, taps, and sanitary pottery. World-famous companies in these industries are for instance Ferragamo, Gucci and Prada. The industrial districts in Tuscany comprise about 387,000 enterprises, of which around 98% have less than 20 employees. Since many businesses in Tuscany are indigenous SMEs rooted in industrial districts, the overall regional proportion of SMEs is likely to be extraordinary high. Although manufacturing activities by industrial districts are still shaping the region´s industry, compared to the total value added, the traditional sectors (27.4%, in 2005) are no longer the leading segments of Tuscany. It has been replaced by niches of machine-building and mechanical engineering, e.g. machine tools, textile apparatus, medical instrumentation, and packaging machinery, which account for about one third of the value added of regional manufacturing. However, in these fields of activity about 180,000 people are employed, which stands for more than the half of all employees in the industrial sector. Further important industrial activities are in manufacturing of transport equipments, plastics and rubber products, chemicals, foods, steel, metals, glass/ceramics and pharmaceuticals, employing about 84,000 people. Reputable companies from those fields are Galileo, Nuova Pignone and Breda. In recent years, the biotechnology and life science sector became increasingly important, employing about 13,000 people. Top players active in that field are among others Novartis, Menarini, El.En, Boehringer Ingelheim, Eli Lilly, and Abiogen (cf. BELUSSI 2003; CRESCINI/PELA 2008; EUROSTAT 2011; TOSPRO 2011).

Concerning the importance of the traditional sector and the industrial districts, the abovementioned quantitative shift is matched by qualitative changes. Firstly, the industries apart from the traditional sectors are not organized in similar types of territorial clusters. Secondly, the average size of those businesses has changed. Even if their size is not very large, the enterprises from the 'modern' sectors are significantly larger than the firms from the traditional

sectors. Lastly, the firms from the modern sectors do not concentrate their production in specific fields as the firms in the traditional sectors do, whereby their products are far more varied and diversified (from low-tech to high-tech) and no segment excels the others. A further change is that more and more Chinese-owned and run enterprises are active in the traditional sectors. They specialized predominately in the so-called 'fast fashion' segment and produce middle quality range fashion articles. With this added new product specialization it could be possible to reduce the process of downsizing in the districts again (cf. CRESCINI/PELA 2008).

Although the industrial sector is still important for the region, the service sector became increasingly dominant, since there was a restructuring phase in the industry sector since the 1980s, along with high job losses. Essential fields of activity in the service sector are in tourism, transport and logistics, and business-related services (cf. BOI 2007; EUROSTAT 2011; POR 2004a).

In 2007, the overall scope of exports was €26.3b (7.3% of national total), imports came to €19.6b (5.3% of national total). The traded commodity patterns are in line with the dominating industrial sectors. Main export goods were products from the mechanical industry (e.g. metal products, machinery, means of transport) with a share of 39.6%, followed by products from the traditional sectors (e.g. textiles, clothing, leather, footwear) with 25.8% and chemical products, pharmaceuticals, artificial and synthetic fibres with 15.0%. In 2007, the primary target markets were Europe (62.3%), Asia (17.8%), and America (13.7%), followed by far distance from Africa (5.1%). Tuscany traditionally is a net exporting region and the scope of imports and exports depicts the openness of the Tuscan economy but also its dependence on demand from overseas markets (cf. CRESCINI/PELA 2008:23; ISTAT 2011).

2. RTDI Characteristics

2.1 R&D Efforts and Input into the Process of Knowledge Generation

Tuscany´s GERD amounts to €1.05b in 2007, thus contributing 5.8% to the Italian total. The R&D expenditures per capita amounted to €288. Therewith, Tuscany has the 8thlargest per capita spending on R&D after Piemonte (€524), Lazio (€505), Emilia-Romagna (€478), Lombardia (€411), Friuli-Venezia Giulia (€408), Autonomous Province of Trento (€360), and Liguria (€316). When expressed as a percentage of GDP, the GERD is used to indicate the overall R&D intensity of a country or region. This measure unfolds the emphasis placed on R&D activities within a given economy. In 2007, R&D expenditures per GDP are 1.01%, thus slightly below the national average (1.18%) but well below the EU-27 average (1.85%) (cf. EUROSTAT 2011). Additionally, the regional R&D expenditure per GDP quota is far away from meeting the target of 3% defined by the "Europe 2020 Strategy" (cf. EC 2011). Comparing both the R&D expenditures per capita and per GDP of Tuscany with that of the other AMCER-regions, the region ranks in the pre-last and last place, respectively (see App. Tab. 6).

In 2007, the FTE employment in R&D amounts to 13,977, which is 6.7% of the overall Italian R&D personnel. The R&D personnel (FTE) per 1,000 employees amounted to 9.2. This figure almost corresponds with the Italian standard (9.1). In Comparison with the EU-27 average (11.0), the Tuscan figure is far below-average. Regarding the R&D personnel per 1,000 employees in comparison to the other AMCER-regions, Tuscany ranks in the lower third again (see App. Tab. 6) (EUROSTAT 2011).

The R&D sector can be sub-divided into the BES, the GOV, the HES, and the PNP. Their relative importance varies greatly across regions, however, generally reflecting different economic or research structures and traditions, respectively. With regard to the innovation system approach, the proposition of BERD is considered as an indicator of the overall innovative capacity of a region. Although, this should not be over-interpreted, because the other sectors also provide important stimuli to the process of knowledge and technology production.

The RTDI sector in Tuscany is clearly not business-oriented. The BERD amounts to only 40.5% (€424.4m) of the overall GERD, in 2007. Moreover, the share of the BES in R&D employment (FTE) accounts for merely 33.3% (4,653 employees) of the overall R&D employment. Regarding the business orientation of both the R&D expenditures and the R&D personnel (FTE), Tuscany´s RTDI sector is one of the least business-shaped among the AMCER regions (see App. Tab. 6) and also a lot less business-oriented than the EU-27 average (63.7%, 52.1%) (cf. EUROSTAT 2011). Nevertheless, due to the in general small size of the firms, their product specialization and their linkage to traditional sectors the innovation capacities as well as the scope of research activity are often underestimated. The firms´ product and market features generate various incremental innovations, "which derive from small variations in the production process, do not require substantial technological discontinuity and spring from the capacity of firms to adapt their production to changes in demand" (COLETTI 2007:39). However, it is undeniable that the Tuscan system lags in terms of research and innovation activities, especially in the private sector. Finally, the weaknesses of the private sector in terms of RTDI activities partly explain the steadily erosion of the region´s international competitiveness in its traditional industrial sectors (cf. COLETTI 2007).

The HES as well as the GOV play a far more important role in terms of R&D expenditures and personnel (FTE). In the HES the shares of R&D expenditures and personnel amount to 50.5 (€529.9m) and 50.6% (7,074 employees), respectively. Accordingly, the shares of R&D expenditures and personnel in the GOV are 8.0 (€84.3m) and 14.8% (2,067 employees). Tuscany hosts a broad university and research system which supports and accelerates technology transfer activities and the formation of partnerships with the private sector and other public research centres. Essentially in this context are the university centres of Florence, Pisa and Siena. Additionally, Pisa has also two schools of excellence, namely the Normal School, and the Sant'Anna School of Advanced Studies. Tuscany also hosts important local institutes of the main national research institutes (CNR, INFN and INFM). In addition, there are numerous science and technology centres, technology and innovation agencies, research consortiums, specialized manufacturing service centres, and business incubators for innovative businesses in the region (cf. COLETTI 2007). The PNP plays rather a subordinated role with a share of 1% (€10.1m) in expenditures.

As described here, the Tuscan system is rather unique. On the one hand, R&D is well developed in the public sector, whereas, on the other hand, it is hardly developed the private sector. While the region suffers from low levels of R&D and innovation from the business sector, its higher education institutions show a highly developed capability for advanced R&D activities and high-tech industries. Hence, there seems to be a mismatch between the industrial basis and the public research sector. In addition to it, this can be traced back to an ineffective knowledge transfer process, due to limited capacities on the part of intermediate structures (cf. COLETTI 2007). Due to both circumstances, Tuscany has difficulties in "linking the drivers of theoretical development and transferral of codified technical and scientific knowledge (research centres and universities) and the repositories of contextual knowledge (businesses). The relation between these two spheres in Tuscany, except in rare cases, is complex, due to culture, interests and the mode of governance of the learning process" (COLETTI 2007:3).

The main Tuscan R&D sectors are in the fields of radar, space, and laser technologies, ICT research, as well as biotechnology and life sciences. These research fields are high-tech-oriented and mostly dominated by the public sphere. The business sector plays a rather subordinated role.

The R&D-related activities and their outcomes are not uniform across regional areas within Tuscany (cf. EUROSTAT 2011). Most of the research and innovation performance is bundled in the regions of Florence (Firenze), Pisa, and Siena, what is due to the circumstance that most

of the overall important research actors (universities and research centres) are in these regions (cf. COLETTI 2007). Therewith the broad mass of innovation competences is concentrated in the centre of Tuscany.

2.2 Human Capital Endowment

In 2009, HRSTC in Tuscany amounted to 0.200m, representing 6.6% of national total (3.038m) and 12.0% of the economically active population. With this share of knowledge workers Tuscany ranks in the last place in comparison with the other AMCER regions (see App. Tab. 7) (cf. EUROSTAT 2011).

Moreover, in 2009, Tuscany had a stock of 36,225 employees working in high-tech industries and knowledge-intensive services, i.e. 4.7% of national total and 2.3% of total employment in the region. Therewith, Tuscany´s share in total employment is below-average in Italian standards (3.4%) (cf. EUROSTAT 2011). In comparison with the other AMCER regions, Tuscany ranks in the last place again (see App. Tab. 7).

The education level of the human capital forms the basis for productive and innovative activities in developed countries and regions. In 2010, Tuscany had 242,794 students in the secondary education level (ISCED 2-4), i.e. 65.5 students per 1,000 inhabitants. Thus, regarding the Italian standard (77.4), this is far below-average. Overall, 39.6% of the Tuscan population of working age (25-64 year-olds) has an upper secondary education attainment (ISCED 3), in 2010. This is compared to both the Italian (40.4%) and the EU-27 average (46.8%) well below-average. Regarding the tertiary education level (ISCED 5-6), the region had 144,628 students in that field in 2010, i.e. 39.0 students per 1,000 inhabitants. Considering the Italian average (33.5), the Tuscan figure is far above-average. Altogether, 15.3% of the population of working age has a tertiary education attainment (ISCED 5-6). This is compared to the Italian average (14.8%) slightly above-average but towards the EU-27 average (25.9%) again well below-average. The proportion of the 30-34 year-olds with a tertiary education attainment amounts to only 24.3% in the NUTS-1 region "Centro"[1] (Italy: 19.8%; EU-27: 33.6%), thus central Italy does not meet the 40%-target defined by the "Europe 2020 Strategy" (cf. EC 2011; EUROSTAT 2011). Comparing the figures of secondary and tertiary level students per 1,000 inhabitants of Tuscany with those in the other eight AMCER regions, the region ranks in terms of secondary level students in the lower third and in terms of tertiary level students in the upper third (see App. Tab. 7).

Regarding the early leavers from education and training, which can be interpreted as at least temporarily lost human capital, in the education vintage 2010, they account for 14.8% in central Italy[2]. This is a minus of 5.6 percentage points compared to the year 2000 and thus suggesting a pronounced positive trend. Additionally, this result is far better than the Italian average (18.8%) but still below the EU-27 standard (14.1%) (cf. EUROSTAT 2011). Apart from the fact that the Tuscan figure is generally rather high, moreover, the regional proportion of early school leavers does not meet the maximum target of 10% defined by the "Europe 2020 Strategy" (cf. EC 2011). Compared to the other AMCER regions, the Tuscan proportion ranks in the upper midfield (see App. Tab. 7). Against the backdrop of the aging Tuscan society (see 4.1 below), high reintegration costs, increasing pressure for innovation, productivity, and competitiveness, profound reforms are urgent.

Because the technological progress is increasingly challenging developed countries and regions and therewith requirements to education are steadily rising, further education of adults is playing an increasingly important role in knowledge and innovation-driven economies in general and for aging societies in particular. The Tuscan participation share of adults aged 25-64 in education and training amounts to 7.2%, in 2010, therefore being above the Italian

[1] There were no data for Tuscany (NUTS-2 level) available.

[2] There were no data for Tuscany (NUTS-2 level) available.

(6.2%) and below the EU-27 average (9.1%). The regional figure ranks in the lower midfield compared to the other AMCER regions, although it should be mentioned that the top regions have far better values (see App. Tab. 7) (cf. EUROSTAT 2011).

2.3 Potential for Innovation

In the course of this work, the number of patent applications at the EPO is taken as an indicator for the potential for innovation, thus depicting the production of knowledge and technologies. Although in the innovation process patents are somewhere between inventions and innovation and therefore covering only a part of the whole innovation process, they are among the most widely used innovation indicators (cf. GRUPP 1997; FRIETSCH et al. 2008).

In Tuscany, between 2000 and 2003 1,011 patents were applied for at the EPO, accounting for 6.2% of the national total. Between 2004 and 2007 the number of patent applications amounted to only 999 (5.7% of national total), a decline of about 1.2%. At the same time, the patent applications per million inhabitants shrank from 289 in 2000-2003, to 277 in 2004-2007 (minus 4.1%). Among the Italian regions Tuscany ranks in the upper third, regarding the overall patent output (cf. EUROSTAT 2011). In comparison to the other eight AMCER regions, regarding both the absolute and the relative patent application figures, the region ranks in the lower third together with Catalonia and Andalusia (see App. Tab. 8).

Since patents are in most cases the result of extensive R&D activities, it is possible to determine the R&D productivity (measured as EPO patent applications per million R&D expenditures in 2005). Moreover, this indicator unveils how effective the money spent on R&D is utilized in the process of knowledge generation. The Tuscan R&D productivity amounts to 0.26, thus being below-average compared to the Italian standard (0.31) (cf. EUROSTAT 2011). Despite apparently existing weaknesses, compared to the other AMCER regions the Tuscan R&D productivity still ranks in the midfield (see App. Tab. 8).

Concerning the technically more challenging high-tech patents, Tuscany accounted for 69 applications at the EPO between 2004 and 2007. Nonetheless, between 2000 and 2003 the region´s high-tech patent applications still amounted to 98, thus baring a decline of 29.6% over time. The high-tech patent applications per million inhabitants come to 19 in the period of 2004-2007. For the same period, the proportion of high-tech patent applications to all patent applications amounted to 6.9%. Among the Italian regions, Tuscany ranks in the upper midfield, regarding high-tech patent applications. Comparing the region´s figures with that of the other AMCER-regions, it ranks in the pre-last place (see App. Tab. 8). These results reflect the above-mentioned circumstances that Tuscany is only to a small proportion, a high-tech region. However the most Tuscan high-tech patent applications have been made in the fields of communication technologies (37.2%), computer and automated business (33.3%), and micro-organism and genetic engineering (16.2%) (cf. EUROSTAT 2011). The here drawn focus in high-tech patent applications reflects the above-mentioned research specialization of the higher education sector, thus emphasizing the regional importance of this sector for high-tech innovation and research, and knowledge creation.

3. RTDI Governance and Innovation Policy

3.1 Governance

With the Bassanini Law in place at the end of the 1990s and the reform of Chapter V of the Constitution in 2001, the central government gave specific powers with respect to industry, innovation and technological development to the regions. Since this point in time, the regions are the central designers of their research and innovation governance (cf. COLETTI 2007).

Through its regional administration as well as territorial actors in the field of research and innovation, Tuscany is on the one hand, connected to the public research sphere (e.g. universities and research centres) and on the other hand, through direct aid mechanisms to the business sector. Supported by universities and research centres the regional administration tries to

create direct links between the (public) research institutions and the business sector. This aims on fighting against the already addressed ineffective knowledge transfer processes, the limited capacities on the part of intermediate structures, and the acceleration of learning processes in order to strengthen the regional competitiveness (cf. COLETTI 2007).

Tuscan provinces and municipalities are also significant actors, because through special offices, they have the chance to promote actively innovation and technology development and transfer activities within their areas of jurisdiction in consultation with the regional administration (cf. COLETTI 2007).

Tuscany has no single body assigned to innovation. In fact, a set of institutions is concerned with innovation governance aspects. One of the important actors is the Regional Ministry for Productive Activities, which carry out, among other functions, innovation and technology transfer in the production system. Another key actor is the Regional Office for Innovation. It serves as hub for all programmes and projects implemented and put forward in the field of research and innovation with European, national, and regional funds. The office administrates European funds under the Objective 2 Programme and the Regional Operational Programme, regional funds, CIPE funds, funds under the new objective 3, projects within the EU Research Framework Programme, and other projects and networks aiming on innovation and development of knowledge society. The regional financing body FIDI Toscana is a significant actor of the regional research and innovation system. It administers a wide range of financial incentives provided by the region. Further, the Regional Agency for Development and Innovation in the Agricultural and Forestry Sector (ARSIA) could be mentioned. It is an operational technical body of the Tuscan administration in the fields of agriculture and forestry. The agency has the task to act as an intermediary between the production system, the R&D sector and the proprietor of special technologies. In addition, it promotes process and product innovations, transfer measures and it carries out technical assistance activities. A further institution, although it has no direct jurisdiction in the area of innovation, is Toscana Promozione. Its task is, on the one hand, to attract foreign investors to settle down in Tuscany, and, on the other hand, to mediate between Tuscan business partners and firms and foreign actors. In doing so, Toscana Promozione operates together with a network of professional associations, institutions, enterprises, universities and research centers. Through the work of the institution, it supports the region both in obtaining new knowledge and technologies as well as in technological upgrading (cf. COLETTI 2007).

Although, the governance of research and innovation is primarily the task of regional actors, for some purposes, national actors from the central government are engaged in supporting the region with respect to research and innovation matters. For instance, the Ministry of Economy and Finance, the Ministry of Innovation and Technology, and the Italian National Centre for Information Technology in Public Administration in cooperation with the region of Tuscany distributed financial support in order to facilitate infrastructural basic investments (e.g. e-government services, infrastructure for authenticated and secure access to services, and broadband data transmission services), which are urgently needed in a knowledge society (cf. COLETTI 2007).

3.2 Policy

Since the early 1990s, Tuscany steadily began to approach the problem of lagging innovativeness. At that time, the problems of de-industrialization, an economic system with moderate technologies and weaknesses in diffusing innovation already existed and increasingly came to mind. Simultaneously, the Tuscan system already had significant scientific and technological potentials within the regions at that time. Based on that information, firstly the Tuscany Hi-Tech Network Project was established in 1994. The project tries to foster a regional innovation policy and the coordination of the Tuscan scientific community (cf. COLETTI 2007).

Since the above-mentioned jurisdiction and competence reforms have been transcribed in

the early 2000s, additional regional measures in order to promote research and innovation as well as knowledge and technology transfers have expatiated to all Italian regions and have also spread within Tuscany. The region supports innovation policies in all fields of competence, e.g. in the health and cultural sector and in the economy. The objective is to concentrate resources and attention towards the university and the numerous institutions that make up the scientific community in order to improve the quality of the Tuscan regional research system, focusing on meeting between basic and applied research. The regional activities for the development of regional research and innovation are articulated into two axes of intervention: the first aims at the overall coordination and promotion of research carried out by the Region in close cooperation with universities and centres of excellence. The second aims at promoting innovation and industrial research, technology transfer, pre-competitive development, capable of generating spin-offs for regional economic system. Particular importance is also the theme of health research. For these purposes, the regional law on promotion of research in April 2009. The measure, which was preceded by an extensive debate, supports research in universities and research organizations in Tuscany, in line with EU directives and guidelines of national policy, ensuring coordination between the various interventions to support research in the various disciplines (environmental, health, technology) and between research/innovation and dissemination of results (cf. COLETTI 2007).

The support of the region´s research and innovation community is ensured by various funding measures. The main support measures are namely Support for Joint Research Projects between Groups of Companies and Research Organisations in the Field of Socio-Economic Sciences and Humanities, Industrial Research and Experimental Development in the Health Sector, Tuscany Innovation Fund, Credit Guarantee for Small and Medium Enterprises in Tuscany, Public-Private Collaborative Research Projects in the Field of Environment, Transport, Logistics, Info-Mobility and Energy, and Aid Scheme for Industrial Research and Experimental Development (cf. RIM 2011b).

However, innovation policy attempts are facing problems which are diverse and can be attributed to "the Tuscan businesses and the region´s social context, which have little propensity towards innovation and collaboration with universities and centres of research; the different approach of universities, which view the relationship with businesses in a negative light; limited financial resources, which the region has reduced as compared to expectations; and finally, fading consensus, political weakness and shortcomings in territorial representativeness" (COLETTI 2007:8)

4. Trends, Challenges, and Assessment

4.1 Trends and Challenges which are not specific to the R&D Sector

As mentioned in the first section, the long-term economic development of Tuscany in the period of 1995-2008 was above-average compared to both the national and the European average. However, due to increasing competition in the traditional sectors especially from overseas (China and other Asian countries), the Tuscan industrial districts (see Fig. 1) will face enormous challenges. Therewith combined, the traditional sectors are forced to renew and reinvent their production system; otherwise low-cost producers from the competing countries are likely to overtake the markets which have been served by the Tuscan enterprises so far. In this context, Chinese entrepreneurs are supposed to play a central role. Chinese immigrants, who account for about 11% of total immigrants in the region, often own firms in the traditional sectors in Tuscany. In Prato, most Chinese-owned firms specialised in "fast fashion". This process "drastically reduces production and delivery times and [...] historically was born as a system of manufacturing articles of clothing of low cost and low quality. Over time, however, this also involved products in the middle quality range and currently it could represent an important market segment that is capable of reducing the process of downsizing of the

district" (CRESCINI/PELA 2008:19). This modified system did not exist before the Chinese started their businesses in Tuscany. This means that the Chinese firms "whilst exploiting all the advantages linked to an important district, did not attempt to drive away the local firms, but added a new productive specialisation to the district" (CRESCINI/PELA 2008:19).

As pointed out, however, the traditional sector already lost its former dominance, observed in declining value added figures (see part 1). The appearing gap is likely to be further filled by more modern sectors, e.g. machine building and mechanical engineering enterprises, as well as biotechnology and life science firms. Together with the rising relevance of enterprises from these sectors, the enterprise-size structure is likely to change over time, thus increasingly replacing the remarkable influence of small-scale firms.

The population development and especially the aging figures of a population are crucial for innovation related purposes, due to the fact that the youth and size of a population virtually determines its dynamism, innovativeness, and labour supply and therewith its future viability. In 2010, the Tuscan population reached its present maximum of about 3.73m (cf. EUROSTAT 2011). Since 2000, the regional population thus grew by 6.7%. With its population size, the region ranks the 2nd place among the central Italian regions and the 9th place regarding all Italian regions. The already mentioned distribution of population growth figures (part 1) is likely to persist in the future. The high population growth of the recent years is mostly due to high in-migration from abroad. In dependence of the economic development of the region, however, assuming a positive evolution, in-migration can expected to be a central pillar of population growth in the future. Particularly relevant is the development of the population age structure. In 2010, 12.6% of the regional population was younger than 15 years, 64.1% were between 15 and 64 years, thus representing the population of working age and about 23.2% were 65 years or older (retirement age). Hence, the age distribution depicts an ageing regional population where the cohort of the young and adolescent people is markedly smaller than the cohort of the people of pensionable age. This finding is in line with the overall national trend of the Demographic Change in Italy, whereas with its intense characteristics Tuscany belongs to the most concerned Italian regions. However, in 2030, the share of people which are 65 years and older will account for about 28% in Tuscany, underpinning the economic and social challenges the region is confronted in the future (cf. EUROSTAT 2011; GIANNAKOURIS 2010).

4.2 Trends and Challenges which are specific to the R&D Sector

The findings from the upper sections suggest that in the medium-term the public sector will stay the central pillar of research and innovation activities in the regions. The traditional sectors are likely to be further innovative regarding their processes and organisation forms in the future, but they will barely become innovators of technology intensive and demanding products. Firms from the more modern sectors (e.g. machine-building, biotechnology), however, have the chance to further expand their already existing engagement in R&D and innovation-related activities and thus strengthening and accelerating the overall relevance of the business sector in the long-run.

At the moment, due to the clustered public research sphere (universities, research labs) in Firenze, Siena, and Pisa and the simultaneously overall weak business sector participation in research and innovation processes in the rest of Tuscany, the regional research and innovation performance is highly spatially concentrated in the three locations. Already addressed but still one of the main future challenges will also be to further improve the knowledge transfers from the academia to the business sector, and vice versa. The discussed challenges of both the regional patterns of research and innovation performance as well as the intensification of knowledge transfers can, for instance, be handled through a deepened involvement of innovative firms from all over the region and increasing efforts in fostering spinoffs from the academia into the business sphere.

Further, the overall R&D expenses must be enlarged, especially in the business sector,

where the share is disproportionately small. Without doing so it will also be difficult to develop the region´s potential for innovation, because enterprises are, on the one hand, close to customer wishes, and, on the other hand, a driving force for bringing products to market maturity.

In addition, the human capital training and endowment is an existing but against the backdrop of the Demographic Change increasingly important challenge for the region. Without considerable efforts, the region will face problems such as high reintegration costs, and a lack of innovativeness, productivity and competitiveness.

4.3 Assessment of the regional R&D System

4.3.1 Governance Dimension

Concerning the governance dimension, Tuscany could quite clearly be assessed as a *grassroots R&D system*. The innovation system as well as knowledge and technology transfer processes are generated and organized mainly on the local level. Local development agencies and local institutional actors play a predominant role. In the manner of a grassroots system funding is highly diffuse in origin and shaped by a very low supra local or national coordination. Major funding channels are social networks, local banks and funds, and regional support programmes. Tuscany´s degree of specialization with respect to its governance and policy characteristics is likely to be rather low, because enterprises and public actors are active in various and often not connected fields. In general, Tuscany´s research competences are rather limited in the business sector and highly developed in the public sector. Nevertheless, joint projects are mostly rather applied or near market.

4.3.2 Business Innovation Dimension

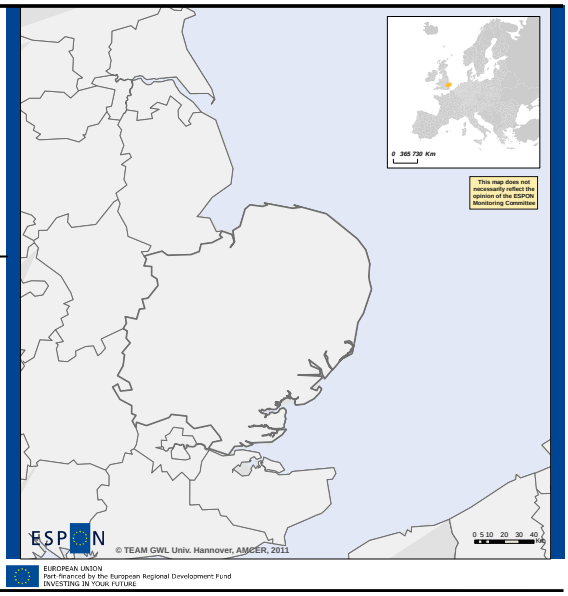
Regarding the business innovation dimension, the Tuscan R&D system can be classified as a *localist R&D system*. The system is still often dominated by a vast proportion of indigenous SMEs from traditional sectors with a quite low research reach and low research resources. Research is mostly performed by a few major local public research institutions (universities and research centres) with relatively high research resources. Basically, those would be capable to co-operate with local firms, but several problems exist, making joint research projects and knowledge transfer difficult. Particular striking is the fact that there is a mismatch between the industrial sector structure and its capabilities for research and innovation, and the fields in which the public research institutions are active. The overall degree of association can be assessed as very high, especially among entrepreneurs within the industrial districts but also between them and regional policymakers. However, in order to enhance the association among the public research sector and the broad mass of the business sphere, on the one hand, the gearing between the traditional sectors and the research actors needs to be improved and, on the other hand, the formation of firms from modern sectors, capable for innovations and research co-operations, needs to be accelerated.

III. Region East of England

United Kingdom

Region East of England

NUTS Code UKH (NUTS-1-Level)



Introduction:

East of England is a British (UK) region in the south-eastern part of England and is comprised of the counties of Essex, Hertfordshire, Bedfordshire, Cambridge shire, Norfolk, and Suffolk. It has borders with three out of twelve regions, particularly with East Midlands to the north, and both the South East and London to the southwest. East of England also borders the North Sea to the west.

The East of England has a surface of 19,126km² and a population of about 5.8m. Therewith the region had a population density of 300, in 2010, which is above the UK average of 250 but below the England average of about 400 (cf. EUROSTAT 2011; ONS 2010).

National/EU context:

The East of England´s regional GDP per capita is below the British but above the European mean. The East of England has a research landscape of great excellence and international relevance attracting many MNEs. The RTDI indicators of East of England are well above the national and EU level. However, large disparities within the region can be observed.

The main R&D sectors of East of England are in the fields of pharmaceuticals, life sciences and biotechnology, aerospace industries, computing/ICT, renewable energy technologies, creative industries, and food technologies. These research fields are often high-tech-oriented and mostly dominated by the business sector, although especially the higher education sector (e.g. Cranfield University and the University of Cambridge) plays a significant role for both realization of and co-operation in R&D activities. Moreover, the top universities play an important role in the education and training of young talents (cf. EEAD 2009a, 2009b).

The region´s innovativeness in relation to the other regions and nations within the UK, measured by the number of patents applied at the EPO, ranks in the 2nd place after the South East. Moreover, even in European terms the region is a strong player with respect to patenting. In 2007, the employment in R&D (FTE) was equivalent to 14.2% of the overall British R&D personnel. The R&D personnel (FTE) per 1,000 employees amount to 18.1. This figure is well-above the UK value (12.1) and the EU-27 average (11.0). Regarding the business orientation of both the R&D expenditures and the R&D personnel (FTE) (82.3%, 65.7%), the region´s RTDI sector is clearly more business-oriented than Britain (62.5%, 45.8%) and the EU-27 (63.7%, 52.1%). (cf. EUROSTAT 2011).

In 2007, the region had the largest per capita spending on R&D among the UK regions, and a R&D intensity of 4.4%, thus being far better than both the national (1.78%) and the EU-27 average (1.85%). However, the region´s R&D productivity amounts to merely 0.14, thus being below the British (0.17) and the EU-27 average (0.27) (cf. EUROSTAT 2011).

1. Socio-economic Characteristics

In 2008, the regional GDP in East of England amounted to about €159.5b, accounting for a share of about 8.8% of the British GDP, therewith forming the 3rd strongest regional economy after London (21.3%) and North West (9.6%). The regional GDP per capita was €28,000 which represents 94.6% of the British and 111.6% of the EU-27 average, respectively. Between 1995 and 2008, the regional economy grew by 5.9% p.a., which is above-average regarding both the national (5.7%) and the EU-27 (4.5%) (cf. EUROSTAT 2011). Comparing the economic performance of East of England with that of the other AMCER-regions, the region ranks in the upper midfield (see App. Tab. 3).

In 2009, the regional labour force amounted to 2.97m, representing 9.5% of UK´s total labour force (31.28m). Therewith, East of England has the 4th-largest labour force after South East (14.1%), London (13.0%), and North West (10.9%). The regional employment rate of the 20-64 year-olds lies at 77.6%, which exceeds the national average of 73.6% (cf. EUROSTAT 2011). Further can be mentioned, the regional employment rate clearly meets the employment rate target of 75% defined by the "Europe 2020 Strategy" (cf. EC 2011).

In 2008, 1.8% of the employees worked in the agricultural sector, 21.5% in industry, and 76.5% in the service sector. These figures almost correspond with the national average (1.4%, 21.4%, 76.9%). Taking the EU-15 average (3.5%, 26.2%, 69.7%), where the more developed countries of the European Union are considered, some profound differences can be observed. Striking is that in the EU-15 average the agricultural sector as well as the industry sector appears to play a much more important role, whereas the proportion of the service sector is less pronounced. This illustrates the relatively inferior importance of the industrial sector, showing that the overall structural change is much more developed in favour of the service sector in both East of England and Britain as a whole (cf. EUROSTAT 2011). Comparing the economic structure of East of England with that of the other AMCER-regions, in terms of its industry sector share East of England ranks in the pre-last position, regarding its service sector share it ranks in the 2nd place (see App. Tab. 4).

The average annual regional unemployment rate accounted for 6.6% in East of England in 2010, coming from 3.6% in 2004. The regional trend is thus following the national development, where the unemployment rate increased from 4.7% (2004) to 7.8% (2010) (cf. EUROSTAT 2011). Especially between 2008 and 2009, the period when the financial crisis affected the economy the most, the unemployment rate of East of England jumped from 4.8% (2008) to 6.2% (2009), unveiling the dependence and interference of the regional economy on financial market effects. However, both the East of England and the national unemployment figures are still well below the EU-27 average of 9.6% in 2010. Comparing the unemployment rate of East of England with that of the other AMCER-regions, the region ranks in the midfield (see App. Tab. 5). Moreover, the long-term unemployment share is the lowest among the AMCER-regions. However, taking the youth unemployment (15-24 year-olds) East of England ranks in the third lowest place. This must be considered critically (see App. Tab. 5). The discussed figures show that East of England´s economy gained great prosperity during the last decade and that the unemployment figures are still relatively low even if they grew in the light of the crises. Nevertheless, further improvements should be tackled with respect to long-term and youth unemployment. Additionally, against the backdrop that financial market instabilities are likely to increase in the future, reforms which support a broadening of the economic structure are required. However, in general, the region performed rather above-average compared to both national and European figures.

The economy of East of England exhibits some intra-regional disparities as indicated through the coefficient of variation of several indicators stated in Tab. 4. The economically stronger regions which are above the regional average are Luton and Hertfordshire to the southeast, Cambridgeshire in the centre, and Peterborough to the west. The economic centres are Cambridge and the south-western regions. The latter are benefiting from both Cambridge´s strong research landscape and the proximity to London. Further, especially the south-eastern parts are increasingly linked with London and the South East in terms of labour and housing markets. Particularly weak are the regions Norfolk and Suffolk to the north and northeast, respectively, and Southend-on-Sea as well as Thurrock to the southeast. The economically powerful regions in East of England extend from the centre to the west and southwest. The reasons for this divergence are complex, such as industrial restructuring, access to large markets, proximity to London, and differences in employment rates and skills. Growth dynamics are much more uneven distributed. In general, the economically better-positioned regions have higher growth rates. In fact, the highest growth rate is realised in Cambridgeshire. However, the south-eastern regions have higher growth rates than the likewise weak regions in the north and northeast. Regarding the unemployment among the regions, it could be observed that it is much more pronounced in the south-eastern parts than in the rest of East of England. Concerning the natural population development, the lowest growth figures dominate in the southwest, followed by the southeast and the north-eastern regions. The highest population growth can be found in Cambridgeshire and Peterborough, the economically strongest regions, which have excellent infrastructure, which has led to steady levels of job creation over the past two decades (cf. EUROSTAT 2011; RIM 2011c).

Table 4: Intra-regional socio-economic Disparities in East of England (selected Indicators)

Coefficient of variation of GDP per capita 2008 (in %)	Coefficient of variation of the yearly average GDP per capita growth rate 1998-08 (in %)	Coefficient of variation of the unemployment rate 2009 (in %)	Coefficient of variation of the population dynamics 2002-08 (in %)
20.25	48.08	20.48	43.02

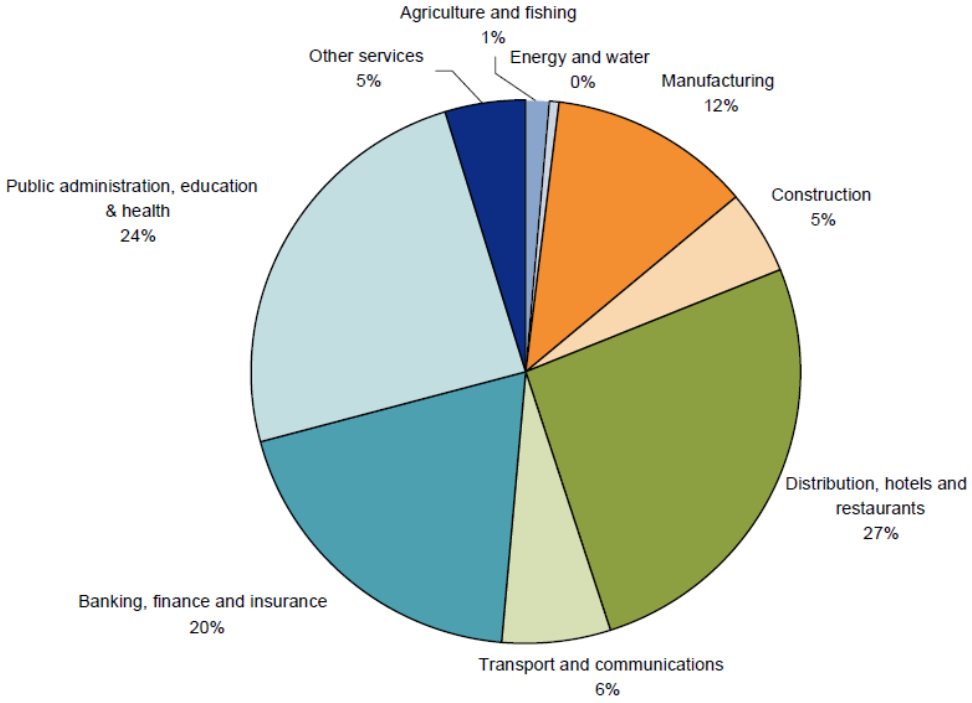
Remark: disparity calculations based on NUTS-3 level data

(Source: own creation and calculations; based on data from EUROSTAT 2011)

The economy of East of England employs about 2.7m people and the largest absolute employment sectors in the region are distribution, hotels and restaurants (600,000 employees, in 2004), public administration, education and health (560,000), banking, finance and insurance (450,000), and manufacturing (230,000). Using Location Quotients[3], compared against the national average, economic activity in the East of England is characterised by a strong presence of agriculture and fishing, construction, manufacturing industries and the hotels and restaurant trade. Transport and communications and distribution, hotels and restaurants are slightly above the national picture, whereas public administration and defence, education and health, banking, and energy and water falling below the national average (cf. EEDA 2006; EUROSTAT 2011).

[3] A value of 1 or more indicates that a particular industry sector matches or has a stronger presence at the regional level when compared to national figures.

Figure 2: East of England Industry Shares of Regional Employment, 2004



(Source: EEDA 2006)

Regarding firm size, the East of England´s economy is rather characterized by SMEs. Employment in firms with less than 250 employees (=SME) accounted for about 55% of total employment (2008). Nonetheless, comparing the region´s employment share of SME´s with that of the EU-27 average (67%, in 2005), it can be determined that it is somewhat more characterized by large-scale enterprises. In addition, the revenue/turnover profile of the region is dominated by large enterprises (59.1 per cent), while 11.1 per cent from medium-sized enterprises, and 29.8 per cent from small-sized enterprises. That elucidates an ambivalent picture with respect to the shaping enterprise-size structure. However, for the economy of the East of England larger firms play an important role (cf. BIS 2009a).

In 2009, the overall scope of exports was £20.39b (12.4% of national total), the scope of imports came to £40.67b (24.7% of national total). Such data suggests that the value of imports to the East of England is approximately twice that of exports from the region, showing that the region´s domestic demand is predominant and that the economy is producing mainly for the domestic UK market. The main sectors of export were machinery and transport, accounting for 38.1% of total exports, chemicals – 23.8% and miscellaneous manufactures – 13.5% (2009). In 2009, the primary target markets were the EU, accounted for £12,213m (59.9%), North America, £3,134m (15.4%) and Asia and Oceania, £2,442m (11.9%). The data outline also that in terms of imports and exports, the effects of the wider economic crisis were felt strongly in 2009. Thus, exports in 2009 from the East of England fell by 8.3% from 2008. Yet, by 2010, they had returned and increased from their 2008 levels. Regarding imports, they fell by 11% in 2009 and by 2010, had just about returned to their 2008 levels. Such figures highlight that the effects of the wider economic recession in UK in 2008-2009 led certainly to reduced demand for imported products in 2009. Regarding exports, these were not as badly hit as imports and have quickly increased from their 2008 levels in 2010, demonstrating potential some sustainability in the East of England's export sectors (cf. HMRC 2011).

2. RTDI Characteristics

2.1 R&D Efforts and Input into the Process of Knowledge Generation

East of England´s GERD amounted to €7.99b in 2007, thus contributing 21.9% to the UK

total. The R&D expenditures per capita amounted to €1,418. Therewith, the region has the largest per capita spending on R&D followed by the South East (€915), the North West (€624) and London (€596). When expressed as a percentage of GDP, the GERD is used to indicate the overall R&D intensity of a country or region. This measure unfolds the emphasis placed on R&D activities within a given economy. In 2007, R&D expenditures per GDP are 4.4%, thus far better than both the national (1.78%) and the EU-27 average (1.85%) (cf. EUROSTAT 2011). Therefore, the regional R&D expenditure per GDP quota does easily meet the target of 3% defined by the "Europe 2020 Strategy" (cf. EC 2011). Comparing both the R&D expenditures per capita and per GDP of East of England with that of the other AMCER-regions, the region ranks in the 1st place (see App. Tab. 6).

In 2007, the FTE employment in R&D amounts to 48,905, which is 14.2% of the overall British R&D personnel. The R&D personnel (FTE) per 1,000 employees amount to 18.1. This figure is again well above both the UK (12.1) and the EU-27 average (11.0). Regarding the R&D personnel per 1,000 employees in comparison to the other AMCER-regions, the region ranks in the 2nd place after Länsi-Suomi (see App. Tab. 6) (EUROSTAT 2011).

The R&D sector can be sub-divided into the BES, the GOV, the HES, and PNP. Their relative importance varies greatly across regions, however, generally reflecting different economic or research structures and traditions, respectively. With regard to the innovation system approach, the proposition of BERD is considered as an indicator of the overall innovative capacity of a region. Although, this should not be over-interpreted, because the other sectors also provide important stimuli to the process of knowledge and technology production.

The RTDI sector in East of England is clearly business-oriented. The BERD amounts to 82.3% (€6.58b), in 2007. Moreover, the share of the BES in R&D employment (FTE) accounts for 65.7% (32,131 employees) of the overall R&D employment. Regarding the business orientation of both the R&D expenditures and the R&D personnel (FTE), the region´s RTDI sector is clearly more business-oriented than Britain (62.5%, 45.8%) and the EU-27 (63.7%, 52.1%). Comparing the same aspects between East of England and the other AMCER-regions, the region ranks in both cases in the 2nd place (see App. Tab. 6), thus having a more business-oriented RTDI sector than the most AMCER-regions (cf. EUROSTAT 2011). About 75% of the business R&D expenditures are bundled in the manufacturing sector, which is significant in proportion to the employed people, accounting for 11% of employment in the region. The high degree of business orientation in R&D is due to the presence and scale of firms and top-universities (see below) in the region. It is home of many national and multinational high-tech and research-intensive enterprises such as CSR, Domino, Unipath, Lotus Engineering, Plastic Logic, Xaar, Microsoft, GSK, AstraZeneca, BAE Systems, BT, Unilever, and Ford. They are all conducting at least a part (in many cases the whole) of their R&D activities in the region. Since many of these enterprises could in principle carry their R&D anywhere in the world and, moreover, many MNEs even have R&D labs in the East of England in addition to those in their headquarters. This is underpinning the strengths and the strategically importance of the region. Although, in general, the share of firms that are active in research and innovation tends to increase with the business size in the region, the proportion among SMEs which are active in that field is almost equal in size, thus underpinning also the relevance of SMEs for the regional knowledge and technology production (cf. BIS 2009b; EEDA 2009a).

Although the proportion of the HES and the GOV is quantitatively significantly smaller than that of the BES, their research activities are of great relevance for the entire region. Thanks to the great excellence of the HES (e.g. Cambridge University) and its outstanding international reputation the region was able to develop an unique environment in which research-oriented firms (e.g. MNEs, spinoffs or industry-university co-operations; see below) are able to conduct sophisticated knowledge and technology production. In the HES the

shares of R&D expenditures and personnel amount to 10.6 (€848.96m) and 28.1% (13,764 employees), respectively. Accordingly, the shares of R&D expenditures and personnel in the governmental sector are 8.9 (€535.7m) and 6.2% (3,010 employees), alternatively. Hence, after the BES the HES sector is the second most important R&D sector in East of England. However, although the overall contribution of the public sphere is smaller, the East of England captures significant levels of public investments into R&D and is the location for several centres of international research excellence. The government conducts a large proportion of its health research in the region, and numerous Medical Research Council establishments are located there. Moreover, the research activities in the region´s universities are rated as being world leading. On the other hand, the PNP does not seem to play any role (cf. EUROSTAT 2011; EEDA 2009a).

East of England hosts a broad private and public research landscape. There are seven universities in the region. Areas of R&D driven development are spread across a wide spectrum of technological expertise across the region. Cambridge has innovation in the pharma and health care sectors and Norwich is home to leaders in the food and crop science sectors (EEDA 2009b:6). Within Cambridge, of the 1400 high-tech firms within the sub-region 200 are direct University spinoffs and the sub-region continues to attract interest from MNEs which want to establish their European headquarters for R&D activities (EEDA 2009b:7). In Norwich, the Norwich Research Park comprises collaboration between the University of East Anglia, the Norfolk and Norwich University Hospital, and four independent research centres: the John Innes Centre, the Institute of Food Research, the Genome Analysis Centre and the Sainsbury Laboratory. With over 9,000 people, the Norwich Research Park has one of Europe's largest single-site concentrations of research in Health, Food and Environmental Sciences (EEDA 2009b:7). In Bedfordshire, Colworth is an international leader in the food, health and wellness and pharmaceutical technology sectors (EEDA 2009b:6). Automotive engineering is strong in Hethel and Dunton, with technological advances in the built environment being made at the Building Research Establishment in Watford (EEDA 2009b:6). Creative media is also strong around Norwich and Leavesden, as are services to the oil and gas industries around Lowestoft and Great Yarmouth (EEDA 2009b:6). Similarly, Peterborough has shown a substantial growth in the development of cleantech businesses, of which 350 are located around the City (out of 1500 within the region as a whole). In addition, telecommunications are predominant in Martlesham and aviation and aerospace in Hertfordshire (EEDA 2009b:6). In Ipswich, Innovation Martlesham (an established ICT cluster, building on the success of Adastral Park, British Telecom's R&D headquarter which employs 3,800 people) has attracted more than ten major IT suppliers and six spin-out companies, as well as specialist organisations engaged in venture-funded spin outs, Intellectual Property management and outsourcing (EEDA 2009b:7). The site hosts research units of four universities, whilst British Telecom and its partners on site are engaged in the development of a wide range of products and services including 21CN - the next generation broadband network based on the growing convergence of voice, data and computing technologies (EEDA 2009b:7). Innovation Martlesham tenants are encouraged to develop close collaboration with British Telecom research units and BT partners such as Alcatel, Cisco Systems, Fujitsu, Prysmian and Nokia Siemens Networks (EEDA 2009b:7). South Hertfordshire houses a substantial concentration of multi-national biomedical organisations including Eisai, Roche, Glaxo SmithKline, Merck Sharp & Dohme, Biopark, the Royal Veterinary College, the University of Hertfordshire (including the schools of Life Sciences, Pharmacy, Health and Human Sciences, Postgraduate Medicine and the Medical Technology Innovation Centre), the National Institute for Biological Standards & Control, the UK Stem Cell Bank, Rothamsted Research as well as local life science SMEs (EEDA 2009b:7). However, even though sophisticated R&D is conducted in the region, most of the industrial production happens in Asia (e.g. China) or East of Europe.

The main R&D sectors of East of England are in the fields of pharmaceuticals, life sciences and biotechnology, aerospace industries, computing/ICT, renewable energy technologies, creative industries, and food technologies. These research fields are often high-tech-oriented and mostly dominated by the business sector, although especially the higher education sector (e.g. Cranfield University and the University of Cambridge) plays a significant role for both realization of and co-operation in R&D activities. Moreover, the top universities play an important role in the education and training of young talents (cf. EEAD 2009a, 2009b).

The RTDI-related parameters are not uniform across regional areas within East of England as indicated through the coefficient of variation of several indicators stated in Tab. 5. There are substantial differences within the region in terms of both innovation capacity and performance, most notably in skills and education performance and the density of knowledge-intensive businesses within the sub-regions. Some local areas within the region have especially weak levels of qualifications attainment which limit their capacity for innovation (EEDA 2009a:3). In general, the regions Bedfordshire and Hertfordshire, and East Anglia are the leading regions with regard to RTDI aspects ahead of the region Essex. Qualitative data indicates that there are sectoral hotspots with Cambridge, Stevenage and Harlow being held as leaders in business and innovation. There is a strong presence of enterprise centred on agricultural research and agricultural science throughout Norfolk and Cambridgeshire. In addition, throughout East Norfolk, Suffolk and Essex innovation initiatives are focused on developments in renewable energy (cf. EUROSTAT 2011).

Table 5: Intra-regional RTDI Disparities in East of England (selected indicators)

Coefficient of variation of hight-tech employment (hightech-employment as percentage of total employment) 2009 (in %)	Coefficient of variation of knowledge workers (HRSTC employment of the economically active population) 2009 (in %)	Coefficient of variation of R&D employment (R&D employment as a percentage of total employment) 2008 (in %)	Coefficient of variation of the persons with a tertiary education attainment (as percentage of total population) 2010 (in %)	Coefficient of variation of the patent applications at the EPO per million inhabitants 2004-2007 (in %)
40.77	23.01	36.01	18.30	34.40

Remark: disparity calculations based on NUTS-2 level data

(Source: own creation and calculations; based on data from EUROSTAT 2011)

The R&D sector has been concentrated into particular geographic areas within the East of England over time. Cambridge is at the centre of these key areas of growth and is surrounded by Peterborough, Norwich, Great Yarmouth and Lowestoft, Haven Gateway, the Thames Gateway South Essex, Milton Keynes South Midlands and the London Arc (cf. EEDA 2009c). This clustering can be explained by several factors. Interviewees from the East of England Development Agency (EEDA) stated that a culture of innovation was already present prior to the establishment on the Regional Development Agency in 1998. As such, innovation strategies have largely been focused on existing strengths in innovation. Projects and initiatives were also developed with a view to achieving self-sustainability. In line with this, initiatives were often developed strategically within, or in close proximity to, key areas so as to capitalise on existing drivers of growth (cf. CLG 2008: 8). Intentions were also that the existing innovation culture would also result in knowledge spillovers into new areas. The three largest growth areas include:

- Thames Gateway, a regeneration area of national importance which includes part of South Essex (Essex Thames Gateway);
- Milton Keynes – South Midlands, which includes Luton and Bedfordshire; and
- London-Stansted-Cambridge.

Haven Gateway, Norwich and Thetford were identified as New Growth Points in October 2006. Within the East of England Plan, these new growth points were where the most significant development and regeneration strategies would be concentrated (CLG 2008:8-9).

2.2 Human Capital Endowment

In 2009, HRSTC in East of England amounted to 0.477m, representing 8.6% of national total (5.575m) and 16.3% of the economically active population. With this share of knowledge workers, the region ranks in the upper midfield in comparison with the other AMCER regions (see App. Tab. 7) (cf. EUROSTAT 2011).

Moreover, in 2009, the East of England had a stock of 156,413 employees working in high-tech industries and knowledge-intensive services, i.e. 13.1% of national total and 5.7% of total employment in the region. Therewith, East of England´s share in total employment is far above average in UK standards (4.1%). In comparison with the other AMCER regions, East of England ranks clearly in the 1st place (see App. Tab. 7) (cf. EUROSTAT 2011). These figures and comparisons illustrate the region´s outstanding position for knowledge and technology production in general and its role in high technologies in particular.

The education level of the human capital forms the basis for productive and innovative activities in developed countries and regions. In 2010, the East of England had 527,714 students in the secondary education level (ISCED 2-4), i.e. 92.9 students per 1,000 inhabitants. Thus, regarding the UK standard (95.2), this is slightly below-average. Overall, 42.3% of the population of working age (25-64 year-olds) of East of England has an upper secondary education attainment (ISCED 3), in 2010. This is compared to the UK (41.1%) above-average and towards the EU-27 average (46.8%) well above-average. Considering the tertiary education level (ISCED 5-6), the region had 170,251 students in that field, in 2010, i.e. 30.0 students per 1,000 inhabitants. Regarding the UK average (33.4), the figure of East of England is below-average. Altogether, 32.3% of the population of working age has a tertiary education attainment (ISCED 5-6). This is compared to the UK (35.0%) below-average but towards the EU-27 average (25.9%) above-average again. Moreover, in 2010, the share of the 30-34 year-olds with a tertiary education attainment amounts to already 38.9% (UK: 43.0%; EU-27: 33.6%) coming from 34.9% in 2008, thus barely missing the 40%-target defined by the "Europe 2020 Strategy" (cf. EC 2011; EUROSTAT 2011). However, the depicted trend promises that the region will accomplish the aim in the near future. Nonetheless, comparing the figures of secondary and tertiary level students per 1,000 inhabitant of East of England with those in the other eight AMCER regions, the region ranks in terms of secondary level students in the upper midfield and in terms of tertiary level students in the pre-last place (see App. Tab. 7). Concerning the relatively low level of tertiary level students it should be mentioned that – in contrary to tertiary education systems in many other countries – the English system is often highly selective (quality before quantity), especially with respect to top universities (e.g. Cambridge University).

Regarding the early leavers from education and training, which can be interpreted as at least temporarily lost human capital, in the education vintage 2010, they account for 16.2%. This is a minus of 3.7 percentage points compared to the year 2000 and thus suggesting a positive trend. Nonetheless, this result is well above both the UK average (14.9%) and the EU-27 standard (14.1%) (cf. EUROSTAT 2011). Apart from the fact that the region´s figure is generally rather high, moreover, the regional proportion of early school leavers does not meet the maximum target of 10% defined by the "Europe 2020 Strategy" (cf. EC 2011). Compared to the other AMCER regions, the proportion of East of England still ranks in the midfield (see App. Tab. 7). Against the backdrop of the aging society in the East of England (see 4.1 below), high reintegration costs, increasing pressure for innovation, productivity, and competitiveness, profound reforms are urgent.

Because the technological progress is increasingly challenging developed countries and regions and therewith requirements to education are steadily rising, further education of adults is playing an increasingly important role in knowledge- and innovation-driven economies. The region´s participation share of adults aged 25-64 in education and training amounts to

19.6%, in 2010, therewith being in line with the UK (19.4%) average but far better than the EU-27 average (9.1%) and most of the other AMCER-regions (see App. Tab. 7) (cf. EUROSTAT 2011). The figures show that the East of England as well as the UK in general has realized the importance of further education for a knowledge economy.

2.3 Potential for Innovation

In the course of this work, patent applications are taken as an indicator for the potential for innovation, thus depicting the production of knowledge and technologies. Although in the innovation process patents are somewhere between inventions and innovation and therefore covering only a part of the whole innovation process, they are among the most widely used innovation indicators (cf. GRUPP 1997; FRIETSCH et al. 2008).

Within this work, the potential for innovation will be measured by the number of patents registered at the EPO. Between 2000 and 2003 in East of England, a number of 3,922 patents were applied at the EPO, accounting for 17.4% of the national total. Between 2004 and 2007 the number of patent applications amounted to only 2,947 (15.8% of national total), a decline of about -24.9%. At the same time, the patent applications per million inhabitants shrank from 726, in 2000-2003, to 531, in 2004-2007 (minus 26.9%). Among the UK regions and nations East of England ranks in the 2nd place after the South East, regarding the overall patent output (cf. EUROSTAT 2011). In comparison to the other eight AMCER regions, regarding both the absolute and the relative patent application figures, the region ranks in the upper midfield (see App. Tab. 8).

Since patents are in most cases the result of extensive R&D activities, it is possible to determine the R&D productivity (measured as EPO patent applications per million R&D expenditures in 2005). Moreover, this indicator unveils how effective the money spent on R&D is utilized in the process of knowledge generation. The R&D productivity of East of England amounts to 0.14, thus being below-average compared to the British standard (0.17) (cf. EUROSTAT 2011). Additionally, the region ranks in the pre-last place compared to the other AMCER regions, unveiling apparently existing efficiency problems which should be tackled in order to guarantee a better outcome in the future. The region should make use of these reserves, since the potential productivity improvements would lead to a cost-neutral knowledge and technology production enhancement (see. App. Tab. 8).

Concerning the technically more challenging high-tech patents, East of England accounted for 878 applications at the EPO between 2004 and 2007. Nonetheless, between 2000 and 2003 the region´s high-tech patent applications still amounted to 1479, thus baring a decline of -40.6% over time. The high-tech patent applications per million inhabitants come to 158 in the period of 2004-2007. For the same period, the proportion of high-tech patent applications to all patent applications amounted to 29.8%. Again, regarding high-tech patent applications, among the UK regions and nations, East of England ranks in the 2nd place after the South East. Comparing the region´s figures with that of the other AMCER-regions, it ranks in the upper third (see App. Tab. 8). These results underpin the above-mentioned circumstance that the region is to a high degree high-tech oriented. However, the most high-tech patent applications of East of England have been made in the fields of communication technologies (41.9%), computer and automated business (33.2%), micro-organism and genetic engineering (17.6%), and semiconductors (9.3%) (cf. EUROSTAT 2011).

The here drawn focus in high-tech patent applications reflects the above-mentioned research and business specialization of the region.

3. RTDI Governance and Innovation Policy

3.1 Governance

The UK system is currently in a transitional stage regarding the governance structures and relations of national, regional, and local governments. In June 2009, the UK Government

merged the Department for Business, Enterprise and Regulatory Reform (BERR) and the Department for Innovation, Universities and Skills (DIUS) to create the new Department for Business, Innovation and Skills (BIS). The key objective of this new Government Department is that many of the innovation and S&T-related responsibilities of the two former departments of BERR and DIUS will now be located in BIS. BIS works with the Technology Strategy Board (TSB), currently acting as the UK's national innovation agency, to deliver innovation strategies. The recent closure of the nine Regional Development Agencies means that responsibility for regional strategy will now be undertaken by the TSB. At this transitory stage, it is difficult to establish a current picture of the relationship between national and regional government. However, useful insights can be gained from looking back at the nature of this relationship prior to the current transitory stage (GA 2009:14):

Prior to the establishment of BIS, the DIUS worked closely with the BERR. The DIUS worked with a range of organisations to promote UK innovation, occasionally in a formal sponsorship role (GA 2009:14-15). These organisations included Regional Development Agencies (RDAs), the TSB, UK Intellectual Property Office (UK-IPO), National Endowment of Science Technology and the Arts (NESTA), the Design Council, National Weights and Measures Laboratory and BSI British Standards. The DIUS had responsibility for leading and managing the Foreign and Commonwealth Office (FCO) Science and Innovation Network (SIN). The FCO SIN was established in 2000 as a cross-Government network, supporting a wide range of customers across Government and beyond. One of the main purposes of FCO SIN is to strengthen UK innovation and inform effective policymaking and leadership. BIS has since adopted the role of working in conjunction with the FCO SIN (GA 2009:15).

The UK government provides support to the private sector by encouraging companies to devote more effort towards R&D and innovation via a number of mechanisms, including tax credits administered via the Treasury, and the work of the TSB, which has responsibility for the formulation and delivery of national technology strategy. Lastly, operating at a number of levels throughout the system is a wide range of business support organisations, operated by Government or on behalf of Government. These include Business Links (UK 71), RDAs, research and technology organisations that carry out a broad range of research related activities, technology brokers such as the British Technology Group and other information providers (GA 2009:16).

Since the RDAs were established in 1998, regional innovation policies were carried out by them to a certain extent. With respect to EEDA which was the principal body in designing, funding and implementing regional innovation policy. EEDA is a non-departmental public body accountable to the Parliament via the Secretary of State of the BIS. Its board includes representation of elected authorities (i.e. Local County, city and town councils), universities, businesses, the third sector, and a member of the Government Office for the East of England (GOEE). Along with the East of England Science and Industry Council (EESIC) EEDA developed the innovation section of the Regional Economic Strategy. The Council represents the interests of major regional innovation stakeholders, i.e. large and small businesses, higher education institutes and the National Health System. Moreover, it aims to coordinate regional innovation actors and operates as an independent advisory body toEEDA on matters relating to science and innovation. EEDA is one of the key regional budget holders and is responsible for delivering a number of regional innovation programmes and initiatives. Particular concerns, regarding the Regional Innovation Strategy, include the development of regional networks to foster collaboration, and interactions between universities and research institutions and local/regional businesses, particularly SMEs. Additionally, EEDA is also being encouraged to set up Science and Industry Councils or similar bodies to bring together representatives from both the private sector and universities. However, EEDA has no legislative power and its responsibilities regarding innovation and research primarily lie in developing, funding

and implementing policies which help to bridge the gap between the business and the higher education sector. Most other research and innovation related policies (tax, higher education policy, industrial policy, research policy) are developed and implemented at the national level, with some national innovation policies delivered regionally via EEDA and its diverse sub-contractors (cf. GA 2009; RIM 2011c).

3.2 Policy

At the national level innovation policies are spread across several initiatives. The BIS and the TSB provide a range of support for R&D and innovation including grants and support for Knowledge Transfer; and is establishing a network of elite Technology and Innovation Centres to commercialise R&D on new and emerging technologies. In addition, the creation of the UK Innovation Investment Fund was announced on 29 June 2009. The fund will invest in technology-based businesses with high growth potential. It will focus on investing in growing small businesses, start-ups and spinouts, in digital and life sciences, clean technology and advanced manufacturing. Two strategies are outlined under the UK Innovation Investment fund: the UK Future Technologies Fund (£200m), and the Environmental Investment Fund (£125m). Tax relief is also offered for enterprises which engage in technological R&D, and is provided through R&D tax credits. The credit is made available in one of two ways: either as a tax deduction based on R&D spending or it may be possible for certain loss making SMEs to surrender their losses in return for a cash payment from Her Majesty's Revenue and Customs. Central government also offers business opportunities from public procurement, including pre-commercial procurement such as the Small Business Research Initiative and Forward Commitment Procurement. BIS is leading on this agenda through:

- working with Departments to ensure that robust Innovation Procurement Plans are in place;
- working, through the Technology Strategy Board, to ensure Government makes best use of the Small Business Research Initiative to provide business opportunities for innovative companies whilst solving the needs of Departments; and
- encouraging use of outcome based specifications in the public sector through supporting projects from central and local government on use of Forward Commitment Procurement.

The Office of Government Commerce published its 'Driving Innovation through Public Procurement' document to provide guidance to those working in government on how they can utilise the purchasing power of the public sector to drive both buyer and supplier innovation in the procurement process.

The government also offers support for UK companies to identify and benefit from developments in science and innovation overseas via the Global Science and Innovation Network. BIS and the Foreign & Commonwealth Office jointly fund a network of Science Officers overseas. The SIN consists of around 90 staff, based in 40 British Embassies, High Commissions and Consulates, across 25 countries around the world. The government is also active in promoting innovation through knowledge transfer initiatives between HES and other public sector research establishments, and the BES. In addition, UK Trade & Investment (UKTI) provides expert trade advice and practical support to UK-based companies wishing to grow their businesses overseas. Priorities include fostering innovation in UK and overseas companies, encouraging entrepreneurship in the UK and supporting and promoting major innovation-related projects.

Priorities at the regional level are to develop policies from central government into meaningful regional strategies. EEDA ran innovation support schemes such as the Knowledge Transfer Partnership, science parks and enterprise hubs with key priorities regionally developing from national priorities. Key priorities for the East of England were: life sciences and healthcare, ICT and low carbon fuel innovations. Innovation in the East of England is charac-

terised by strategic investments around science parks and enterprise hubs. EEDA were particularly successful with partnership working. There were a number of science parks that EEDA invested in which involved the support of large corporate organisations. The rationale behind this approach was that the investment itself had a much wider market impact if backed by large recognisable corporate organisations. Initially, science parks and technology hubs represented incubation facilities. However projects were based on the principal of open innovation, as it is beneficial for entrepreneurs and innovators in marketing their ideas. EEDA's role in implementing regional innovation strategy was in strategic leadership to bring partners together and tailoring initiatives to the needs of key innovation companies. The Business finance team complemented the innovation team and a Science and Industry Council with projects through guidance on grants, priority grants and larger loans. Life Sciences and ICT are strong in the East of England, and thus staff at EEDA felt that they were building on strengths within the region and capitalising on how to drive them forward.

4. Trends, Challenges, and Assessment

4.1 Trends and Challenges which are not specific to the R&D Sector

Labour markets within the East of England are concentrated in the regions discussed in detail above. The infrastructure of transport is concentrated and limited around labour markets within these areas of growth. Motorways are focused around access to the London Arc and direct motorway access links exist to Milton Keynes South Midlands, Thames Gateway South Essex, Cambridge and Peterborough (cf. EEDA 2009c).

In addition to the clustering of transport educational skills in the East of England are typically lower than the national average in certain subject areas. For example, around a quarter of businesses in the East of England are of the view that the ICT skills of their workforce are inadequate (EEDA 2010a:102). The numbers of pupils passing IT-related GCSEs and A Levels is lower than in many other regions, while the percentage of people enrolling on IT-related further education courses is lower than expected, given the size of the region's IT workforce (EEDA 2010a:102). A further challenge for the region is to equip properly its business managers to achieve productivity benefits from ICT (EEDA 2010a:102). Skills have been identified as one of the key constraints on the region's economic prospects (EEDA 2010a:109). The qualification attainment of the region's population has improved over recent years, but the rate of improvement has been lower than in other regions and the region performs below average in terms of the qualifications held by its residents (EEDA 2010a:108). The region also performs below the national average in terms of workplace qualifications (EEDA 2010a:108). Also, employer-provided training is less likely to occur in the East of England than in other regions, for example, 26.7 per cent of employed working-age residents participated in on-the-job training in 2007 lower than the national average of 29.3 per cent (EEDA 2010a:108). The East of England was also second from bottom in terms of the proportion of employers providing either on- or off-the-job training for staff in 2007 (EEDA 2010a:108).

Published reports also discuss a concern with trends in ageing populations. The East of England is projected to be the fastest growing populations within the UK (EEDA 2010b:1). It already had the highest percentage increase in population between 2001 and 2009 of all regions in England at 6.8%, compared with the England average of 4.8% (cf. ONS 2010). The population development and especially the aging figures of a population are crucial for innovation related purposes, due to the fact that the youth and size of a population virtually determines its dynamism, innovativeness, and labour supply and therewith its future viability. The population of the East is projected to increase by 14.6% from 2010-2030, increasing from 5.79m in 2010 to 6.64m by 2030, and as the population ages, the numbers in the oldest age bands will increase the fastest. In 2008, 17.8% of the regional population was younger than 15 years, 65.3% are between 15 and 64 years, thus representing the population of working age,

and about 16.9% are 65 years or older (retirement age). Compared to the western European age distribution East of England´s figures are markedly better. However, in 2030, depending on the region within the East of England, the share of people which are 65 years and older will regionally vary between 19 and 24%, underpinning the economic and social challenges the region is confronted in the future (cf. EUROSTAT 2011; GIANNAKOURIS 2010).

4.2 Trends and Challenges which are specific to the R&D Sector

In 2008, EEDA published a Regional Economic Strategy (RES) which outlined the future of innovation strategy for the East of England from 2008-2031. In addition to the RES, there is an additional Regional Spatial Strategy (RSS) (2008) and an Implementation plan (2010) for addressing the aims of the RES. In the field of innovation and research the priorities are to develop a thriving culture of innovation and creativity, commercializing R&D and adopting innovation, strengthening clusters around leading private sector R&D companies and research-intensive universities, and positioning the East of England and Greater South East as global innovation region. The Implementation Plan's sectoral focus was developed to be consistent with regional investment priorities agreed with the TSB and supported the government's New Industry, New Jobs agenda (NINJ), launched in April 2009 (EEDA 2010a:84). NINJ aims to create a 'total business environment' in which the totality of public sector activity supports industrial growth and sectoral strengths in priority areas including: advanced manufacturing; composites; digital technologies; life sciences and medical; low carbon and plastic electronics (EEDA 2010a:84). The RES and the RSS aimed for specific outcomes for enterprise and innovation, specifically to deliver higher rates of employment, economic growth and environmental sustainability through:

- increasing the share of businesses that are 'innovation active';
- increasing start-up rates to 60 per 10,000 resident adults by 2031 (over 13,000 more businesses created each year than there were in 2007);
- raising total entrepreneurship activity rates above the UK average and, within that, raising female entrepreneurship nearer to male entrepreneurship;
- increasing the share of SMEs that use external advice; and
- increasing the share of East of England SMEs that operates internationally (EEDA 2010a:84).

The Implementation Plan aimed to address the above objectives through ensuring the appropriate scale, focus and accessibility of publicly funded business support and tailoring interventions to the short-term deterioration in economic conditions without neglecting investment in economic assets important to long-term performance (EEDA 2010a:84). This included prioritising investment which strengthens existing and emerging areas of international comparative advantage such as R&D, life and biosciences, ICT and clean technologies delivering activity within a national context of fewer, simplified business support services (EEDA 2010a:84).

The extent to which the aims and objectives outlined in the RES, the RSS and the Implementation plan are adopted by the TSB is open to question. Detailed information on the Implementation Plan can be found in the East of England Implementation Plan 2010.

Although EEDA have been instrumental in implementing innovation policy in the East of England, they are due to face closure as a regional development agency in 2012. The primary challenge faced in the immediate term is fulfilling the projections made in the absence of a development agency for the East of England. Interview data with EEDA employees indicated that changes are occurring at the local, regional and national level with regard to governance and innovation. One recent proposal currently in development is the establishment of Local Enterprise Partnerships as new bodies which will have an instrumental role in the implementation of innovation policy at the local level. The current recession and subsequent cuts in public funding mean that regional development agencies face closure, with the TSB remain-

ing to undertake responsibility for the implementation of innovation. Regional responsibility for innovation and technology is being incorporated into the TSBs strategic agenda.

However, many EEDA initiatives will remain active. A central concern for project management at EEDA was to work towards sustainable developments in innovation. Thus many of the initiatives have been developed to become financially self-sustaining and are not dependent on regional funding. Some science parks and technology hubs initially having developed from EEDA have now moved on to continuation funding from national initiatives or other bodies, or private sector investment in areas where enterprises have developed to generate profit. The limitation of removing RDAs is that the pool of expertise at the regional level will no longer be unified with EEDA at the centre. Interview data indicated that remaining staff members at EEDA were optimistic that the legacy left behind would continue to regenerate. Although developments in innovation may be slowed by the current recession and the closure of EEDA, the business culture in the region is such that developments in innovation are likely to continue.

4.3 Assessment of the regional R&D System

4.3.1 Governance Dimension

In general, regarding the governance dimension, the R&D system of the East of England is a mixture of a *network* and a *dirigiste system* due to the British central state. Institutional support is initiated mainly at the regional level, thanks to support schemes such as the Knowledge Transfer Partnership, science parks and enterprise hubs with key priorities regionally developing from national priorities. However, EEDA has no legislative power and its responsibilities regarding innovation and research primarily lie in developing, funding and implementing policies. Most other research and innovation related policies (tax, higher education policy, industrial policy and research policy) are developed and implemented at the national level, with some national innovation policies delivered regionally via EEDA and its diverse subcontractors. Nevertheless, due to the governance structure, the national and the regional actors are highly connected and in an ongoing exchange. Since the involved actors are centrally coordinated the overall degree of coordination can be assessed as quite high. In the manner of a dirigiste system, funding is largely determined centrally, with decentralized units in the region. In the contrary, the regional research competences are more like in a network system. The East of England´s research competences are quite broad in nature, thus covering basic, applied and experimental research. This is due to the extended regional private and public research landscape. Nevertheless, since the R&D system is clearly business-oriented and therewith the private business sector contributes a major proportion of the overall research activities, its focus is on applied and experimental research. The region´s degree of specialization with respect to its governance and policy characteristics is rather flexible, proven by the evolution of regional political aspects concerning research and innovation in recent years.

4.3.2 Business Innovation Dimension

Concerning the business innovation dimension, the R&D system of the East of England is somewhere in between a *globalised* and an *interactive R&D system*. Although many global and large companies conduct their R&D activities in the region and R&D activities generally tend to increase with business size, however, the proportion among large firms and SMEs active in that field is rather balanced. Moreover, regarding the research reach, the R&D system of the East of England hosts a broad mix of public and private research institutes, regional headquarters of larger firms and regional actors keen to promote innovation. Even though the business sector contributes by far the biggest share in research and innovation, the public sector is of great importance for the region. The East of England captures significant levels of public investments into R&D and is the location for several centres of international research excellence. The government conducts a large proportion of its health research in the region,

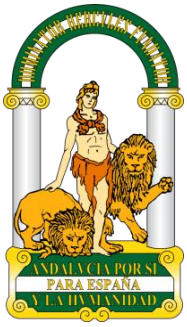
and numerous Medical Research Council establishments are located there. Moreover, the research activities in the region´s universities are rated as being world leading. This ambivalent characteristic continues for associtionalism. The overall degree of association can be assessed to be well engineered, especially in the central leading industries and regional hot spots. Nevertheless, the political actors promote actively the existence and foundation of network initiatives by the needs of larger firms.

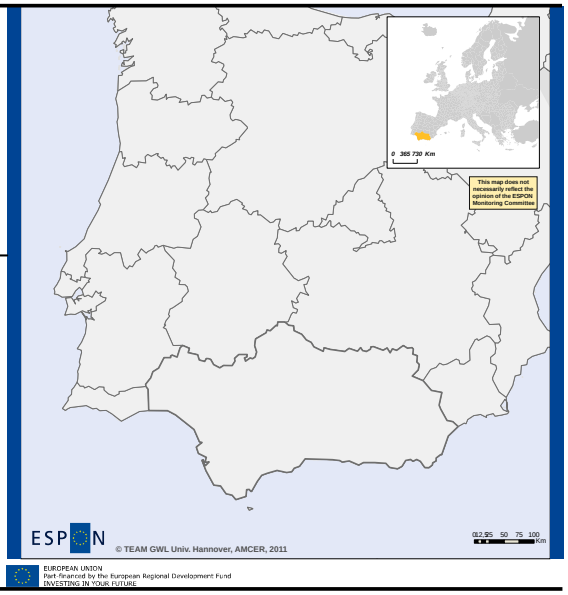
IV. Region Andalusia

SPAIN

Region Andalusia

NUTS Code ES61 (NUTS-2-Level)





Introduction:

Andalusia is an autonomous Spanish region located in the south of the Iberian Peninsula and bordering the regions Extremadura and Castilla-La Mancha to the north, and Murcia to the northeast. Moreover, the Mediterranean Sea is located to the south and Portugal to the west, therewith it is at a crossroads among the Atlantic and the Mediterranean as well as the EU and the Southern Mediterranean Basin.

Andalusia has a surface of 87,597 km² and a population of about 8.15m. Therewith the region has a population density of 94 per km², in 2009, which means that it is slightly more populated than the Spanish average (91) but sparsely populated by European standards (116, in 2008). The regional capital is Seville with about 700,000 inhabitants (cf. EUROSTAT 2011).

National/EU context:

Andalusia´s regional GDP per capita is well below the Spanish and the European average. However, over the last 30 years, the region has undergone changes and addressed serious historical gaps in terms of physical, educational and health infrastructures. Andalusia displays partly positive trends about global welfare. However, challenges are still numerous in the path towards the convergence to the most advanced European regions. The major challenge is the high unemployment, especially among the young people. From the sectoral point of view the region is shaped by tourism, agriculture and a number of mature industries like furniture, marble manufacturing and so on. Interestingly, evolving high-tech sectors can be observed in the field of new agro food clusters, aeronautics, and renewable energies. However, the RTDI indicators of Andalusia are mostly below the national and the EU level.

Andalusia´s major R&D sectors are (although there are mostly comparatively small) sustainable energy, food production, aerospace (there is a rather large cluster of aerospace multinationals and SMEs), ICT, and the life sciences and biotechnology sector. Less innovative but also important is tourism. Politically chosen (by the PAIDI, see section 3.2) to be the main future research areas are: aeronautics, biotechnologies and bio-engineering, health sciences, ICT, nanotechnologies and advanced materials, and tourism (cf. MARCHESE/POTTER 2010). In general, the region´s RTDI sector is clearly is *not* sufficiently business-oriented

The region´s innovativeness in relation to the other regions within Spain, measured by the number of patents applied at the EPO, ranks in the upper third. In European context the re-

gion´s innovativeness is rather weak. In 2007, the employment in R&D (FTE) was equivalent to 11.0% of the overall Spanish R&D personnel. The R&D personnel (FTE) per 1,000 employees amount to 6.9. This figure is well below the Spanish (10.0) and the EU-27 average (11.0). Regarding the business orientation of both the R&D expenditures and the R&D personnel (FTE) (37.1%, 26.0%), Andalusia underperforms Spain (55.9%, 43.5%) and the EU-27 mean (63.7%, 52.1%) (cf. EUROSTAT 2011).

In 2007, the region´s per capita spending on R&D ranks in the lower third compared to the other Spanish regions. The region´s R&D intensity was 1.02%, thus being below both the national average (1.27%) and the EU-27 mean (1.85%). The region´s R&D productivity amounts to merely 0.06, thus being below the Spanish (0.13) and the EU-27 average (0.27) (cf. EUROSTAT 2011).

1. Socio-economic Characteristics

In 2008, the regional GDP in Andalusia amounted to about €149.0b, accounting for a share of about 13.7% of the Spanish GDP, therewith forming the 3rd strongest regional economy after Catalonia (18.6%) and Madrid (17.8%). The regional GDP per capita was €18,400, which represents 77.0% of the Spanish and 73.3% of the EU-27 average, respectively. This is due to low levels of labour productivity. Regarding this aspect the region ranks among the weakest in Spain. This poor performance results from the local industry structures but also of low levels of formal tertiary education (cf. MARCHESE/POTTER 2010). Nonetheless, between 1995 and 2008, the Andalusian economy grew by 7.0% p.a., which is slightly above-average regarding the national (6.9%) figure and well above-average taking the EU-27 (4.5%), but below the AMCER average (cf. EUROSTAT 2011; see App. Tab 3). The housing sector and the therewith the closely related construction sector – both highly important for the region – have played a significant contribution to the described economic dynamism. Moreover, like everywhere in Spain, marked increases of immigration positively influenced the strong Andalusian GDP growth in the past (cf. OECD 2010a). Some immigrants are retirees from European countries; however, most of them are Ibero Americans or Africans, coming to Spain or Europe, respectively, due to poverty and in the hope for employment and because of an existing demand for cheap labour particularly in the agricultural and construction sector. However, despite there was a long period of nominal growth since the 1990s this phase has now ended due to economic difficulties in the course of the latest financial crisis (see below). Amongst others, the difficulties in this context are related to the economic and industrial structure, productivity, labour market structures, the region´s integration into world markets, education, and weaknesses regarding the creation of knowledge and technologies (see below and the following sections; cf. also O'KEAN 2008).

In 2010, the regional labour force amounted to 3.97m, representing 17.2% of Spain´s total labour force (23.09m). Therewith, the region´s labour force size ranks in the top among the Spanish regions. The regional employment rate of the 20-64 year-olds lies at 54.2%, which is even below-average compared to the already very low national average of 62.5% (cf. EUROSTAT 2011). Taking the employment rate target of 75% defined by the "Europe 2020 Strategy", the Andalusian employment rate is far too low (cf. EC 2011).

In 2008, 7.5% of the employees worked in the agricultural sector, 23.2% in industry, and 69.3% in the service sector. In comparison to the national average (4.3%, 27.8%, 67.9%) one can see profound differences, where the region´s industry sector is less and the agricultural as well as the service sectors are partly more accentuated. Taking the EU-15 average (3.5%, 26.2%, 69.7%), where the more developed countries of the European Union are considered, almost the same can be observed, although the service sector is now in line with the average. The importance of the agricultural sector is extraordinary high, reflecting the pending challenge of economic diversification in Andalusia's numerous rural areas, and, in contrast, the

relevance of the industry comparatively low (cf. EUROSTAT 2011). Comparing the economic structure of Andalusia with that of the other AMCER-regions, in terms of its industry sector share the region ranks in the lower third, regarding the service sector share it ranks in the upper midfield (see App. Tab. 4). Due to the underdeveloped industrial structures Andalusia has extraordinary weaknesses regarding the amount of the production of industry-related or applied and near market knowledge and technologies (see section 2.3). However, promising developments can be observed in the agricultural sector which is worth to mention. Such sector also involves new tech-based developments and dynamics on innovations. In the case of the strawberry production in Huelva, greenhouse agriculture in Almería or the olive-oil production the region is a world-class benchmark. In those cases the region´s agricultural sector is incorporated within a (tech-based) global value chain in the food sector.

Between 1999 and 2006 a strong recovery of the unemployment occurred with rates declining from 26.5 to 12.7%. However, since 2007 the average annual regional unemployment rate heavily increased, going up to 28.0% in 2010. The regional development is thus following the national trend, where the unemployment rate rose from 8.5% (2006) to 20.1% (2010) (cf. EUROSTAT 2011). Both the Andalusian and the national unemployment figures are far above the EU-27 average of 9.6% in 2010. A particularly strong upsurge happened in the years 2008 and 2009, when the financial crisis affected the regional economy the most. Especially the collapse of the real estate industry and the therewith closely related construction industry were responsible for the large increases in unemployment. Comparing the overall as well as the youth unemployment figures of Andalusia with that of the other AMCER-regions, the region exceeds by far the values. Moreover, the relatively high long-term unemployment share must be considered critical (see App. Tab. 5). "High levels of unemployment, large numbers of temporary workers and low productivity undermine the performance of Andalusia's labour market. Although the overreliance of the region on the construction industry and the subsequent housing bubble has clearly contributed to these problems, even the sectors that employ highly educated workers are affected by structural problems" (MARCHESE/POTTER 2010:8).
The Andalusian economy exhibits some intra-regional disparities as indicated through the coefficient of variation of several indicators stated in Tab. 6. Around half of Andalusian population lives in the 8 province capitals, plus the cities of Jerez de la Frontera and Algeciras, and their respective metropolitan belts. Metropolisation, characterized by such factors as demographic growth of municipalities of the agglomeration belt or the transfer of processing activities and services to these same municipalities, emerged in the 1960s and have increased over the following decades. Urban agglomerations concentrate the majority of regional economic activities. Not only do they maintain a high level of socioeconomic dynamics, but they also make up vanguard places in terms of innovative activities, such as patent creation, advanced business services or R&D projects. In this perspective, capital cities are the main players, especially Seville and Málaga (cf. ZOIDO NARANJO/CARAVACA BARROSO 2005).

Another strong feature of Andalusia's development pattern is the dynamism of both the coastal strip and an inner axis of medium-sized cities. Concerning the former, as the rest of the Spanish littoral, the Andalusian seashore has evolved to rising figures in demographic and economic terms. Such a functional shift was based on several factors, one of them being crucial: climate conditions, which took to unexpected levels the development of residential, touristic and leisure functions and also it has created a highly competitive production of fruit, vegetables and other agricultural products grown in greenhouses, which acts as a driver of active business networks/clusters (inputs providers, agro-industries, exporting firms, service companies, etc.) (cf. ZOIDO NARANJO/CARAVACA BARROSO 2005).

Rural areas show a mixed economic trend, between areas which can be considered as emergent thanks to their dynamism and competitive capacity (i.e. local productive systems), and stagnant areas which still cannot find answers to current socio-economic logics. Main villages

have improved their social infrastructures and facilities, raising living standards. When looking at the majority of studied variables, a major part of regional rural areas appears as stagnant, with insufficient socioeconomic dynamics, a depopulation trend and deterioration of some natural resources. Andalusian mountainous areas are undergoing a more than secular process of reconversion, from a diversified economy favouring food self sufficiency to a new functional linking with nearer more populated areas, cities and coastal areas, which involves demographical regression and the reduction or extinction of many industrial and agricultural activities. To a large extent, a requalification of resources – such as the protection of high-value natural spaces, the improvement of habitability, facilities and building in population settlements – has recently occurred in these areas. While there has been a global recovery of handicraft activities and agricultural products with denomination origin, tourism functions and services have developed unequally (cf. ZOIDO NARANJO/CARAVACA BARROSO 2005).

Table 6: Intra-regional socio-economic Disparities in Andalusia (selected Indicators)

Coefficient of variation of GDP per capita 2008 (in %)	Coefficient of variation of the yearly average GDP per capita growth rate 1998-08 (in %)	Coefficient of variation of the unemployment rate 2009 (in %)	Coefficient of variation of the population dynamics 2005-09 (in %)
10.16	11.56	7.06	77.44

Remark: disparity calculations based on NUTS-3 level data

(Source: own creation and calculations; based on data from EUROSTAT 2011)

The Andalusian economy employed about 2.8m people, in 2010. The regional economy is traditionally shaped by agricultural and agro-food activities (i.e. olive oil, rice, fresh vegetables, see-food and aquiculture), thus being a major supplier to the European market. The employment in the whole agro-food value chain accounts for 20% of total employment in the Andalusian economy. However, the service sector dominates the economy, in particular tourism. Andalusia ranks in the 2nd place among the most popular regions in Spain, attracting 13.9% of visitors to Spain due to its strong natural and cultural assets. Apart of the existence of a number of industrial districts in some mature sectors (e.g. leather manufacturing, furniture, natural stone processing, ceramics) Andalusia also has some evolving and developing industrial sectors, such as the aeronautics industry (8,786 employees), the ICT sector (36,000), and the health sector and biotechnology (2,800). Moreover, Andalusia achieved to develop a strong renewable energy sector, particularly in the biomass, the wind and the solar energy technologies. Also metal-mechanics industry (including defence industries) are important pillars in the region, generating about 75,000 jobs and making up 40% of the national production (cf. MARCHESE/POTTER 2010; OECD 2011).

The Andalusian economy is mostly shaped by SMEs. Of great relevance are micro firms in the region (self-employed or employing less than 10 people), accounting for more than 95% of the firms. While Andalusia had high rates of business foundations combined with significant employment increases during the last period of economic growth (mid 1990s until present economic downturn) (see above), the region's evolution of medium-sized firms (between 50 and 500 employees) did not accelerate, reflecting a structural problem in growing local enterprises so that they can contribute more significantly to employment creation, innovation and regional growth. Despite the very high proportion of SMEs in the region most RTDI activities have been carried out by large-sized enterprises (cf. MARCHESE/POTTER 2010).

Overall, the Andalusian economy is less integrated into the international division of labour as other regions in Spain. It is estimated that only 1.4 % of Andalusian firms are involved in export markets, compared to the national average of 4%. The region only accounts for approximately 10.0% of Spanish exports in 2010, worth about €18.47 billion, ranking it behind the regions Madrid, Catalonia, Basque Country and Valencia. Official statistics suggest that about 16,000 enterprises are involved in export markets, but only 3,000 on a regular basis, as

opposed to the 100 that have also foreign-based establishments. The region´s scope of imports came to €23.22b (9.8% of national total). Such data implies that the value of imports to Andalusia exceed that of exports from the region, showing that the region´s domestic demand is predominant. The main exports were intermediate goods (64%) and consumer goods (29.9%). Capital goods accounted for only 6.1%. In detail, in 2009, vegetables, fruits and preparations of them were the main export commodities of the region (22.0%), followed by mineral oils (11.5%), oils (7.9%), aircraft and space vehicles (5.6%), smelting, iron and steel (5.2%), copper and products thereof (5.1%), electrical devices (3.7%), and chemicals (3.4%). Therefore, the traded commodity patterns are broadly in line with the dominating economic sectors. In 2009, the primary target markets were the EU, accounted for about two-thirds, as well as North America and other European countries. The data outline also that in terms of imports and exports, the effects of the wider economic crisis were felt strongly in 2009. Of note however, exports in 2009 from Andalusia fell by 14.0% from 2008. Yet, by 2010, they had returned and increased from their 2008 levels. Regarding imports, they fell by 34.0% in 2009 and by 2010, had still not returned to their 2008 levels. Such figures highlight that the effects of the wider economic recession in Spain in 2008-2009 led certainly to reduced demand for imported products in 2009. Regarding exports, these were not as badly hit as imports and have quickly increased from their 2008 levels in 2010, demonstrating some sustainability in the Andalusian export sectors (cf. EUROSTAT 2011; EXTENDA 2011; MARCHESE/POTTER 2010).

2. RTDI Characteristics

2.1 R&D Efforts and Input into the Process of Knowledge Generation

The region´s GERD amounted to €1.48b in 2007, thus contributing 11.1% to the Spanish total. The R&D expenditures per capita amounted to €187. Therewith, Andalusia´s per capita spending on R&D ranks in the lower third compared to the other Spanish regions. The highest spending has Madrid (€592). When expressed as a percentage of GDP, the GERD is used to indicate the overall R&D intensity of a country or region. This measure unfolds the emphasis placed on R&D activities within a given economy. In 2007, R&D expenditures per GDP were merely 1.02%, thus being below both the national average (1.27%) and the EU-27 mean (1.85%) (cf. EUROSTAT 2011). As a result, the regional R&D expenditure per GDP quota is far away from meeting the target of 3% defined by the "Europe 2020 Strategy" (cf. EC 2011). However, it is important to mention that the region has undertaken considerable efforts to enhance its R&D expenditures, taking into account the fact that Andalusia´s quota was at 0.59%, in 2001. Nonetheless, comparing both the R&D expenditures per capita and per GDP of Andalusia with that of the other AMCER-regions, the region still needs to make progress (see App. Tab. 6).

In 2007, the FTE employment in R&D amounts to 22,103, which is 11.0% of the overall Spanish R&D personnel. The R&D personnel (FTE) per 1,000 employees amounted to 6.9. This figure is well below the Spanish mean (10.0), the EU-27 average (11.0), and the AMCER values (see App. Tab. 6) (cf. EUROSTAT 2011).

Andalusia´s major R&D sectors are (although there are mostly comparatively small) sustainable energy, food production, aerospace (there is a rather large cluster of aerospace multinationals and SMEs), ICT, and the life sciences and biotechnology sector. Less innovative but also important is tourism. Politically chosen (by the PAIDI, see section 3.2) to be the main future research areas are: aeronautics, biotechnologies and bio-engineering, health sciences, ICT, nanotechnologies and advanced materials, and tourism (cf. MARCHESE/POTTER 2010).

The R&D sector can be sub-divided into the BES, the GOV, the HES, and the PNP. Their relative importance varies greatly across regions, however, generally reflecting different economic or research structures and traditions, respectively. With regard to the innovation system

approach, the proposition of BERD is considered as an indicator of the overall innovative capacity of a region. Although, this should not be over-interpreted, because the other sectors also provide important stimuli to the process of knowledge and technology production.
So far, the RTDI sector in Andalusia is *not* sufficiently business-oriented. The BERD amounts to only 37.1% (€0.548b) of the overall GERD, in 2007. Moreover, the share of the BES in R&D employment (FTE) accounts for 26.0% (5,750 employees) of the overall R&D employment. Regarding the business orientation of the R&D expenditures and the R&D personnel (FTE), the region´s RTDI sector underperforms Spain (55.9%, 43.5%) and the EU-27 mean (63.7%, 52.1%). Comparing the same aspects between Andalusia and the other AMCER-regions, the region has the lowest BES participation (see App. Tab. 6) (cf. EUROSTAT 2011). R&D activities in Andalusia are carried out, as expected, mainly by medium-high-technology and high technology sectors, which are made of a vast majority of SMEs. In terms of investments, low-technology services (energy, gas and water) and medium-technology manufacturing (agro-food, paper, rubber and plastic industry, non-metallic mineral) also play an important role in regional R&D. Large companies from traditional low-technology sectors invest in internal or external R&D activities as the main solution for product differentiation in a context of high competition. Companies from medium-high-technology and high technology manufacturing sectors (SMEs or large companies from multinational groups, with heterogeneous technological skills) have acquired capacities to subcontract R&D. The typical Andalusian R&D company, according to the initial objective of R&D activities it carries out, does not hold as a priority the increase of knowledge, the creation of science; it focuses on the search for technology application and creation (cf. RUIZ RODRÍGUEZ 2005).

Both the HES and the GOV play a far more pronounced role in terms of R&D expenditures and personnel (FTE). In the HES the shares of R&D expenditures and personnel amount to 40.1 (€592.8m) and 48.9% (10,806 employees), respectively. Accordingly, the shares of R&D expenditures and personnel in the GOV are 22.8 (€336.9m) and 25.0% (5,528 employees), alternatively. Hence, the public sphere, especially the HES is shaping the Andalusian R&D system, while – as intended in the region´s development strategy (see section 3) – the universities hold the key part of trickling down the R&D benefits to the BES. This has traditionally been the case, whilst the private sector continues to lag behind despite experiencing an upsurge since 2002 thanks to policy efforts to increase the BERD. The PNP plays rather a subordinated role with a share of 0.05% (€0.73m) in expenditures (cf. EUROSTAT 2011; MARCHESE/POTTER 2010).

The regional research landscape – as mentioned above – is pretty much dominated by the ten public universities. In addition there are 18 research institutes (most of them part of the CSIC research national system), technological parks, technological centres as well as numerous network initiatives. The private sector´s research capabilities, however, are still rather limited. This is due to the circumstance that the HES has been the principal beneficiary of the increase in public funds for research and in technology parks since the 1990s. Other factors that have negative impacts on corporate strategies, the recruitment of scientists and technology investments and expenditure in R&D activities are company size, the weight of the innovation culture among regional entrepreneurs and financial markets. A process of technology modernization of the regional economy has allowed a differentiation and quality improvement of products, which involves dependency from external suppliers of equipment and specialized inputs, as regional suppliers concentrate on engineering. Public support to modernisation has played a significant part in this process, especially regarding cooperation with public R&D centres and the purchase of material technology. However, strong public funding has proved little relevant so far for the development of R&D and technology modernization among private companies at a large scale (cf. MARCHESE/POTTER 2010; RUIZ RODRÍGUEZ 2005).

Although the share of the BES in R&D spending has grown significantly since the 1990s,

the proportion (see above) remains low compared to the Spanish and the OECD (64.2%) average. The sustaining privileged position of the public sphere, and especially of the universities, is even strongly reinforced by the priority afforded to them in the region's strategic plans. Moreover, there still exists a marked mismatch or disconnection, respectively, between university research and industry needs. This is because "[s]upport for innovation remains limited and fragmented within and among universities [and] [t]here is currently no effective guidance system for business to identify where best to source support for innovation" (OECD 2010a:186). Technology centres and parks have been developed to foster the connections between universities and companies. They are endeavouring to address these disconnection issues, but progress still has to be made in the awareness between companies of the existence and functions of these stakeholders. Meanwhile technology centres need to improve their supply of services. Moreover, coordination between the research priorities of universities and those of regional strategic plans is missing in many cases. This is, for instance, evident in the relative absence of effective prioritizing of research in biotechnology, ICT or tourism in the region´s universities. Moreover, a recent study found out that more than half of the asked enterprises did not engage in any type of collaboration with universities, while slightly above 40% entertained some forms of collaboration (cf. MARCHESE/POTTER 2010). MARCHESE and POTTER (2010:29) conclude that "[f]irstly, a large number, indeed the majority of innovation-oriented firms [...] do not keep active relationships with PROs. Secondly, informal and non R&D-intensive types of collaboration are the norm rather than the exception among those firms that engage with PROs. Thirdly, the formal exploitation of intellectual property rights only involves a very small minority of firms, even when the most innovative and R&D-intensive firms of the region are taken into consideration."

The RTDI-related parameters and the companies' capacity of innovation and competitiveness are not uniform across regional areas (Provinces) within Andalusia. Medium-high-technology manufacturing sectors and medium-high-technology services are concentrated in main urban areas and the coastal strip. Andalusian innovative companies tend to be located in provincial capitals and their surroundings, such as in Seville, Malaga, Cadiz Bay area, plus the two petro-chemical poles of Huelva and Bay of Algeciras as well as to a lesser extent in the axis of medium-sized cities inner region located (from Southern Cordoba province to Jaén). Examples are Lucena in Cordona (furniture), Linares (a traditionally mining and industrial city in the north-western province of Jaén), the county of "Poniente Almeriense" (with the highest concentration of high-tech greenhouses in the world). Innovation potential can result from the presence of dynamic primary productive sectors such as the cases of intensive agriculture in the west coast of Huelva (around berry productions) or the area of Jerez (homeland of the sherry wine). Also directly from geographical positioning like Antequera (in the very centre of the region, in Malaga province, with an important role on logistics) or the existence of a natural resource like the processing industry of non-metallic minerals around Macel in Almeria province (cf. RUIZ RODRÍGUEZ 2005).

2.2 Human Capital Endowment

In 2009, HRSTC in Andalusia amounted to 0.566m, representing 14.2% of national total (3.994m) and 14.5% of the economically active population. With this share of knowledge workers the region ranks in the lower third in comparison with the other AMCER regions (see App. Tab. 7) (cf. EUROSTAT 2011).

Moreover, in 2009, the region had a stock of 70,949 employees working in high-tech industries and knowledge-intensive services, i.e. 10.8% of national total and 2.4% of total employment in the region. Therewith, the Andalusian share in total employment is well below the Spanish standard (3.5%) (cf. EUROSTAT 2011). In comparison with the other regions Andalusia ranks in the last pre-place (see App. Tab. 7). The low level of both the HRSTC employment and the high-tech employment figures underpin the regions lack in research and innova-

tion related industries described before (see section 2.1).

The education level of the human capital forms the basis for productive and innovative activities in developed countries and regions. In 2010, Andalusia had 616,440 students in the secondary education level (ISCED 2-4), i.e. 75.6 students per 1,000 inhabitants. Thus, regarding the Spanish standard (66.9), this is above-average. Overall, 18.8% of the Andalusian population of working age (25-64 year-olds) has an upper secondary education attainment (ISCED 3), in 2010, which is compared to both the Spanish mean (22.0%) and towards the EU-27 standard (46.8%) well below-average. Considering the tertiary education level (ISCED 5-6), the region had 288,334 students in that field, in 2010, i.e. 35.4 students per 1,000 inhabitants. Regarding the Spanish average (39.3), the region´s figure is again below-average. Altogether, 25.5% of the population of working age had a tertiary education attainment (ISCED 5-6). This is compared to Spain as a whole (30.7%) and the EU-27 (25.9%) well below-average. The proportion of the 30-34 year-olds with a tertiary education attainment amounts to only 33.0% in the NUTS-1 region "Sur"[4] (Spain: 40.6%; EU-27: 33.6%), thus the south of Spain does not meet the 40%-target defined by the "Europe 2020 Strategy" (cf. EC 2011; EUROSTAT 2011). Comparing the Andalusian figures of secondary and tertiary level students per 1,000 inhabitants with those in the other eight AMCER regions the region ranks in terms of secondary level students in the lower third and in terms of tertiary level students in the upper third (see App. Tab. 7).

Regarding the early leavers from education and training, which can be interpreted as at least temporarily lost human capital, in the education vintage 2010, they accounted for 34.9% in the south of Spain[5], thus representing the highest value among all Spanish NUTS-1 regions. The extraordinary high value is extremely alarming, although it already decreased by 4.8 percentage points compared to the year 2004. This is particularly compared to the EU-27 mean (14.1%) but also towards the already high national average (28.4) far above-average (cf. EUROSTAT 2011). Therewith, the regional proportion of early school leavers does clearly not meet the maximum target of 10% defined by the "Europe 2020 Strategy" (cf. EC 2011). Compared to the other AMCER regions this seems to be a very region specific issue (see App. Tab. 7). Anyway, against the backdrop of the aging society in the region (see 4.1 below), high reintegration costs, increasing pressure for innovation, productivity, and competitiveness, profound structural reforms are obviously urgent.

Because the technological progress is increasingly challenging developed countries and regions and therewith requirements to education are steadily rising, further education of adults is playing an increasingly important role in knowledge- and innovation-driven economies in general and for aging societies in particular. The Andalusian participation share of adults aged 25-64 in education and training amounts to 10.2%, in 2010, therewith being slightly below the national (10.8%) but above the EU-27 average (9.1%). The regional figure ranks in the upper third compared to the other AMCER regions (see App. Tab. 7). However, the upgrading of the HES since the 1990s and lifelong learning seems to be reflected in these figures (cf. EUROSTAT 2011).

2.3 Potential for Innovation

In the course of this work the number of patent applications at the EPO is taken as an indicator for the potential for innovation, thus depicting the production of knowledge and technologies. Although in the innovation process patents are somewhere between inventions and innovation and therefore covering only a part of the whole innovation process, they are among the most widely used innovation indicators (cf. GRUPP 1997; FRIETSCH et al. 2008).

There is a strong concentration of patents in a small number of enterprises and universities

[4] There were no data for Andalusia (NUTS-2 level) available.

[5] There were no data for Andalusia (NUTS-2 level) available.

(e.g. Seville). SMEs are rather absent with regard to patenting. Between 2000 and 2003 in Andalusia a number of merely 183 patents were applied at the EPO, accounting for 5.2% of the national total. Between 2004 and 2007 the number of patent applications amounted to already 202 (4.3% of national total), an increase of about 10.5%. At the same time the patent applications per million inhabitants rose from 25, in 2000-2003, to 26, in 2004-2007 (plus 4.8%). Regarding the overall patent output, among the Spanish regions Andalusia ranks in the upper third (cf. EUROSTAT 2011). However, in comparison to the other eight AMCER regions, regarding both the absolute and the relative patent application figures, the region ranks clearly in the last place (see App. Tab. 8). The OECD (2010a:32) states that the yet not fully developed legal basis for intellectual property protection in Spain is a cause for this. According to MARCHESE and POTTER (2010) the low patent output results from the traditional role of the HES as being the main source of R&D spending and personnel. Additionally, there are several constraints existing making the exploitation of intellectual property rights difficult for universities and their staff. Other studies state (e.g. INE 2008) that Andalusian firms (mostly SMEs) are rather process than product innovation oriented and that the main barriers are the costs of innovations as well as a lack of interest in technological innovations on part of the BES. Bringing these aspects together, the above-mentioned mismatch between the public research institutions (mostly universities) and the industrial sector is a main constraint for better innovation potentials.

Since patents are in most cases the result of extensive R&D activities, it is possible to determine the R&D productivity (measured as EPO patent applications per million R&D expenditures in 2005). Moreover, this indicator unveils how effective the money spent on R&D is utilized in the process of knowledge generation. The Andalusian R&D productivity amounts to only 0.06, thus being well below-average compared to the Spanish average (0.13) and the figures of the other AMCER regions (see App. Tab. 8) (cf. EUROSTAT 2011). Measured by the R&D productivity, it is worth noting, that the Andalusian R&D system seems to be generally comparably inefficient.

Concerning the technically more challenging high-tech patents, Andalusia accounted for merely 31 applications at the EPO between 2004 and 2007. Between 2000 and 2003 the region´s high-tech patent applications amounted to 53, a decrease of -41.0% and a contrasting trend compared to the overall patent applications (see above). The high-tech patent applications per million inhabitants come to 4 in the period of 2004-2007. For the same period, the proportion of high-tech patent applications to all patent applications amounted to 15.3%. Among the Spanish regions, Andalusia ranks in the upper third again. However, comparing the region´s performance with that of the other AMCER-regions, it ranks in both absolute and relative terms clearly in the last place (see App. Tab. 8). These results again seem to reflect the above-mentioned circumstance that the region lacks competences in research and innovation related activities. However, it should be mentioned that it is suggested that some of the R&D conducted by the BES is not depicted in the region´s patent figures due to a headquarter bias. While there were generally only a few high-tech patent applications, they have been made in the fields of micro-organism and genetic engineering (61.0%), and communication technologies (21.1%). Other fields were semiconductors (7.7%), aviation (5.9%), and computer and automated business (4.3%) (cf. EUROSTAT 2011).

Although Andalusia increased its R&D performance during the last years, as stated in the subchapters of section 2, Andalusia underperforms vis-à-vis Spain and the EU in most R&D-related indicators and did not initiate sustaining convergence processes regarding R&D. The region´s R&D parameters are far below its potentials in terms of both production (13.5% of the national total) and population (17.8% of the national total). As a result the future development of the region runs into danger (MARCHESE/POTTER 2010).

3. RTDI Governance and Innovation Policy

3.1 Governance

Andalusia is an Autonomous Community with strong devolved powers and competences. Over the last years, Andalusia, one of the EU Convergence Regions, has undergone substantial changes regarding the map of innovation support stakeholders. In this process the Regional Ministry of Economy and the Ministry of Innovation, Science and Enterprise (MISE) merged, forming the currently so-called Ministry of Economy, Innovation and Science (MEIS). What triggered this shift was the decision by the regional government to gather higher education policy and industrial policy under a single department as well as to give the signal of better coordinating economic policies and of giving an increasing importance to business innovation and entrepreneurship as the main drivers of local development (MARCHESE/POTTER 2010).

Major regional organisations engaged in the promotion of research, innovation, and economic development are the regional innovation and development agency (IDEA), the trade promotion agency (EXTENDA), the R&D-oriented Technology Corporation of Andalusia (CTA, a PPP platform specifically oriented to R&D projects) and the Andalusia Technology Network (RETA), which co-ordinates the work of the range of scientific and tech parks and the technological sectoral-oriented centres. To a lesser extent it is also important to mention the role of the agency for entrepreneurship (ANDALUCIA EMPRENDE).

IDEA, which is at the core of the innovation support system, manages a pack of business support measures and schemes, which grade of innovation as main eligibility criteria of projects. CTA is a public-private partnership focused on the funding of R&D projects on strategic sectors, which should include the participation of University. RETA plays a two-fold role in the Andalusian research and innovation system. Firstly, it coordinates and connects the policy support to entrepreneurship and SME development provided by various actors of the Andalusian research and innovation system, including technology parks, technology centres and universities, and it ensures that the support is coherent, in line with the needs and accessed by local firms and entrepreneurs. Secondly, it introduces traditional firms to innovation and R&D activities. This happens via networks signposting innovation programmes to firms outside of technology parks. Finally, the RETA helped the Andalusian government to reach enterprises with its innovation policies beyond the small group of R&D-intensive firms. Altogether, these organisations play a major role in the coordination and governance of entrepreneurship, research and innovation (MARCHESE/POTTER 2010).

It should be underlined that the funding of both the nodes of RETA and the research units from the regional public universities is grouped under the same budget line of the regional government. The Andalusian Knowledge Agency has been set up this year in order to manage the funding of the system and to assess its quality. This new agency will also be in charge of technology transfer competencies. Financial support to companies for innovation projects is managed by IDEA, while public risk capital facilities have been grouped under a single umbrella: INVERCARIA. INVERCARIA is owned by IDEA.

Three additional important actors in the Andalusian research and innovation system are technology parks, technology centres, and business innovation centres. The implementation of technology parks dates back to the early 1990s. They can be either industry-focused (e.g. Malaga´s PTA and Seville´s Cartuja-93 park) or sector-oriented (e.g. Seville‘s Aerópolis (aeronautics industry) or Granada‘s (health sciences)) and often host business incubators. There is a strong will to turn technology parks as the main nodes of local innovation systems. Other knowledge agents and companies are encouraged to establish links with them. Until now, private companies have not significantly responded to these impulses. Technology centres are always sector-oriented and linked to an industry which is relevant to the region, thus being a pillar of regional cluster development (e.g. biotechnology). In addition to their tech-

nology development task they also provide a wide range of business development services. Business innovation centres support innovation in already existing SMEs but also the creation of new innovative firms. They provide services typically for such facilities (e.g. business consulting, training, and incubation) (MARCHESE/POTTER 2010).

In the Spanish highly decentralized political and institutional context, the regional system is being articulated with State-level public stakeholders, namely the Ministry of Science and Technology and the Centre for Industrial Technology Development (CDTI), a public state agency under the responsibility of the Ministry of Science and Innovation and the national reference in financial support to research, development and innovation projects. There is actually an agreement between the IDEA Agency and the CDTI. At national level, the funding schemes of R&D&i is currently grouped under the National Plan for research, development and innovation (Plan Nacional de I+D+i 2008-2011) which is managed by the Ministry of Science and Innovation. The national fiscal agency also manages an exemption scheme for R&D activities within the corporation tax system. Andalusia's R&D system receives significant funding from the ERDF Technology Fund for the 2007-2013 period.

3.2 Policy

In the current decade, Andalusian industrial and SME policy is shaped by the themes entrepreneurship, research & innovation and internationalization & scaling up, whilst in the former decades emphasis was put on the restructuring of labour-intensive sectors (1980s) and the promotion of endogenous development and local production systems as well as the reduction of regional disparities (1990s). Regarding the new regional policy focus, in recent years, the Andalusian administration implemented major strategic documents, which, apart from the Innovation and Modernisation Plan for Andalusia (PIMA, 2005-2010), cover the current EU funding period 2007-2013:

- Firstly, the Plan for Competitiveness. With this framework programme the regional government supports the development of entrepreneurship, SMEs, the knowledge society, and human capital.
- Secondly, the Innovation and Modernisation Plan for Andalusia (PIMA). The PIMA aims on the creation of conditions, which enhance the region´s innovativeness. The mid- to long-term overall objective is to reduce the welfare gap towards the other, more competitive economies. The plan constitutes the region's research and innovation agenda and fosters co-operation between the academia and the BES. In this way knowledge transfers and research-based spinoffs shall be accelerated.
- Thirdly, the Andalusian Plan for Research, Development and Innovation (PAIDI). The PAIDI is closely interwoven with the PIMA. However, the PAIDI highlights the objectives, such as the generation of knowledge and capitalisation of such, the development of an entrepreneurial and innovative culture in universities, businesses and research centres, the improvement of the sources of knowledge exchange facilitating technological development and innovation, and the involvement of private initiative through research, technological development and innovation. In many respects the targets of the PAIDI and the PIMA are aiming in the same direction (i.e. industry-university collaboration). Moreover, the PAIDI defines the key actors of the Andalusian research and innovation system, namely technology and knowledge actors (e.g. technology parks), knowledge generation institutions (e.g. universities, research centres, private R&D labs, etc.), knowledge transfer organisations (i.e. technology centres), as well as coordination and management authorities (e.g. IDEA, RETA, CTA, etc.). The PAIDI also set the main priority research areas (see above) (cf. MARCHESE/POTTER 2010).

The support of the region´s research and innovation community is ensured by various funding measures. Some of the main support measures are namely the Incentives for Companies

Competitive Co-operation 2008-2013, the Incentives for the Promotion of Innovation and Business Development in Andalusia 2008-2013 (R&D&i), the Incentives for R&D of the Technological Corporation of Andalusia, the Programme of Innovation Support in Small and Medium Enterprises (INNOEMPRESA), the Innovation Voucher, and the Incentives for Andalusian Knowledge System Agents (cf. RIM 2011d).

Moreover, the region introduced the support framework 'Incentives for Andalusian Knowledge System Agents' based on annual calls. This law has been recently modified in order to concentrate on the funding of projects. Funding for day-to-day operations (wages, running costs) on a yearly basis was clearly a factor of insecurity for technology centres. Currently, technology centres negotiate directly with the regional government on medium-term financial frameworks (4 years, with a gradually decreasing share of public funding). The establishment of new funding agreements is conditioned by the capacity of self-funding through the provision of advanced services to companies and by the successful application to competitive calls. Regional public funding should then not exceed 30% of basic funding. The system is unfortunately flawed by too much flexibility in the granting of the condition of "knowledge agents" while the finding opportunities attracted a number of rent-seekers, with poor capacity as innovation agents.

Another relevant programme from the MEIS is the "Talentia" programme: a programme carried out in the best universities which aims at training talents and preparing their incorporation into Andalusian companies.

The regional support to RTDI combines a focus on key regional historical strengths, (food technologies and aeronautics), the support to traditional mature industrial sectors (textile, natural stone, furniture) and to emergent sectors or horizontal issues such as plastic industry, renewables (solar energy), ICTs, biotechnologies and new materials. One concrete expression of this approach is the priorisation (or the establishment of increased share of public support in the total budget of projects) of projects from these sectors within the aforementioned support schemes.

Regarding higher education, the national government started in 2008 a programme (Programa Campus de Excelencia Internacional) focused on the promotion of strategic groupings between universities and other institutions located in their environment in order to create "knowledge ecosystems". Andalusian universities are proving active in participating in this initiative.

4. Trends, Challenges, and Assessment

4.1 Trends and Challenges which are not specific to the R&D Sector

The long-term economic development of Andalusia in the period of 1995-2008 was above-average compared to both the national and the European average. Thus, before the economic crisis, growth indicators were making likely a convergence of Andalusia's economy towards European standards in the forthcoming years. Nonetheless, the region is still lagging far behind and the catching-up process was mainly due to the housing bubble and immigration. Moreover, due to the recent financial and economic crisis the region currently faces a drastic economic downturn. If the region wants to make sustainable progresses and increase its overall competitiveness it is challenged to broaden and further renew its economic and industrial structure, increase productivity, reduce the extraordinary high unemployment by addressing existing structural labour market problems, and enhance the integration of Andalusian firms into world markets. The improvement of the infrastructure, facilities and accessibility of rural areas, along with their economic diversification and their evolution towards the 'technology society', are necessary steps in order to impulse new attractiveness while, in some extent, urban agglomerations are starting to experience saturation. Regarding economic activities, Andalusia has certainly to seize the opportunity offered by its 'natural advantages' and its

emerging energy sector to become a world reference in energy technology and sustainability, while efforts to strengthen the production system are to be pursued (cf. O'KEAN 2008). If Andalusia will not approach these points, the future development trend of the region is likely to run into danger.

The population development and especially the aging figures of a population are crucial for innovation related purposes, because the youth of a population virtually determines its dynamism and innovativeness and therewith its future viability. In 2009, the Andalusian population reached its present maximum of about 8.15m (cf. EUROSTAT 2011). Since 2000, the regional population thus grew by 12.5%. With its population size the region ranks the 1st place among both the southern Spanish regions and regarding all Spanish regions. However, depopulation trends in rural areas are likely to persist in the future. In this context, medium towns may play a rebalancing role in the face of a relative saturation of the main urban areas, which will also contribute to positive demographic trends in surrounding rural areas. There are two principal features of recent demographic development: decrease of fertility and growingly positive migration balances. Hence, the high population growth of the recent years is increasingly due to high in-migration from abroad. This circumstance makes Andalusia rather similar to most of the other of European countries. In 2009, 19.8% of the regional population was younger than 15 years, 82.5% were between 15 and 64 years, thus representing the population of working age and about 17.2% were 65 years or older (retirement age). Despite the above-mentioned recent demographic trends, at present the Andalusian age distribution figures are still markedly better than those of most European regions. Nevertheless, the future trends are basically the same as what is expected in Europe's countries and regions at large: reduction of the potential of natural growth and demographic ageing (unquestioned tendencies) and uncertainty on the evolution of fertility rates and the levels of migrations flows. Accordingly, projections assume that in 2030, the share of people which is 65 years and older will already account for about 20% in Andalusia, showing the economic and social challenges the region is confronted in the future (cf. EUROSTAT 2011; FERNÁNDEZ CORDÓN 2008; GIANNAKOURIS 2010).

4.2 Trends and Challenges which are specific to the R&D Sector

Andalusia has serious weaknesses concerning the amount of its R&D expenditures and personnel. In order to develop further future perspectives, it is essential for the region to step up efforts to strengthen the currently under represented R&D sector. Otherwise the region will face huge difficulties in escalating the knowledge and technology production and continuing the catching up process.

Moreover, Andalusia needs to address its weaknesses with respect to the involvement of industry in R&D. However, in the short- and mid-term the public sphere, especially the HES, is likely to stay the central pillar of R&D activities. Since the Andalusian economy is highly shaped by SMEs with low absorptive capacities, limited capacity for investment in R&D, nascent innovation culture, and low number of patents generated, the region needs to strengthen the development of larger firms, including MNEs. According to the OECD those firms are often responsible for the bulk of R&D (cf. OECD 2010a). In Andalusia, innovation is just emerging as the driver of regional economic development, the result of great efforts to promote and support it in recent years (see above). In a situation of concentration of R&D activities among a limited number of companies combined with the lack of intra and intersectoral connections at regional level, the dissemination of innovation to the rest of the production system is limited.

A further challenge is to fight the traditional lack of co-operation among SMEs and between them and universities. Generally, there is the need for enhanced and better co-ordinated innovation support, and especially the BES requires an effective guidance system in order to identify where best to source support for innovation (e.g. universities, technology centres,

etc.). Moreover, the universities are facing the challenge to improve the coordination between their research priorities and those of regional economic strategic plans (cf. OECD 2010a). The increase of innovation and co-operation capacities and culture among companies is clearly an immediate stake, which should result in the rise of the private sector in RTDI expenditure, an important weakness of the region, while public administration has been giving more and more importance to these issues. Human resources shall act as the main driver for change and there are first signs of the emergence of a new generation of entrepreneurs who may lead it. Obviously, this challenge requires taking action in the education and training system.

However, instead of putting the main emphasis on science and technology-driven innovation – as happened in recent years – "there is a need to improve incremental demand-led innovation and research in non high-tech and traditional industries of relevance to the region, such as construction, tourism, transport, distribution and logistics, new materials and green technologies. Cluster development should be conceptualised across the manufacturing-service divide, to connect for example agribusiness cluster with tourism. Excellent framework conditions in place, such as digitalisation and connectivity, should be mobilised for SME development" (OECD 2010a:186).

Despite economic catch-up effects the quality of human capital did not improve proportionally in Andalusia. However, in order to be able to compete nationally and internationally the human capital needs to be upgraded, as shown in this section. A problem is that Spanish universities are not well performing in international comparison. The University of Granada and the University of Seville are the only two universities among the world´s top 500 universities. The University of Malaga as well as all other universities in Andalusia do not rank in any of the major world rankings. An exception is the San Telmo International Business School with headquarter in Seville and linked to IESE which belong to the top business schools in the world – a clear asset for Andalusia. Moreover, vocational training should be further strengthened due to that it has been very successful in giving students a realistic chance to obtain a job. Interestingly, the number of vocational students during the last two decades increased, while the number of university students decreased and the number of dropouts slope upwards. Anyway, in general, Andalusia faces the problem of a discrepancy between the needs of the economy and performed workforce development programmes. This circumstance makes it difficult for the BES to obtain adequately trained labour and generate the needed stock of (highly) skilled workers who are able to transfer relevant knowledge for research and innovation in regional industry networks and clusters (cf. MARCHESE/POTTER 2010).

4.3 Assessment of the regional R&D System

4.3.1 Governance Dimension

Concerning the governance dimension Andalusia is rather close to a *network R&D system*, even though some *grassroots tendencies* are discernable. Support of RTDI projects happens on regional or national levels, although the regional level has the most competences due to its Autonomous Community status with strong devolved powers. In the manner of a network system funding is guided and assessed by public and private regional banks and funds, government, semi-state-owned, and private agencies or firms as well as regional research institutes. The Andalusian research competences are relatively broad in nature, covering basic, applied and experimental research. Simultaneously, the output is comparatively low. However, since the R&D system is highly dependent on public actors (especially the HES) the share of basic research is not negligible, although the system is generally more applied and experimental oriented (but also here the HES contributes the major part to the overall activities, especially in terms of applied research). Due to the high degree of decentralisation and a high number of involved actors, the need for coordination can be assessed as very high. There is a clear need for a greater involvement of the private sector in the governance of the regional

R&D system, especially at the level of research and technology infrastructures and facilities (technology centres and parks), where public-private cooperation is expected to act as a driver. The region´s degree of specialization with respect to its governance and policy characteristics is rather flexible, proven by the evolution of changing regional political emphases on questions concerning economy, modernisation, research, and innovation in recent decades.

4.3.2 Business Innovation Dimension

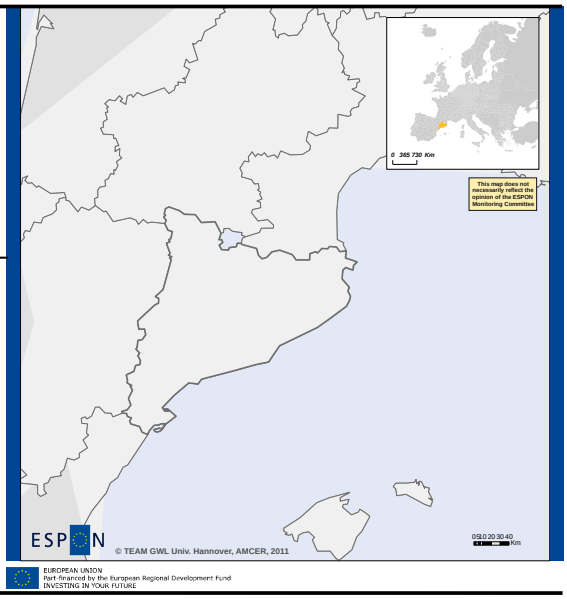
In general, regarding the business innovation dimension, the Andalusian R&D system exhibits clear traits of a *localist R&D system*. The system is dominated by a vast proportion of indigenous SMEs with a quite low research reach and low research resources. In general, Andalusian firms are rather process than product innovation oriented. Technology production (e.g. through patents) is strongly concentrated on a small number of enterprises and capable universities. However, research is mostly performed by a few major local public research organisations (universities and research centres) with relatively high research resources. Particular striking is the fact that there is a mismatch between the industrial sector structure and its capabilities for research and innovation, and the fields in which the public research institutions are active. The overall degree of association can be assessed as quite high, especially among entrepreneurs within the same (often traditional) industries but also between them and regional policymakers. As for business association, Andalusia has already shown some development. Until recently, sectoral associations concentrated on lobbying and collective agreements (convenios collectivos). Issues of competitiveness have been scarcely addressed so far. A change is however taking place in some sectors, for instance with ETICOM in the ICT sector. In parallel to the sectoral approach of association, there are numerous local associations (city-level) of small companies, especially from the retail sector. Chambers of Commerce, established at provincial level and funded by mandatory contributions of large companies, has focused on training and foreign trade. However, in order to further enhance the association among the public research sector and the broad mass of the business sphere, on the one hand, the gearing between the traditional sectors and the research actors needs to be further improved and, on the other hand, the formation of medium- and large-sized firms from modern sectors, capable for innovations and research co-operations, needs to be accelerated.

V. Region Catalonia

SPAIN

Region Catalonia

NUTS Code ES51 (NUTS-2-Level)



Introduction:

Catalonia is an autonomous Spanish community with its own language and distinct cultural heritage located in the northeast of the Iberian Peninsula and bordering the French regions Languedoc-Roussillon and Midi-Pyrénées as well as Andorra to the north, the Mediterranean Sea to the east, the Valencian community to the south, and Aragon to the west.

Catalonia has a surface of 32,113 km² and a population of about 7.29m. Therewith the region has a population density of 227 per km², in 2009, which means that it is much more populated than both the Spanish (91) and the European average (116, in 2008). Barcelona, the region´s capital and its economic as well as research and innovation centre has about 1.6m inhabitants in its core and 5.5m within the metropolitan boundaries (cf. EUROSTAT 2011; OECD 2010b).

National/EU context:

Catalonia´s regional GDP per capita is above the national and the European average. The region is traditionally one of the most dynamic, open, industrial and innovative regions in Spain. The Catalonian economy contributes the most to the Spanish GDP and is very much characterised by industrial activities or production-related services, respectively. The region has a dense community of SMEs, often forming local production systems, but also an active presence of MNEs.

Regarding innovation-related indicators the region is one of the top-performing regions in Spain. However, in comparison to the European level the region often achieves below average values with respect to RTDI indicators.

Catalonia´s current core R&D sectors are logistics, health, optics, agro-industry, ICT, chemicals, sustainable energy, functional alimentation, water, and clean materials and technologies. The RTDI sector in Catalonia is clearly business-oriented. Catalonia´s local production systems contribute significant proportions to the knowledge and technology production, although they are often active in rather incremental and low-tech oriented activities. Currently, most technologically advanced research and innovation activities are conducted by a small group of firms (often larger enterprises) in only a few sectors. These effects are especially noted for manufacturing but not necessarily for services (cf. EUROSTAT 2011; OECD 2010b, 2010c).

The region´s innovativeness in relation to the other Spanish regions, measured by the number of patents applied at the EPO, ranks in the 1st place. However, in European terms the region is rather weak with respect to patenting. In 2007, the employment in R&D (FTE) was equivalent to 21.0% of the overall Spanish R&D personnel. The R&D personnel (FTE) per 1,000 employees amount to 12.3. This figure is well above the national (10.0) and the EU-27 (11.0) average. Regarding the business orientation of both the R&D expenditures and the R&D personnel (FTE) (62.8%, 52.9%), the region exceeds Spain (55.9%, 43.5%) and the EU-27 mean (63.7%, 52.1%) (cf. EUROSTAT 2011).

In 2007, Catalonia´s per capita spending on R&D ranks in the upper third among the Spanish regions. The region´s R&D intensity lies at 1.5%, thus being above the national average (1.27%) but below the EU-27 mean (1.85%). Catalonia´s R&D productivity amounts to 0.21, thus being above the Spanish standard (0.13) but below the EU-27 average (0.27) (cf. EUROSTAT 2011).

1. Socio-economic Characteristics

In 2008, the regional GDP in Catalonia amounted to about €202.8b, accounting for a share of about 18.6% of the Spanish GDP and therewith forming the strongest regional economy followed by Madrid (17.8%) and Andalusia (13.7%). The regional GDP per capita was €27,900, which represents 116.7% of the Spanish and 111.2% of the EU-27 average, respectively. Between 1995 and 2008, the Catalonian economy grew by 6.8% p.a., which is slightly below average regarding the national (6.9%) figure and well above-average taking the EU-27 (4.5%) (cf. EUROSTAT 2011). Although the Catalonian industries as well as industry-related services are major pillars of economic prosperity in the region (see below), like in Spain, much of the strong regional GDP growth has been due to population increases resulting from immigration. Some immigrants are retirees from European countries; however, most of them are Ibero Americans or Africans, coming to Spain or Europe, respectively, due to poverty and in the hope for employment and because of an existing demand for cheap labour particularly in the agricultural and construction sector. However, in contrary to Spain most of the immigrants to Catalonia had little or no education, whereof Catalonia now has the highest share of unskilled immigrants in the country. Hence, the result was a vigorous decrease in labour productivity for Catalonia (and in Spain) from 115% of the OECD average in 1995 to merely 91% in 2005. Comparing the economic performance of Catalonia with that of the other AMCER-regions, the region ranks in the midfield (see App. Tab. 3). However, the strong period of nominal growth since the 1990s has now ended (see below) (cf. OECD 2010c).

In 2010, the regional labour force amounted to 3.81m, representing 16.5% of Spain´s total labour force (23.09m). Therewith, the region´s labour force size ranks in the 2nd place among the Spanish regions after Andalusia. The regional employment rate of the 20-64 year-olds lies at 67.1%, which is above average compared to the very low national average of 62.5% (cf. EUROSTAT 2011). Nevertheless, taking the employment rate target of 75% defined by the "Europe 2020 Strategy", the Catalonian employment rate is still far too low (cf. EC 2011).

In 2008, 2.0% of the employees worked in the agricultural sector, 33.1% in the industry, and 65.0% in the service sector. In comparison to the national average (4.3%, 27.8%, 67.9%) one can see profound differences, where the region´s industry sector is more and the agricultural as well as the service sectors are less accentuated. Taking the EU-15 average (3.5%, 26.2%, 69.7%), where the more developed countries of the European Union are considered, the same findings can be observed. This underpins Catalonia´s long-standing and persistent industrial tradition. However, due to a number of factors, such as oil crises, the EU membership, and the Olympic Games in 1992, a steadily transition of the Catalonian economy happened. Due to these developments the tertiary sector gained increasing importance. Both the tertiary and the construction sector have offered employment possibilities to many (often low-

skilled) immigrants and absorbed many of the job losses in manufacturing. Nonetheless, the industry remains a central pillar of the region´s overall economy. Manufacturing and therewith related production services still account for about 54% of employment and 59% of GVA. Compared to Spain the region is specialised in medium high-tech and high-tech manufacturing. Employment in the high-tech manufacturing sector accounts for 4.5% and 32.1% in medium high-tech. However, high-tech specialisation is increasing since the early 1990s, while medium high-tech has been losing in importance. The combined share of both high-tech and medium high-tech manufacturing is greater in Catalonia (8%) than in the EU-15 (below 7%) (cf. EUROSTAT 2011; OECD 2010b, 2010c). Comparing the economic structure of Catalonia with that of the other AMCER-regions, in terms of its industry sector share the region ranks in the 1st place, regarding the service sector share it ranks in the last place (see App. Tab. 4). Not least because of its industrial structures Catalonia has compared to the other Spanish region many strengths regarding the knowledge and technology production (see section 2.3).

Between 1999 and 2007, a strong recovery of the unemployment occurred with rates declining from 10.8 to 6.5%. However, since 2007, the average annual regional unemployment rate heavily increased, going up to 17.8% in 2010. The regional development is thus following the national trend, where the unemployment rate rose from 8.5% (2006) to 20.1% (2010) (cf. EUROSTAT 2011). However, simultaneously the Catalonian as well as the national economy is shaped by 'black economy' activities, employing many officially unemployed and accounting almost one-fourth to the GDP. Both the Catalonian and the national unemployment figures are far above the EU-27 average of 9.6% in 2010. A particularly strong upsurge happened in the years 2008 and 2009, when the financial crisis affected the regional economy the most. Especially the collapse of the real estate industry and the therewith closely related construction industry were responsible for the large increases in unemployment, particularly in the large population of lesser-skilled employees. Comparing the overall as well as the youth unemployment figures of Catalonia with that of the other AMCER-regions, the region exceeds by far the values, outstripped only by Andalusia. Moreover, the relatively high long-term unemployment share must be considered critical (see App. Tab. 5). Due to the knowledge that the growth induced by the construction and housing sector is not sustainable and the "need for sustainable competitiveness, Catalonia has increasingly made science, technology and innovation a focus for regional action in support of economic development" (OECD 2010b:2). Nevertheless, the figures reveal the region´s need for enormous efforts on the part of the government to carry out constant reforms.

The Catalonian economy exhibits some intra-regional disparities as indicated through the coefficient of variation of several indicators stated in Tab. 7. The metropolitan area of Barcelona accounts in terms of both population and economy for about three-quarter of the Catalonian stocks and is simultaneously the most dynamic region. Barcelona successfully went through a phase of transformation with declining industry ('Manchester of Southern Europe'). Nowadays the metropolitan area acts as a global gateway, creative hub, and science city (e.g. biotechnology) and operates as a magnet for students, researchers and artists from Europe and the rest of the world, with direct impact on the regional economy. However, there is partly also a socio-economically dynamic network of medium-sized cities and small towns spread throughout the other three often more rural shaped provinces (Tarragona, Girona, Lleida). However, together the three provinces account for merely one-quarter of the regional population and economy. Tarragona and Girona each generating 10% of the regional GDP and Lleida 6%. Moreover, Girona and Tarragona have a population density per km² at 107 and 108, respectively, and Lleida at 32, compared to Barcelona with 657, showing that Lleida is by far the most rural sub-region in Catalonia. In terms of the natural population development Tarragona, Girona, and Lleida are far more dynamic than Barcelona, however, in the end Bar-

celona strongly profits from high in-migration. The provinces of Lleida and Girona have comparatively lower productivity levels and are more shaped by agriculture and lower-technology industries, whereas Barcelona and Tarragona have higher productivity levels and more medium high-tech and high-tech industries (cf. OECD 2010b, 2010c).

Table 7: Intra-regional socio-economic Disparities in Catalonia (selected Indicators)

Coefficient of variation of GDP per capita 2008 (in %)	Coefficient of variation of the yearly average GDP per capita growth rate 1998-08 (in %)	Coefficient of variation of the unemployment rate 2009 (in %)	Coefficient of variation of the population dynamics 2005-09 (in %)
2.29	7.75	18.99	40.36

Remark: disparity calculations based on NUTS-3 level data

(Source: own creation and calculations; based on data from EUROSTAT 2011)

The Catalonian economy employed about 3.1m people, in 2010, and is characterised by a high degree of diversity. The region´s primary sector is comparatively insignificant regarding its overall contribution to the GDP, however, there are strong subsectors existing (e.g. cava, wine, meat products, fruits) which are traded throughout the world. Nonetheless, the regional economy is traditionally shaped by industrial activities (see above). The most important sectors in terms of employment are metal products and food, accounting for nearly one-fourth. Moreover important sectors are chemicals, pharmaceuticals, packaging, vehicles, machinery, electrical household appliances as well as computer and office IT equipment. Of great relevance is also the construction sector, although it has not the overall economic weight as in other Spanish regions. Emerging industrial sectors in the region are the renewable energy sector, life sciences and biotechnology, aeronautics, and waste management. Tourism and related businesses are of particular relevance in the tertiary sector. Expanding tertiary sectors are business-related services, whether trading, transport, and ICTs. Moreover, Catalonia or rather Barcelona in particular are European centres of the creative economy, ranking among Europe´s Top 25 regions "with important 'clusters' of cultural and creative industries" (OECD 2010c:158). Most important creative industries are design (i.e. textile, industrial design, and architecture), software, television and radio as well as advertising. Especially for knowledge-intensive businesses creative industries are likely to play an important role due to their radiation of 'talent, technology and tolerance' (cf. ACCIÓ 2011; OECD 2010b, 2010c; RIM 2011e).

The Catalonian economy is shaped by indigenous SMEs. About 99.8% of the Catalonian enterprises are SMEs and they employ about 74% of the workforce. The remaining 0.2% of the firms (employing more than 250 people) account for about 26% of the employment. The dominance of SMEs and their often highly specialised orientation led to the evolution of a number of local production systems. Their fields of activity vary from traditional to modern sectors. The majority is located in or around the metropolitan area of Barcelona, but some are also spread around the other regions within Catalonia. Moreover, Catalonia hosts numerous foreign firms (about 3,300). Most of them are active in industries such as agro-food, automotive, engineering, pharmaceutics or biotechnology and originated in France (18.5%), Germany (16.9%), USA (10.8%), Italy (10.2%), and the Netherlands (9.1%). Although the majority of research and innovation activities is conducted by a relatively small number of firms (often larger enterprises), the contribution of SMEs and local production systems is significant and of great importance (see below) (cf. ACCIÓ 2010; OECD 2010b, 2010c)

As the openness of the Catalonian economy could be pointed out the same can be observed for trade. It is estimated that about 11% of Catalonian firms are involved in export markets, compared to the national average of 4%. Moreover, about 20% of all manufacturing firms do export their products and over 35% of all Spanish exporters are located in Catalonia. The region accounts for approximately 25.4% of Spanish exports in 2009, worth about €41.46 billion, making it to the top exporting region in Spain. The region´s scope of imports came to

€57.46b (27.3% of national total). Such data suggests that the value of imports to Catalonia exceed that of exports from the region, showing that the region´s domestic demand is predominant, although a high export-orientation could be observed. About 95% of the exports were industrial goods, whereof most were intermediate goods (53.9%), followed by consumer goods (38.7%). Capital goods accounted for the smallest share (7.4%). In detail, in 2009, chemical products (22.5%) were the main export commodities of the region, followed by motor vehicles and transport materials (16.6%), food and beverages (11.1%), textiles, leatherwork, and footwear (8.6%), as well as electric and electronic material and equipment (8.0%). Therefore the traded commodity patterns are broadly in line with the dominating economic sectors. In 2009, the primary target markets were the EU, accounted for about three-quarters, as well as other European countries, South and Central America, and North America. The data outline also that in terms of imports and exports, the effects of the wider economic crisis were felt strongly in 2009. Of note however, exports in 2009 from Catalonia fell by 17.9% from 2008. Regarding imports, they fell by 25.5% in 2009. If the region, in 2010, already returned and increased from its 2008 levels remains unclear at the moment, due to that currently no up-to-date data is available. Such figures highlight that the effects of the wider economic recession in Spain in 2008-2009 led certainly to reduced demand for imported products in 2009. Regarding exports, these were less affected than imports, demonstrating some sustainability in the Catalonian export sectors (cf. ACCIÓ 2011; EUROSTAT 2011; IDESCAT 2011; MARCHESE/POTTER 2010).

2. RTDI Characteristics

2.1 R&D Efforts and Input into the Process of Knowledge Generation

Within Catalonia a vast proportion of the research and innovation competences and resources are bundled in the metropolitan area of Barcelona. However, Catalonia´s GERD amount to €2.91b in 2007, thus contributing 21.8% to the Spanish total. The R&D expenditures per capita amounted to €410. Therewith, Catalonia´s per capita spending on R&D ranks in the upper third compared to the other Spanish regions. The highest spending has Madrid (€592). When expressed as a percentage of GDP, the GERD is used to indicate the overall R&D intensity of a country or region. This measure unfolds the emphasis placed on R&D activities within a given economy. In 2007, R&D expenditures per GDP are 1.5%, thus being above the national average (1.27%) but below the EU-27 mean (1.85%) (cf. EUROSTAT 2011). The regional R&D expenditure per GDP quota is still far away from meeting the target of 3% defined by the "Europe 2020 Strategy", although a strong increase in R&D expenditures could be observed in recent years (cf. EC 2011). Moreover, comparing both the R&D expenditures per capita and per GDP of Catalonia with that of the other AMCER-regions, the region ranks in the lower third, respectively (see App. Tab. 6).

In 2007, the FTE employment in R&D amounts to 43,037, which is 21.40% of the overall Spanish R&D personnel. The R&D personnel (FTE) per 1,000 employees amounted to 12.3. This figure is well above both the Spanish (10.0) and the EU-27 average (11.0). Regarding the R&D personnel per 1,000 employees in comparison to the other AMCER-regions, Catalonia ranks in the midfield (see App. Tab. 6) (cf. EUROSTAT 2011).

The R&D sector can be sub-divided into the BES, the GOV, the HES, and the PNP. Their relative importance varies greatly across regions, however, generally reflecting different economic or research structures and traditions, respectively. With regard to the innovation system approach, the proposition of BERD is considered as an indicator of the overall innovative capacity of a region. Although, this should not be over-interpreted, because the other sectors also provide important stimuli to the process of knowledge and technology production.

Catalonia´s current core R&D sectors are logistics, health, optics, agro-industry, ICT, chemicals, sustainable energy, functional alimentation, water, and clean materials and tech-

nologies. The RTDI sector in Catalonia is clearly business-oriented. The BERD amounts to 62.8% (€1.826b) of the overall GERD, in 2007. Moreover, the share of the BES in R&D employment (FTE) accounts for 52.9% (22,786 employees) of the overall R&D employment. Regarding the business orientation of the R&D expenditures and the R&D personnel (FTE), the region´s RTDI sector exceeds Spain (55.9%, 43.5%) and the EU-27 mean (63.7%, 52.1%). Comparing the same aspects between Catalonia and the other AMCER-regions, the region ranks in both cases in the midfield (see App. Tab. 6) (cf. EUROSTAT 2011). Concerning the BES, in general, Catalonia has the highest share of innovative firms in Spain, accounting for 22.5%, followed by Madrid (15.6%) and Andalusia (15.0%). Catalonia´s local production systems contribute significant proportions to the knowledge and technology production, although they are often active in rather incremental and low-tech oriented activities. However, further boosting of research and innovation activities of SMEs seem to be crucial in the light of sustainable economic development and increasing intensity of competition. Currently, most technologically advanced research and innovation activities are conducted by a small group of firms (often larger enterprises) in only a few sectors (see below). These effects are especially noted for manufacturing but not necessarily for services (cf. EUROSTAT 2011; OECD 2010b, 2010c).

At first sight, regarding their shares in R&D expenditures and personnel (FTE) both the HES and the GOV seem to play a less pronounced role. In the HES the shares of R&D expenditures and personnel amount to 23.3 (€677.4m) and 32.1% (13,805 employees), respectively. Accordingly, the shares of R&D expenditures and personnel in the GOV are 13.7 (€398.3m) and 14.7% (6,305 employees), respectively. However, while the BES carries out the vast proportion of R&D, the Catalonian technology and knowledge transfer system is highly public-driven due to that the infrastructure (e.g. science, technology and innovation centres/parks, research institutions, and network initiatives) for such matters is mainly public funded and relatively recent. Especially the HES has a major relevance regarding the whole public sector. Catalonia has 12 universities (eight public and four private) which are all located in larger cities. Out of these 12 universities nine are located in the city or the metropolitan area of Barcelona, respectively. The remaining universities are located in Tarragona, Girona and Lleida. Catalonia accounts for 25% of the Spanish scientific knowledge production, whereof 60% is due to universities. Furthermore, in recent years the increased number of universities led to improvements regarding the higher education attainment, the attraction of students as well as the support of more professional degrees and lifelong learning (see below). Moreover, the universities are encouraged to support the regional economic development through knowledge and technology transfers ('third mission') (cf. EUROSTAT 2011; OECD 2010b, 2010c).

However, while the knowledge generation sub-system has steadily been upgraded in both the BES and the HES (although there are still needs for further improvements; see section 2.3), the knowledge diffusion sub-system still has outstanding weaknesses. Indeed, the region´s universities are engaged through several institutional measures in order to promote this. These embrace technology transfer offices, network initiatives, public-private R&D partnership programmes and science and technology parks. However, especially the HES still has problems with respect to knowledge transfers through co-operations with the BES. This is particularly the case for universities in Barcelona, whereas the engagement among universities in the other sub-regional capitals of Catalonia is often better. A reason for that is the large number of actors concentrated in Barcelona. More general existing constraints limiting the knowledge transfer within the region and among the actors are, firstly, problems within the universities governance bodies to utilize measures in order to support university engagement with regional firms, secondly, a lack of incentives for individual researchers, and, thirdly, a generally missing culture of cooperation between the HES and BES. Moreover, the region´s

policy mix in order to support research and innovation has mostly been focused on research (cf. OECD 2010b, 2010c). "The low absorption capacity of firms, notably SMEs, limits their ability to adapt and absorb knowledge from universities, other tertiary education institutions and other research institutions. A number of technology transfer institutions and mechanisms have been created in recent years, but often strongly driven by public sector entities and the proliferation has led to confusion and varying degrees of quality. The private sector appears to take a less active role than it should in supporting technology transfer" (OECD 2010c:116).

The PNP plays rather a subordinated role with a share of 0.24% (€6.825m) in expenditures (cf. EUROSTAT 2011).

2.2 Human Capital Endowment

In 2009, HRSTC in Catalonia amounted to 0.630m, representing 15.8% of national total (3.994m) and 16.6% of the economically active population. With this share of knowledge workers the region ranks in the upper midfield in comparison with the other AMCER regions (see App. Tab. 7) (cf. EUROSTAT 2011).

Moreover, in 2009, the region had a stock of 117,493 employees working in high-tech industries and knowledge-intensive services, i.e. 17.9% of national total and 3.7% of total employment in the region. Therefore, the Catalonian share in total employment is above the Spanish standard (3.5%) (cf. EUROSTAT 2011). In comparison with the other AMCER regions Catalonia ranks in the 3rd place after East of England and Flanders (see App. Tab. 7). The relatively high level of both HRSTC employment and high-tech employment figures explain and underpin the regions already above-mentioned relative strengths in research and innovation related activities.

The education level of the human capital forms the basis for productive and innovative activities in developed countries and regions. In 2010, Catalonia had 443,166 students in the secondary education level (ISCED 2-4), i.e. 60.8 students per 1,000 inhabitants. Thus, regarding the Spanish standard (66.9), this is below average. Overall, 21.9% of the Catalonian population of working age (25-64 year-olds) has an upper secondary education attainment (ISCED 3), in 2010, which is compared to both the Spanish mean (22.0%) and towards the EU-27 standard (46.8%) below-average. Considering the tertiary education level (ISCED 5-6), the region had 250,930 students in that field, in 2010, i.e. 34.4 students per 1,000 inhabitants. Regarding the Spanish average (39.3), the region´s figure is again below average. Altogether, 30.8% of the population of working age had a tertiary education attainment (ISCED 5-6). This is compared to Spain as a whole (30.7%) and the EU-27 average (25.9%) above average. The proportion of the 30-34 year-olds with a tertiary education attainment amounts to 39.9% in Catalonia, in 2009 (Spain: 40.6%; EU-27: 33.6%), thus the region almost meets the 40%-target defined by the "Europe 2020 Strategy" (cf. EC 2011; EUROSTAT 2011; IDESCAT 2011). Comparing the Catalonian figures of secondary and tertiary level students per 1,000 inhabitants with those in the other eight AMCER regions the region ranks in terms of secondary level students in the last place and in terms of tertiary level students in the upper midfield (see App. Tab. 7).

Regarding the early leavers from education and training, which can be interpreted as at least temporarily lost human capital, in the education vintage 2010, they accounted for 29.8% in the east of Spain[6], thus ranking among the highest values of the Spanish NUTS-1 regions. The outstandingly high value is extremely alarming, although it already decreased by 5.5 percentage points compared to the year 2003. This is particularly compared to the EU-27 mean (14.1%) but also towards the already high national average (28.4) far too high (cf. EUROSTAT 2011). Therewith, the regional proportion of early school leavers does clearly not meet the

[6] There were no data for Catalonia (NUTS-2 level) available.

maximum target of 10% defined by the "Europe 2020 Strategy" (cf. EC 2011). Moreover, compared to the other AMCER regions the Catalonian proportion ranks in the pre-last place (see App. Tab. 7). Against the backdrop of the aging society in the region (see 4.1 below), high reintegration costs, increasing pressure for innovation, productivity, and competitiveness, profound structural reforms are obviously urgent.

Because the technological progress is increasingly challenging developed countries and regions and therewith requirements to education are steadily rising, further education of adults is playing an increasingly important role in knowledge- and innovation-driven economies in general and for aging societies in particular. The Catalonian participation share of adults aged 25-64 in education and training amounts to 9.9%, in 2010, therewith being slightly below the national (10.8%) but still above the EU-27 average (9.1%). The regional figure ranks in the upper midfield compared to the other AMCER regions, although it should be mentioned that the top regions still have far better values (see App. Tab. 7). However, the upgrading of the HES since the 1990s and lifelong learning seems to be reflected in these figures (cf. EUROSTAT 2011).

2.3 Potential for Innovation

In the course of this work the number of patent applications at the EPO is taken as an indicator for the potential for innovation, thus depicting the production of knowledge and technologies. Although in the innovation process patents are somewhere between inventions and innovation and therefore covering only a part of the whole innovation process, they are among the most widely used innovation indicators (cf. GRUPP 1997; FRIETSCH et al. 2008).

Although there is a strong concentration of patents in a small number of enterprises (often larger firms) in the region, SMEs play an important role with regard to patenting (cf. BOIX/GALLETTO 2009). Between 2000 and 2003 in Catalonia a number of 1,452 patents were applied at the EPO, accounting for 41.1% of the national total. Between 2004 and 2007 the number of patent applications amounted to already 1,816 (38.5% of national total), an increase of about 25.1%. At the same time the patent applications per million inhabitants rose from 229, in 2000-2003, to 265, in 2004-2007 (plus 15.5%). Regarding the overall patent output, among the Spanish regions Catalonia ranks in the 1st place (cf. EUROSTAT 2011). This underpins the in section 2.1 already mentioned important technological position of Catalonia within Spain. Nonetheless, despite this position and a positive trend, in comparison to the other eight AMCER regions, regarding the absolute figure the region ranks in the upper midfield, however, taking the relative patent application figure, the region merely ranks in the pre-last place (see App. Tab. 8). "The rationale for this weak performance is, in short, the persistent gap between research and innovation in Catalonia" (BACARIA et al. 2004:64). However, in this context it should also be mentioned, that it is suggested that some of the R&D conducted by the BES – especially in Barcelona – is not depicted in the region´s patent figures due to a headquarter bias (cf. OECD 2010b).

Since patents are in most cases the result of extensive R&D activities, it is possible to determine the R&D productivity (measured as EPO patent applications per million R&D expenditures in 2005). Moreover, this indicator unveils how effective the money spent on R&D is utilized in the process of knowledge generation. The Catalan R&D productivity amounts to 0.21, thus being well above-average compared to the Spanish standard (0.13) (cf. EUROSTAT 2011). Nevertheless, compared to the other AMCER regions, the Catalonian R&D productivity ranks in the lower third (see App. Tab. 8). The figures unveil that the Catalonian R&D system still has some inefficiencies which should be addressed.

Concerning the technically more challenging high-tech patents, Catalonia accounted for merely 174 applications at the EPO between 2004 and 2007. Between 2000 and 2003 the region´s high-tech patent applications amounted to 187, a decrease of -7.2% and a contrasting trend compared to the overall patent applications (see above). The high-tech patent applica-

tions per million inhabitants come to 25 in the period of 2004-2007. For the same period, the proportion of high-tech patent applications to all patent applications amounted to 9.6%. Among the Spanish regions, Catalonia ranks in the 2nd place after Madrid, again illustrating the region´s relative technological sophistication. However, comparing the region´s performance with that of the other AMCER-regions, it ranks in both absolute and relative terms in the lower third (see App. Tab. 8). The region´s high-tech patent applications mostly have been made in the fields of computer and automated business (37.6%), micro-organism and genetic engineering (27.6%), communication technologies (27.3%), and semiconductors (8.6%) (cf. EUROSTAT 2011).

As stated in the sections 1 and 2, Catalonia is clearly among the Spanish top regions regarding both the economy and RTDI aspects. However, although the region has comparatively good framework conditions and a good infrastructure, in international comparisons it becomes clear that the region often still lacks competitiveness with respect to most R&D-related indicators, unveiling the need for further efforts and improvements. This is particularly the case in terms of knowledge and technology transfer and output.

3. RTDI Governance and Innovation Policy

3.1 Governance

Catalonia is historically an Autonomous Community with strong devolved powers and competences including a wide range of research and innovation related responsibilities. The Catalonian R&D policies are promoted and coordinated by the Catalan Ministry of Enterprise and Labour. Under the ministry level, there are also several public agencies and publicly funded foundations that play an implementation role in R&D and innovation. The governance of its research and innovation system is highly complex and led partly to inefficiencies and confusion among the actors. In order to simplify the structures and unwind the proliferation of research entities, networks, science parks, etc. the regional administration undertook several measures in recent years.

Major regional organisations engaged in the promotion of research, innovation, and economic development which are resulting from this process are the Innovation and Internationalization Agency (ACCIÓ), the Agency for Management of University and Research Grants (AGAUR), responsible for managing university and research grants, recruitment of research talents, and the promotion of science, technology, innovation and advisory services, the Fundació Institució Catalana de Support a la Recerca, which aim is to increase social recognition of research by science dissemination and to explore new avenues for cooperation involving the public and private sectors in the scientific research activities in Catalonia, the Catalonian Research Centre Agency (CERCA) and the Catalan Technology Centres Network (TECNIO), both acting as a consortium of different technology transfer entities (e.g. technology parks, science parks, research centres, etc.). Under the Directorate General for Research there is a team that co-ordinates research and innovation activities. Major actors from the innovation and knowledge community are private companies, research centres, universities, innovation intermediaries, and hospitals (cf. OECD 2010b).

In the Spanish highly decentralized political and institutional context, the regional system is being articulated with State-level public stakeholders, namely the Ministry of Science and Technology and the Centre for Industrial Technology Development (CDTI), a public state agency under the responsibility of the Ministry of Science and Innovation and the national reference in financial support to RTDI projects.

3.2 Policy

Since the 1980s Spain and Catalonia increasingly put an emphasis on innovation policy matters. In the first two decades the focus was predominately put on capacity and infrastructure building. Since the 2000s, in line with the Spanish key objective to enhance the capability for

innovation of the BES, Catalonia's policy approach has been focused on knowledge generation. However, in recent years policies which accelerate the exploitation of knowledge gained increasing interest. Moreover, recently the government increasingly projects the focus on the knowledge and technology transfer, especially from the HES and among the HES and the BES (e.g. SMEs). On the one hand, the government wants to support spinoffs and the foundation of RTDI-intensive firms. On the other hand, it is assumed that interactions between the two spheres are "particularly important for small and medium-sized enterprises (SMEs) which frequently lack the managerial skills that could help them specialise and increase productivity" (OECD 2010c:20). But universities also gain from such interactions namely because SMEs account for about 30% of the Spanish patent production (cf. BACARIA et al. 2004; OECD 2010b, 2010c).

At present, R&D and innovation policies are mainly framed by the document: 'The Catalan Agreement on Research and Innovation (CARI) 2020' and the 'Research and Innovation Plan 2010-2013', which is now undergoing a revision due to economic changes. The main priorities of the CARI 2020 are: to improve skills and profiles, to encourage talent flows that generate value, to strengthen the public research system increasing its efficiency and impact, to boost business innovation and differentiation and new RTDI-intensive enterprises, to promote innovation in public services and the government, to encourage demand and political action to act as drivers of RTDI, to make science, technology and innovation a structural element of society, to integrate Catalan research and innovation system agents into global networks, to organise the levels and actors of governance so as to achieve an effective model, to improve the design, implementation and execution of RTDI policies, to consolidate the RTDI funding framework of the Government of Catalonia.

The support of the region´s research and innovation community is ensured by various funding measures. Some of the main support measures are namely the Measure to finance investment project into industry, the Seventh Framework Programme R+D projects, the measure New Technology-Based Business (NEBTs), the R&D Collaborative Projects, the measure Innovative Enterprise, and the measure Cooperative Innovative. Considering Catalonia´s scale and performance the region often belongs to the largest recipients of RTDI-related programme funds from the national government and the EU framework programme (cf. OECD 2010c; RIM 2011e).

4. Trends, Challenges, and Assessment

4.1 Trends and Challenges which are not specific to the R&D Sector

The long-term economic development of Catalonia in the period of 1995-2008 was slightly below-average compared to the national mean but well above the European average. If the region succeeds to address the in section 4.1 mentioned points regarding RTDI aspects and additionally further strengthens its relatively diverse and competitive industries, Catalonia has the chance to extend its strong position among the Spanish and the European regions. Nonetheless, the region faces several problems. Most striking are the increase of productivity, the reduction of the extraordinary high unemployment by addressing existing structural labour market problems, and, from an intra-regional perspective, the dispersion of economic wealth among the sub-regions because most of the economic activities are bundled in the metropolitan area of Barcelona.

The population development and especially the aging figures of a population are crucial for innovation related purposes, because the youth of a population virtually determines its dynamism and innovativeness and therewith its future viability. In 2009, the Catalonian population reached its present maximum of about 7.29m (cf. EUROSTAT 2011). Since 2000, the regional population thus grew by 17.3%. With its population size the region ranks the 1st place among the eastern Spanish regions and the second regarding all Spanish regions. However, although

the Catalonian population experienced its largest period of growth there are two principal features of recent demographic development: decrease of fertility and growingly positive migration balances. Hence, the high population growth of the recent years is due to high in-migration from abroad. This circumstance makes Catalonia rather similar to most of the other of European countries. In 2010, 15.1% of the regional population was younger than 15 years, 68.2% were between 15 and 64 years, thus representing the population of working age and about 16.6% were 65 years or older (retirement age). Despite the above-mentioned recent demographic trends, the Catalonia's age distribution figures depict an ageing regional population where the cohort of the young and adolescent people is smaller than the cohort of the people of retirement age. The future trends are basically the same as what is expected in Europe's countries and regions at large: reduction of the potential of natural growth and demographic ageing (unquestioned tendencies) and uncertainty on the evolution of fertility rates and the levels of migrations flows. Accordingly, projections assume that in 2030, the share of people which is 65 years and older will already account for about 21.5% in Catalonia, showing the economic and social challenges the region is confronted in the future (cf. EUROSTAT 2011; GIANNAKOURIS 2010).

4.2 Trends and Challenges which are specific to the R&D Sector

Catalonia has in comparison to the other Spanish regions many advantages regarding RTDI aspects. The region is shaped by R&D activities from the BES. This trend is likely to continue due to the region´s relatively well-developed research infrastructure and economic structure. However, in order to make further progresses in building up a knowledge-based economy and to catch-up with more developed European regions Catalonia needs to increase further its R&D efforts. Especially against the backdrop of the current crisis and increasing pressure for financial consolidation on part of both the public sector and the BES this target is particularly challenging in the future.

Currently, most of the research and innovation competences and resources are concentrated in the metropolitan area of Barcelona. Given the assumption that regions without enough competences and capacities in R&D will face difficulties in participating in and gaining from a knowledge driven economy it is likely that regional economic disparities will sharpen in the future. Against this backdrop the region will face the challenge of supporting the dispersion of R&D-intense activities within Catalonia without stalling regional economic dynamism.

Although the knowledge generation is not as high as in other European regions, there have been upgrading trends in recent years, making Catalonia to one of the top Spanish regions. However, the persistent weaknesses regarding the knowledge diffusion, which are due to a disconnection between the public sphere and the BES as well as low absorption capacities on part of SMEs, are strongly challenging Catalonia, because they are affecting a larger extension of knowledge and technology production and thereby undermining its future development prospects. In this context the region is obliged to stronger integrate universities in co-operations with the BES and accelerate spinoffs, and, on the other side, to better engage its SMEs in innovation strategies. Especially the latter is of great importance, because most technologically advanced knowledge production is currently conducted by larger firms, whereas SMEs – which are employing three-quarter of the people – are often active in incremental and low-tech oriented fields.

Although there have already been efforts concerning the improvement of the human capital formation, especially in comparison to the other Spanish regions, there are still needs for further engagement when looking at the international level. The human capital training and endowment are an increasingly important challenge against the backdrop of an aging regional society. Particular weaknesses do exist in the fields of secondary education attainment, and early leavers. Without considerable efforts the region will face problems such as high reintegration costs, and a lack of innovativeness, productivity and competitiveness.

4.3 Assessment of the regional R&D System

4.3.1 Governance Dimension

Concerning the governance dimension Catalonia is rather close to a *network R&D system,* even though some *grassroots tendencies* are discernable. RTDI support transfer takes place on different levels, e.g. regional or national as appropriate, although the regional level has the most competences due to its Autonomous Community status with strong devolved powers. In the manner of a network system funding is guided and assessed by regional, national and European funds, the government, semi-state-owned and private agencies or firms as well as regional research institutes. The Catalonian research competences are relatively broad in nature, covering basic, applied and experimental research. Basic research is mainly due to universities and public research centres, whereas applied and experimental research activities are highly concentrated in the BES. Nonetheless, although the Catalonian output ranks at the top between the Spanish regions it is comparatively low in international comparison. However, since the R&D system is mainly carried by the BES it is shaped by applied and near-market competences. Due to the high degree of decentralisation and a high number of involved actors, the need for coordination can be assessed as very high. The region´s degree of specialization with respect to its governance and policy characteristics is rather flexible, proven by the evolution of changing regional political emphases on questions concerning the further development of the research and innovation system.

4.3.2 Business Innovation Dimension

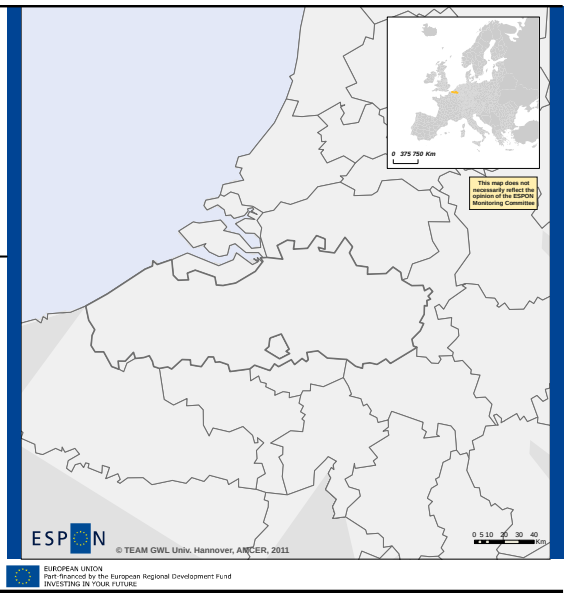
Regarding the business innovation dimension, the Catalonian R&D system can be classified as an *interactive system* with *globalised traits*. The region has a dense community of SMEs, often forming local production systems, but also an active presence of MNEs. To a certain extent one could state that there is a balance between large and smaller firms. Catalonia´s local production systems contribute significant proportions to the knowledge and technology production, although they are often active in rather incremental and low-tech oriented activities. Nevertheless, most technologically advanced research and innovation activities are conducted by a small group of firms (often larger enterprises or MNEs) in only a few sectors. Universities are the most important public research and innovation actors but due to their focus on knowledge generation rather than exploitation and problems in conducting knowledge transfers, their overall influence is limited and improvable. Currently, research is largely internal and private rather than public in nature, although a public innovation structure aiming on helping SMEs has been developed. In the end, the gap between the HES and the BES, or in other words between research and innovation, explains the region´s weak performance, although there is actually a quite well developed infrastructure existing. This ambivalent characteristic continues for associtionalism. Partly, the degree of association can be assessed to be quite high, although the interconnectedness is expandable. In order to address the weak points, the political actors actively try to influence the existence and foundation of network initiatives together with public actors (e.g. universities). In this context SMEs, firms from smaller sectors and future fields as well as public actors get the opportunity to work collectively on new potentials, the generation of synergy effects and innovative impulses, as well as co-operations.

VI. Region Flanders

BELGIUM

Region Flanders

NUTS Code BE2 (NUTS-1-Level)



Introduction:

Flanders or the Flemish region is one of the three main regions of Belgium. It is located in the northern part of the Belgian Kingdom and is home to the vast majority of the Dutch-speaking Belgians, the rest of them lives in the bilingual region of Brussels, which is entirely surrounded by Flemish territory. The third region of Belgium is the French-speaking Wallonia to the south of Flanders. Additionally, Flanders is bordering the Netherlands to the north, and the North Sea to the northwest.

Flanders has a surface of 13,522 km² and a population of about 6.2m. Therewith the region has a population density of 466 per km², in 2009, which means that it is highly dense populated by both Belgian (356) and European standards (116, in 2008). The institutions of the Flemish region were merged with those of the Flemish Community and have their headquarters in the Belgian capital Brussels (1.07m inhabitants) (cf. EUROSTAT 2011; POA 2010).

National/EU context:

The regional GDP per capita is corresponding with the Belgian mean but well above the European average. In Antwerp – the second largest city of Belgium after Brussels – in the north of the region, Flanders hosts a seaport of great international significance, and the second largest harbour in Europe after Rotterdam.

The region is internationally highly interwoven and shaped by firms from various medium-high and high technology sectors. Regarding the region´s RTDI characteristics it mostly achieves well above average results compared with the national level and European level.

A major R&D sector in Flanders is the ICT sector, representing the highest share of the overall private sector R&D employment. In general, the Flemish business R&D is very much engaged in high-tech-related R&D processes, e.g. in chemistry, pharmaceuticals, ICT, and mechatronics. These sectors together represent about 80% of the total R&D expenses. Hence, the potentials in high-tech are well developed (cf. RIM 2011f). The RTDI sector in Flanders is clearly business-oriented.

The region´s innovativeness in relation to the other Belgian regions, measured by the number of patents applied at the EPO, ranks in the 1st place. Moreover, even in European terms the region is a strong player with respect to patenting. In 2007, the employment in R&D (FTE) was equivalent to 61.3% of the overall Belgian R&D personnel. The R&D personnel

(FTE) per 1,000 employees amount to 13.3. This figure is above the national (12.3) and the EU-27 (11.0) average. Regarding the business orientation of both the R&D expenditures and the R&D personnel (FTE) (68.9%, 60.8%), the region´s RTDI sector roughly meets the Belgian average (69.5%, 58.7%) but excels the EU-27 mean (63.7%, 52.1%) (cf. EUROSTAT 2011).

In 2007, Flanders´ per capita spending on R&D ranks in 2nd place among the Belgian regions. The region´s R&D intensity accounts for 1.99%, thus being slightly above both the national average (1.90%) and the EU-27 average (1.85%). Flanders´ R&D productivity amounts to 0.27, thus being above the Belgian standard (0.21) and in line with the EU-27 average (0.27) (cf. EUROSTAT 2011).

1. Socio-economic Characteristics

In 2008, the regional GDP in Flanders amounted to about €199.3b, accounting for a share of about 57.8% of the Belgian GDP and therewith forming the strongest regional economy followed by Wallonia (23.6%), and Brussels (18.6%). The regional GDP per capita was €32,200, thus corresponding with the Belgian mean but representing 128.3% of the EU-27 average. Between 1995 and 2008, the Flemish economy grew by 3.7% p.a., which is slightly above-average regarding the national (3.6%) figure but below-average taking the EU-27 (4.5%) (cf. EUROSTAT 2011). Comparing the economic performance of Flanders with that of the other AMCER-regions, the region ranks in the 1st place (see App. Tab. 3). As shown, Flanders is a quite prosperous Western European region. It is centrally located and thus benefits from intensive trade relations with its rich neighbouring regions (see below) (cf. RCFG 2011:4).

In 2009, the regional labour force amounted to 2.86m, representing 59.5% of Belgium´s total labour force (4.80m). Therewith, Flanders´s labour force size ranks in the top among the three Belgian regions. The regional employment rate of the 20-64 year-olds lies at 71.5%, which is well above-average compared to the national average of 67.1% (cf. EUROSTAT 2011). Nevertheless, taking the employment rate target of 75% defined by the "Europe 2020 Strategy", the Flemish employment rate is still too low (cf. EC 2011).

In 2008, 1.9% of the employees worked in the agricultural sector, 26.7% in the industry, and 71.3% in the service sector. These figures are roughly in line with the national average (1.8%, 24.7%, 73.5%), whereas the region´s industry sector is more and the service sector is less accentuated. Taking the EU-15 average (3.5%, 26.2%, 69.7%), where the more developed countries of the European Union are considered, some profound differences can be observed. Particularly striking is that in the EU-15 average the agricultural sector appears to play a much more important role, whereas the proportions of the industry and the service sectors are less pronounced. This illustrates both the relatively more pronounced relevance of the industrial and service sectors and the comparable less importance of the agricultural sector in Flanders and partly in Belgium (cf. EUROSTAT 2011). Although the region´s share of industry is comparably high, Flanders shifted very much towards the service sector in recent years. However, comparing the economic structure of Flanders with that of the other AMCER-regions, in terms of its industry sector share the region still ranks in the upper midfield, regarding the service sector share it ranks in the 3rd place (see App. Tab. 4). In Flanders, both the industry and the service sector are relatively technologically sophisticated and knowledge-intensive (see below).

The average annual regional unemployment rate accounted for 5.1% in Flanders in 2010, coming from 5.4% in 2005. The regional trend is thus following the somewhat weaker national development, where the unemployment rate decreased from 8.4% (2005) to 8.3% (2010) (cf. EUROSTAT 2011). Both the Flemish and the national unemployment figures are below the EU-27 average of 9.6% in 2010. Especially between 2005 and 2008 a strong recovery occurred with rates declining from 5.4 to 3.9%. In 2009, when the already in 2007/2008

begun financial crisis seemed to impact the regional real economy the most, the unemployment rates started to increase again and rose to 4.9%, in 2009, and 5.1%, in 2010. However, even though the surge was noticeable it remained moderate. Comparing the unemployment rate of Flanders with that of the other AMCER-regions, the region has the lowest value (see App. Tab. 5). Taking the youth unemployment (15-24 year-olds) Flanders ranks in the midfield. Both figures reveal a relatively well functioning labour market. On the other hand, however, the relatively high long-term unemployment share must be considered critical. This reflects still existing inflexibilities in the labour market, which makes reforms necessary.

Due to Flanders central location within Europe, its dense and integrated multimodal transport structure (canals, railways, highways) as well as its important sea harbour in Antwerp, the region is an important European logistic hub. Thereof, the logistics sector is an overall important branch for Flanders. Key economic sectors are also the petrochemical industry and the ICT industries. Moreover, major multinational car manufacturer are engaged in Flanders (e.g. Volvo, Audi, Ford, Toyota), although their future position is uncertain due to fundamental restructuring in the automotive sector as a consequence of the recent economic crisis. Further economic sectors of certain relevance are pharmaceuticals, food and beverages, electronics, construction as well as textiles and fashion. Smaller but often booming, future-oriented and technology- and knowledge-intensive sectors are life sciences and biotechnology, aerospace industries, and renewable energy industries. By the way, in Antwerp, Flanders hosts the world´s major centre for processing and trading of diamonds. (cf. FIT 2011; RIM 2011f).

The Flemish network economy is very much shaped by SMEs, which are often acting as suppliers, thus representing a central pillar of the Flemish regional economy. In total, Flanders has about 550,000 enterprises whereof more than 90% are SMEs. Taking the whole set of enterprises (industrial and service companies) about 52% are active in research and innovation. Differentiating between the enterprise-size a sophisticated picture comes to light. About 51% of the SMEs and a considerable larger proportion of about 80% of the large-sized enterprises are innovating. However, patent data suggest that in the end MNEs are the major producers of future knowledge and technologies (see section 2.3 below), although SMEs are the dominant employers. (cf. EWI 2011; GRAYDON 2011; UNIZO 2011). That suggests the assumption that particularly the Flemish research and innovation system is shaped by larger enterprises

Flanders is in many respects characterised as an open economy and strongly trade-oriented. Because of the impact of the economic crisis the Flemish trade cracked in 2009, with imports and exports declining from their so far highest values. Imports went down from €192.3b (2008) to €147.1b (2009) (-23.5%) and exports from €174.4b (2008) to €138.3b (2009) (-20.7%). These harsh decreases elucidate the relatively high Flemish integration into the world markets. In 2009, the exports amounted to 52.2% of national total, imports accounted for 58.3%. The traded commodity patterns are pretty much in line with the dominating industrial sectors (see above). Main export goods were agricultural vehicles and machines (12.4%), mineral fuels, mineral oils and products of their distillation (8.8%), plastics (8.0%), organic chemicals and chemical products (7.5%), boilers, machinery and mechanical appliances (7.4%), natural or cultured pearls, precious and semi-precious stones and precious metals (6.9%), iron and steel and their products (6.1%), electrical machinery, equipment and parts (4.5%), pharmaceutical products (2.6%), and optical apparatus and instruments. More than three-fourths of the region´s trade is with fellow European states. Moreover, further important trade partner regions are North America, and Asia. However, the closest trade links (percentage of imports/exports in total trade) Flanders has with Germany (16.1/17.0), the Netherlands (24.5/15.3), and France (10.1/14.0). Until 2004, Flanders was a net exporting region. Since then imports always grew faster than the exports. (cf. EUROSTAT 2011; RIM 2011f; SVR 2011).

2. RTDI Characteristics

2.1 R&D Efforts and Input into the Process of Knowledge Generation

The region´s GERD amount to €3.86b in 2007, thus contributing 60.7% to the Belgian total. The R&D expenditures per capita amounted to €631. Therewith, Flanders has the 2nd-largest per capita spending on R&D after Brussels (€835), but ahead of Wallonia (€476). When expressed as a percentage of GDP, the GERD is used to indicate the overall R&D intensity of a country or region. This measure unfolds the emphasis placed on R&D activities within a given economy. In 2007, R&D expenditures per GDP are 1.99%, thus slightly above both the national average (1.90%) and the EU-27 average (1.85%) (cf. EUROSTAT 2011). However, the regional R&D expenditure per GDP quota is far away from meeting the target of 3% defined by the "Europe 2020 Strategy" (cf. EC 2011). Comparing both the R&D expenditures per capita and per GDP of Flanders with that of the other AMCER-regions, the region ranks in the upper midfield (see App. Tab. 6).

In 2007, the FTE employment in R&D amounts to 35,505, which is 61.3% of the overall Belgian R&D personnel. The R&D personnel (FTE) per 1,000 employees amounted to 13.3. This figure is well above the Belgian standard (12.3). In Comparison with the EU-27 average (11.0) the Flemish figure is far above average. Regarding the R&D personnel per 1,000 employees in comparison to the other AMCER-regions, Flanders ranks in the upper third again (see App. Tab. 6) (EUROSTAT 2011).

The R&D sector can be sub-divided into the BES, the GOV, the HES, and the PNP. Their relative importance varies greatly across regions, however, generally reflecting different economic or research structures and traditions, respectively. With regard to the innovation system approach, the proposition of BERD is considered as an indicator of the overall innovative capacity of a region. Although, this should not be over-interpreted, because the other sectors also provide important stimuli to the process of knowledge and technology production.

The RTDI sector in Flanders is clearly business-oriented. The BERD amounts to 68.9% (€2.7b) of the overall GERD, in 2007. Moreover, the share of the BES in R&D employment (FTE) accounts for 60.8% (21,577 employees) of the overall R&D employment. Regarding the business orientation of the R&D expenditures and the R&D personnel (FTE), the region´s RTDI sector roughly meets the Belgian average (69.5%, 58.7%) but excels the EU-27 mean (63.7%, 52.1%). Comparing the same aspects between Flanders and the other AMCER-regions, the region ranks in both cases in the upper midfield (see App. Tab. 6) (cf. EUROSTAT 2011).

About 36% of the R&D employment is bundled by the ICT sector, therewith representing the highest share of the overall private sector R&D employment. In general, the Flemish business R&D is very much engaged in high-tech-related R&D processes, e.g. in chemistry, pharmaceuticals, ICT, and mechatronics. These sectors together represent about 80% of the total R&D expenses. Hence, the potentials in high-tech are well developed (cf. RIM 2011f).

Both the HES and the GOV play a comparable subordinated role in terms of R&D expenditures and personnel (FTE). In the HES the shares of R&D expenditures and personnel amount to 19.2 (€740.2m) and 13.8% (4,916 employees), respectively. Accordingly, the shares of R&D expenditures and personnel in the governmental sector are 10.8 (€418.9m) and 7.5% (2,674 employees), alternatively. Hence, after the BES the HES sector is the second most important R&D sector in Flanders. However, although the overall contribution of the public sphere is smaller, Flanders carries out significant levels of public investments into R&D. Additionally, it is the location for numerous research institutions and centres and strongly supports co-operations between various research and innovation actors (see below). By doing so, the public sector serves to provide a solid and reliable basis for research and innovation activities. On the other hand, BES collaborates strongly with HES in research and innovation as the share of private funding in the HES is very high (cf. EUROSTAT 2011).

Flanders (including Brussels) hosts a broad research landscape. Public and semi-public actors are 28 higher education institutions (six universities and 22 university colleges), four scientific institutes (INBO, KMSKA, VIOE, ILVO), four strategic research centres (IMEC, VIB, VITO, IBBT), 13 policy research centres, and numerous smaller competence centres for specific (mainly sectoral) knowledge creation. In addition to a significant number of private companies and professional technology organisations conducting research and innovation, the field is supplemented by several collective research initiatives, co-operations and networks (about 15). The co-operations and networks are demand-driven and the knowledge is geared towards specific industry needs and company applications. In the great majority of cases they are oriented towards the needs and interests of the above-mentioned main industrial sectors. However, they are aiming on co-operations among sundry innovation actors on themes with research and innovation relevance at the Flemish level in different industries (BELSPO 2010; RIM 2011f).

The PNP plays rather a subordinated role with a share of 1% (€40.0m) in expenditures (cf. EUROSTAT 2011).

The RTDI-related parameters are not uniform across regional areas within Flanders as indicated through the coefficient of variation of several indicators stated in Tab. 8. There are substantial differences within the region in terms of both innovation capacity and performance, most notably in the density of knowledge-intensive businesses and knowledge outcomes. Some local areas within the region have comparable fewer high-qualified people which limit their capacity for innovation. This seems to be the case for the Provinces Limburg and West-Vlaanderen. In general, the regions Vlaams-Brabant, Antwerp, and Oost Vlaanderen are the leading regions with regard to RTDI aspects ahead of the regions Limburg and West-Vlaanderen (cf. EUROSTAT 2011). It should be stresses, however, that RTDI-indicators on sub-regional level are much less reliable because of scarcer data, and that these indicators are not actively monitored at sub-regional level as the RTDI-policy in the Flanders region is driven by the NUTS-1 level.

Table 8: Intra-regional RTDI Disparities in Flanders (selected indicators)

Coefficient of variation of hight-tech employment (hightech-employment as percentage of total employment) 2009 (in %)	Coefficient of variation of knowledge workers (HRSTC employment of the economically active population) 2009 (in %)	Coefficient of variation of R&D employment (R&D employment as a percentage of total employment) 2007 (in %)	Coefficient of variation of the persons with a tertiary education attainment (as percentage of total population) 2010 (in %)	Coefficient of variation of the patent applications at the EPO per million inhabitants 2004-2007 (in %)
41.68	12.35	n.a.*	17.46	32.58

Remark: disparity calculations based on NUTS-2 level data; * no data below NUTS-1 level available

(Source: own creation and calculations; based on data from EUROSTAT 2011)

2.2 Human Capital Endowment

In 2009, HRSTC in Flanders amounted to 0.619m, representing 58.8% of national total (1.053m) and 21.7% of the economically active population. With this share of knowledge workers Flanders ranks in the 1st place in comparison with the other AMCER regions (see App. Tab. 7) (cf. EUROSTAT 2011).

Moreover, in 2009, the region had a stock of 117,828 employees working in high-tech industries and knowledge-intensive services, i.e. 60.0% of national total and 4.4% of total employment in the region. Therewith, the Flemish share in total employment is almost in line with the Belgian standard (4.5%) (cf. EUROSTAT 2011). In comparison with the other AMCER regions Flanders ranks in the 2nd place (see App. Tab. 7). Both the HRSTC employment and the high-tech employment figures underpin the regions above-mentioned focus on knowledge intensive and high-tech related industries.

The education level of the human capital forms the basis for productive and innovative activities in developed countries and regions. In 2010, Flanders had 720,362 students in the sec-

ondary education level (ISCED 2-4), i.e. 116.0 students per 1,000 inhabitants. Thus, regarding the Belgian standard (119.0), this is slightly below-average. Overall, 37.8% of the Flemish population of working age (25-64 year-olds) has an upper secondary education attainment (ISCED 3), in 2010. This is compared to the Belgian average (35.5%) above-average and towards the EU-27 standard (46.8%) well below-average. Considering the tertiary education level (ISCED 5-6), the region had 208,624 students in that field, in 2010, i.e. 33.6 students per 1,000 inhabitants. Regarding the Belgian average (39.5), the Flemish figure is below-average. Altogether, 35.0% of the population of working age has a tertiary education attainment (ISCED 5-6). This exactly meets the national average (35.0%) but is towards the EU-27 mean (25.9%) well above-average. The proportion of the 30-34 year-olds with a tertiary education attainment amounts to 45.0% (Belgium: 44.4%; EU-27: 33.6%), thus Flanders already meets the 40%-target defined by the "Europe 2020 Strategy" (cf. EC 2011; EUROSTAT 2011). Comparing the Flemish figures of secondary and tertiary level students per 1,000 inhabitants with those in the other eight AMCER regions the region ranks in terms of secondary level students in the 1st place and in terms of tertiary level students in the midfield (see App. Tab. 7).

Regarding the early leavers from education and training, which can be interpreted as at least temporarily lost human capital, in the education vintage 2010, they account for 9.6%. This is a minus of 2.0 percentage points compared to the year 2000 and thus suggesting a positive trend. In addition, this result is far better than the Belgian (11.9%) and the EU-27 standard (14.1%) (cf. EUROSTAT 2011). Moreover, the regional proportion of early school leavers does already meet the maximum target of 10% defined by the "Europe 2020 Strategy" (cf. EC 2011). Compared to the other AMCER regions the Flemish proportion ranks in the 1st place (see App. Tab. 7). Although, in general, the Flemish figures are in many respects promising, against the backdrop of the aging regional society (see section 4.1 below), high reintegration costs, increasing pressure for innovation, productivity, and competitiveness, the region should try to further reduce the quota.

Technological progress is increasingly challenging for developed countries and regions and the requirements in terms of education are steadily rising, further education of adults is playing an increasingly important role in knowledge- and innovation-driven economies in general and for aging societies in particular. The Flemish participation share of adults aged 25-64 in education and training amounts to 8.2%, in 2010, therewith being above the Belgian (7.2%) and below the EU-27 average (9.1%). The regional figure ranks in the midfield compared to the other AMCER regions, although it should be mentioned that the top regions have far better values (see App. Tab. 7) (cf. EUROSTAT 2011).

Altogether, despite some weaknesses in the further education, the region´s engagement in the formation of a solid human capital basis can be assessed as comparatively successful.

2.3 Potential for Innovation

In the course of this work the number of patent applications at the EPO is taken as an indicator for the potential for innovation, thus depicting the production of knowledge and technologies. Although in the innovation process patents are somewhere between inventions and innovation and therefore covering only a part of the whole innovation process, they are among the most widely used innovation indicators (cf. GRUPP 1997; FRIETSCH et al. 2008).

Between 2000 and 2003 in Flanders a number of 3,219 patents were applied at the EPO, accounting for 62.9% of the national total. Between 2004 and 2007 the number of patent applications amounted to already 3,492 (66.3% of national total), an increase of about 8.5%. At the same time the patent applications per million inhabitants rose from 540, in 2000-2003, to 576, in 2004-2007 (plus 6.7%). Among the Belgium regions Flanders ranks in the 1st place, regarding the overall patent output (cf. EUROSTAT 2011). In comparison to the other eight AMCER regions, regarding both the absolute and the relative patent application figures, the region ranks in the upper third together with Länsi-Suomi and Lower Saxony, respectively

(see App. Tab. 8).

There is a strong concentration of patents in a small number of MNEs. SMEs are rather absent with regard to patenting. However, the most productive companies with regard to EPO patents have been able to build up technological top positions internationally. Further, the academic sector is increasingly active in applying for patents as means for protection and valorisation of research results. The main area for Flemish EPO patent applications are chemical technologies, packaging and printing technology, material processing, textiles, paper, telecommunications, and optics. Biotechnology, pharmaceutics, and cosmetics are also relatively well represented.

Since patents are in most cases the result of extensive R&D activities, it is possible to determine the R&D productivity (measured as EPO patent applications per million R&D expenditures in 2005). Moreover, this indicator unveils how effective the money spent on R&D is utilized in the process of knowledge generation. The Flemish R&D productivity amounts to 0.27, thus being well above-average compared to the Belgian standard (0.22) (cf. EUROSTAT 2011). Moreover, compared to the other AMCER regions, the Flemish R&D productivity ranks in the upper third (see App. Tab. 8). Measured by the R&D productivity, it is important to note, that Flanders has a comparable efficient R&D system.

Concerning the technically more challenging high-tech patents, Flanders accounted for 903 applications at the EPO between 2004 and 2007. Between 2000 and 2003 the region´s high-tech patent applications only amounted to 836, an increase of 8.0% over time. The high-tech patent applications per million inhabitants come to 149 in the period of 2004-2007. For the same period, the proportion of high-tech patent applications to all patent applications amounted to 25.9%. Among the three Belgian regions, Flanders ranks in the 1st place again. Comparing the region´s performance with that of the other AMCER-regions, it ranks in absolute terms in the top position and regarding relative figures the upper third (see App. Tab. 8). These results again clearly reflect the above mentioned circumstance that the region is to a high degree high-tech oriented (see section 2.1). The most Flemish high-tech patent applications have been made in the fields of communication technologies (40.7%), computer and automated business (26.8%), semiconductors (17.5%), and micro-organism and genetic engineering (16.3%) (cf. EUROSTAT 2011). Moreover, the here shown focus of high-tech patent applications reflects the above-mentioned research and business specialization in ICT-related industries of the region.

3. RTDI Governance and Innovation Policy

3.1 Governance

Belgium is a culturally fragmented and highly decentralized federal country with seven autonomous entities, namely the Federal State, the three regions (Brussels-Capital, Flanders, and Wallonia) and three communities (Flemish, French, and German). Each entity ensures effective government within its realm of responsibilities. The here relevant regions have considerable competences in the following fields: economic development, innovation, land use, environment and natural resource management as well as agriculture. Although the federal state pursues its own, closely circumscribed, and in parts complementary science policy the regions are the main actors in that field. The federal state´s competences are mostly limited to e.g. taxes, social security, labour, internal and foreign affairs, commercialisation and patent laws. Before exploring policies of the Flemish regions (section 3.2), it is instructive to present the specific powers and competence of the region in the field of research and innovation (cf. BELSPO 2010).

Flanders is competent in the areas of applied industrial research related to the economy, energy policy, public works, telecommunications, environment, transport, water, preservation of nature, land, agriculture, trade, and employment. Regarding innovation the regional support

and its subsidies are implemented for the development of new products and processes in SMEs, technology transfer, public research organisations, venture capital, science parks and incubation centres (supporting start-ups). In short, the Flanders has the major responsibility for economically oriented RTDI promotion (cf. BELSPO 2010).

The great number of distributed competences across the various Belgian authorities implies the need for a high degree of co-ordination. The co-ordination and consultation between the Belgian authorities is organised through the Inter-Ministerial Conference on Science Policy (CIMPS-IMCWB), which structures the dialogues on all matters requiring concerted action at national level. It is the co-ordination instrument between the federal state, the communities and the regions, composed members of respective governments having responsibilities in science policy matters. The CIMPS-IMCWB established two permanent administrative subcommittees, the International Cooperation Commission (CIS) for international matters, and the Federal Co-operation Commission (CFS) for national matters. The CIS and CFS are attended by representatives from each authority. The committees, for instance, deal with the permanent inventory of scientific potential in Belgium, or the positioning of Belgium in the EU's Seventh Framework Programme for Research and Technological Development (cf. BELSPO 2010).

As partly mentioned in section 2.1 the Flemish research and innovation system is shaped by a wide range of actors and stakeholders, most notably public administrations and agencies, knowledge institutes and centres, universities and university colleges, scientific institutes, public research organisations, university hospitals, various collective research centres, innovative networks, incubation centres, private companies, professional technology organisations, and financial intermediaries (cf. BELSPO 2010).

The management of science and fundamental research as well as innovation and applied research is conducted by one specific commission in the Flemish Parliament, a single minister responsible for scientific research and innovation, an advisory council (VRWI) and a single administration responsible for preparing all therewith related policy issues (EWI). The investigation of social aspects of scientific and technological developments in the Flemish region is the task of the Institute Society and Technology (IST). The execution or implementation is managed by the Agency for innovation by Science and Technology (IWT) and specific funding agencies, which support universities, university colleges, scientific institutes (most notably the Research Foundation Flanders (FWO), Hercules research infrastructure fund and the Special Research Fund (BOF), and Flanders Holding Company (PMV) (cf. BELSPO 2010).

3.2 Policy

Since 1995, the Flemish government has an explicit policy stimulating science, technology and innovation. The central theme of the new government is the implementation of the Flanders in Action (ViA) plan. The plan aims on making Flanders one of the top five excelling regions in Europe. The core of the ViA is a new agreement between social partners to enhance innovation (Pact 2020). The following goals are pursued:

- 3% of GDP to R&D activities by 2020;
- increase creativity and innovative capacity, for instance by increasingly involving the non-academic higher education institutes in innovation processes;
- focussing on themes where Flanders has advantages, i.e. strong knowledge position and good economic prospective;
- more attention will be put on output of research policy;
- encouraging students to study sciences and simultaneously bettering the prospects of researchers; and
- 2% of GDP in investments in higher education institutions (cf. BELSPO 2010; RIM 2011f).

The above set targets include:

- yearly increase of the number of patent applications;
- being amongst the EU's top-5 regions for public spending on eco-innovation
- increasing turnover from new or improved products and services; and
- increasing the share of spearhead areas such as ICT and health, logistics, smart electricity networks (GRID) in the economy (cf. BELSPO 2010).

The Policy Note 2009-2014 on Science Research and Innovation formulates and implements the plan for 'Open Innovation Centre Flanders' and addresses the following main targets:

- from idea to economic commercialisation, market results and societal impact;
- enhancing creative and innovative entrepreneurship;
- focussing on economic clusters, thematic spearheads and large projects;
- Flanders as an international player (sufficient participation and return in European Framework Programmes);
- strengthening excellence and dynamism of cutting-edge non-oriented research as a fundament for innovation;
- increasing the opportunities for researchers;
- more streamlined and output-driven research policy;
- top research infrastructure (cf. BELSPO 2010)..

The strategic clusters which are forming the spearheads for technology and innovation and which were identified after an expert consultation are:

- Transportation - Logistics - Services - Supply chain management
- ICT and Services in Healthcare (e-health)
- Healthcare
- New Materials - Nanotechnology - Manufacturing industry
- ICT for socio-economic innovation (e-gov, e-learning)
- Energy and Environment (e.g. smart GRIDs) (BELSPO 2010).

The Policy Note 2009-2014 is largely the continuation of the policy plans of the previous Ministers: simplification and efficiency enhancement of the current set of science, technology and innovation policy instruments. However, the scope of innovation has been broadened from technological innovation to include all improvements due to the addition of knowledge and ideas to products, services, organisations or processes (RIM 2011f). Main changes compared to the efforts of previous Ministers are the explicit preference for light (often virtual) instruments, the focus on 'grand projects' and the widening of the definition of innovation. Moreover, the emphasis has been shifted from simplifying the set of instruments to simplification of individual instruments (cf. RIM 2011f).

The support of the region´s research and innovation community is ensured by various funding measures. The main support measures are namely the Industrial Research Fund (IOF), the SME Programme, the Competence Poles/Centres of Excellence, the Flemish Innovation Fund (VINNOF), and the Technology Transfer (TETRA) Fund (cf. RIM 2011f).

4. Trends, Challenges, and Assessment

4.1 Trends and Challenges which are not specific to the R&D Sector

In 2000 the Lisbon Strategy launched to make the EU the most competitive and dynamic economy in the world against 2010. Flanders also committed to include 70% of people of working age (15-64 years) in the work force by 2010. This objective was placed central to the Flemish labour market policy and also included in the 2020 Pact. In 2009, the figure for Flanders amounted 65.8%, that is 2.3% more than at the start of the Lisbon Strategy. Flanders performs and well above the Belgian average and above the European average. With the growth rate that was achieved during the past year, reaching the 70% target by 2010 is not feasible.

Not only to the aging of the population slows down this effect, but also the economic crisis reinforces this further. Also remain specific groups under-represented in the employment: the elderly, unskilled workers, strangers, people with disabilities and women (cf. RCFG 2010).

The population development and especially the aging figures of a population are crucial for innovation related purposes, because the youth of a population virtually determines its dynamism and innovativeness and therewith its future viability. In 2009, the Flemish population reached its present maximum of about 6.25m (cf. EUROSTAT 2011). Since 2000, the regional population thus grew by 5.2%. With its population size the region ranks the 1st place among the three Belgian regions. Flanders population is projected to grow to over 7m by 2060. In 2010, 16.0% of the regional population was younger than 15 years, 65.5% were between 15 and 64 years, thus representing the population of working age and about 17.9% were 65 years or older (retirement age). Hence, the age distribution depicts an ageing regional population where the cohort of the young and adolescent people is smaller than the cohort of the people of pensionable age. This finding is in line with the overall national trend of the Demographic Change in Belgium. Moreover, the future trends are basically the same as what is expected in Europe's countries and regions at large: reduction of the potential of natural growth and demographic ageing and uncertainty on the evolution of fertility rates and the levels of migrations flows. Accordingly, projections assume that in Flanders in 2030, the share of people which is 65 years and older will already vary regionally between 23 and 28%, underpinning the economic and social challenges the region is confronted with in the future (cf. EUROSTAT 2011; GIANNAKOURIS 2010; RCFG 2010).

4.2 Trends and Challenges which are specific to the R&D Sector

In 2006, based on a SWOT analysis, the VRWI defined a number of key areas for Flanders, linked to future (societal) evolutions by way of six strategic clusters. These were later developed into 10 spearheads for technology and innovation and further developed into action plans. A large part of the themes of these clusters and spearheads served as an impetus for and are promoted by the ViA and related Pact 2020 initiatives of the Flemish Government. While these strategies were developed before the Europe 2020 strategy was presented, they correspond largely with the overall Europe 2020 Strategy aims and are regarded as crucial for the socio-economic policy and well-being of Flanders in the second decade of the century. Examples of specifically defined targets are the 3% R&D to GDP expenditure target, the increase year-by-year of the number of patent applications, or the aim to be in the EU's top-5 of regions for public expenditures on eco-innovation. All these goals are part of the strategic objective of accelerating the transformation of the economy.

At the EU policy-making level, these issues of a global importance and of a specifically research/innovation-related kind are being dealt with mainly in the new 'EU 2020 strategy', the Commission's forthcoming Research and Innovation Action Plan, and the pursuit of the European Research Area (ERA). For all of these topics, the Flemish Government has contributed to various EU consultations from different EU institutions (Council, Commission, Committee of the Regions). Regarding the Europe 2020 Strategy ('Flagship Innovation-Union') and the Commission's Research and Innovation Action Plan, the Flemish Government's point of view is:

1. To welcome the considerable importance given to innovation in the Europe 2020 strategy. To this end, the instruments for innovation and research must further be adapted to better match and serve all of these purposes and targets. At the same time, innovation must be further integrated within government organisations and elaborated horizontally. In addition, 'open innovation' must be promoted within the overall governance structures of the ERA.
2. A better linkage should be made between the innovation and the research targets than has been the case until now.
3. The commonly applied input-indicator of 3% (Barcelona target) alone is too general to

cover the whole field of R&D and innovation. In this specific area, there is a need for a realistic set of input, throughput and output-outcome indicators.
4. Flanders notes with satisfaction the Commission's shift to approaching 'innovation' from broad societal tendencies and challenges, not only the technology and research aspect. Yet there remains a need to create links with the other pillars of the Europe 2020 strategy and more specifically with innovation in the general sense. The anticipation on social inclusion, training, greening of the economy and sustainability requires not only technological innovation, but also the development of innovative applications in other areas such as the social economy, the creative and leisure industries, culture, media, etc. Hence, there is a need to support process-oriented transitions to sustainable production and consumption patterns.
5. Regarding a competitive and greener economy, the emphasis should be put on the link between innovation and industrial policy, as this is important in view of the restructuring of industry and the transformation to a low carbon and recycling economy.
6. Concerning the added value of knowledge as the basis of growth, favourable conditions must be created to diffuse innovation to all sectors and policy fields. Innovation should in this regard also be driven by societal challenges and needs ('societal driven innovation'). This includes a reorientation of research activities to strategic domains.
7. Education is one of the three corners of the knowledge triangle. It is important to foster the transition to innovation through knowledge. Regarding the ERA, this remains high on the agenda in Flemish international policy (cf. BELSPO 2010).

The Flemish Community is fully engaged in helping to realise the ERA; playing an active role, both in terms of attracting foreign researchers and sending its own research personnel abroad, in the development of an open international research community, within which researchers can move freely from place to place, thereby promoting the efficient exchange of knowledge (cf. BELSPO 2010).

In the beginning of March 2010 the Flemish action plan for researchers was published, in response to the European partnership for researchers proposed by the European Commission. Some actions are already under way, such as inciting research organisations to adopt a human resource strategy as a way of implementing the Charter and Code, or an inter-university workgroup, which is developing a proposal for an accurate and objective evaluation of aspiring candidates from Flanders and abroad (cf. BELSPO 2010).

At the same time, the high quality of Flemish universities and research institutions is a clear asset for Flanders in the international scene. As a supplement to the usual bottom-up approach to research and innovation, a cluster approach has been developed. In addition, more emphasis is put on strategic innovation. Initiatives such as joint programming and the EIT, with its KICs, are considered good answers to novel challenges that can only be tackled with joint forces and with respect for the contributions that each angle of the Knowledge Triangle brings. International co-operation should thus be strengthened by inter-sector collaboration. While Flanders is already involved in EIT, notably in the KIC InnoEnergy (on sustainable energy), a more structural approach is called for that will provide Flemish research organisations and companies with the necessary funding to fully participate in these initiatives. At the moment, strategies are being developed by the Flemish government to facilitate participation in joint programming and KICS (cf. BELSPO 2010).

To develop world-class research infrastructure, Flanders is an active participant in the ESFRI scheme. An advisory commission was set up, which prepared a priority list of projects in which to participate. At the moment, steps are being taken to ensure Flemish participation in the shortlisted projects, through intra-Belgian consultation, positioning regarding contents and legal matters and securing the necessary funding (cf. BELSPO 2010).

4.3 Assessment of the regional R&D System

4.3.1 Governance Dimension

Concerning the governance dimension Flanders has a *network R&D system*. Governmental RTDI promotion takes place on different levels, e.g. local, regional, or federal as appropriate, although the local and regional levels have the most competences. In the manner of a network system funding is guided and assessed by public and private regional banks and funds, government, semi-state-owned, and private agencies or firms as well as regional research institutes. The Flemish research competences are broad in nature, covering basic, applied and experimental research. This is due to the extended region´s private and public research landscape. However, since the R&D system is highly business-oriented and the private business sector contributes a major proportion of the overall research activities, it must be said that applied and experimental research are in the focus. Due to the high degree of decentralisation and a high number of involved actors, the need for coordination can be assessed as very high. The region´s degree of specialization with respect to its governance and policy characteristics is rather flexible. Flanders is active in a broad field of sectors and, in addition, continuously anxious to further develop its economic and sectoral structure in order to stay long-term competitive and to ensure future prospects.

4.3.2 Business Innovation Dimension

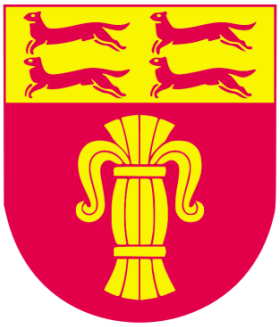
In general, regarding the business innovation dimension, the Flemish R&D system is a mixture of a *globalised* and an *interactive R&D system*. The region´s R&D system is highly dominated by large companies of those most are active globally and supported by clustered supply chains of often dependent SMEs. Although SMEs constitute the main pillar of regional employment, their potential for innovation is often comparatively limited. Regarding the research reach, the Flemish R&D system can be classified somewhere between an interactive and a globalised system. The region hosts a broad mix of public and private research institutes, regional headquarters of larger firms and a regional government keen to promote innovation. These aspects stand for an interactive R&D system. Nonetheless, the R&D system is pretty much dominated by private rather than public research activities, which are mostly conducted by large-scale enterprises, although the public innovation structure also aims on the support of knowledge and technology production of SMEs. These aspects are more of a globalised R&D system. This ambivalent characteristic continues for associtionalism. The overall degree of association can be assessed to be very high and the policy is actively supporting co-operations and networks. Those are demand-driven and the knowledge is geared towards specific industry needs and company applications. In the great majority of cases they are oriented towards the needs and interests of the main industrial sectors. However, they are aiming on co-operations among sundry innovation actors on themes with research and innovation relevance at the Flemish level in different industries. In correspondence to research and innovation and apart from the politically supported associations this field is likely to be largely dominated by large-scale enterprises rather than by SMEs. Although, this depends on both the considered sectors and the SME´s position in the value chain.

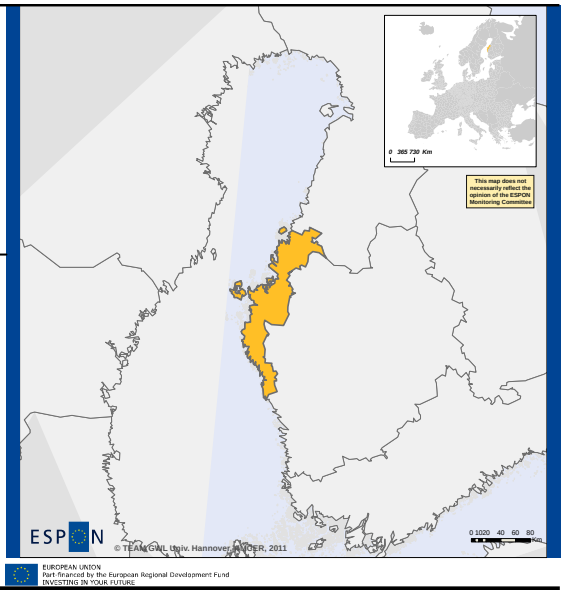
VII. Region Ostrobothnia

FINLAND

Region Ostrobothnia

NUTS Code FI195 (NUTS-3-Level)





Introduction:

Ostrobothnia is a bilingual region with a Swedish speaking majority (Swedish: 51%, Finnish: 45%) situated on the west coast of Finland. Ostrobothnia is a NUTS-3 level region and a part of the Western Finland Province (Länsi-Suomi, NUTS-2 level region). Further NUTS-3 regions of the Western Finland Province are Satakunta, Pirkanmaa, Central Finland, and Southern Ostrobothnia. Ostrobothnia borders Central Ostrobothnia to the north, Southern Ostrobothnia to the west, and Satakunta to the south. Moreover, the region is one of the four regions constituting the historical province of Ostrobothnia.

Ostrobothnia has a surface of 7,749 km² and a population of about 178,000. Therewith the region has a population density of 22.5 per km², in 2010, which means that it is considerably sparsely populated by European standards (116, in 2008) but slightly more populated than the Finnish mean (17.5, in 2008). The region´s capital and its economic as well as research and innovation centre is Vaasa. The city is comparatively international in nature and has about 59,000 inhabitants (cf. EUROSTAT 2011; RCO 2010, 2011a, 2011b).

National/EU context:

Ostrobothnia´s regional GDP per capita is below the Finnish but fairly above the European mean. The region has a longstanding industrial tradition (e.g. sea technologies), hosts the biggest energy sector cluster among the Nordic countries, and has furthermore a broad range of service oriented often industry-related branches. The region focuses on the creation of a knowledge-based and environmentally friendly economy.

From its strong innovation environment many SMEs as well as numerous international companies benefit. Most RTDI competences are highly concentrated in the region´s top R&D location Vaasa. Regarding RTDI indicators in comparison to the national level the region often achieves below average values. With respect to the European level, however, the region mostly obtains well above average results.

The most important sector in Ostrobothnia is the renewable energy branch that includes bio energy and wind power. Another major branch is the sea cluster. Further sectors of significance are metal industry, plastic industry, and environmental technology. Those have deep connections with the energy cluster. The renewable energy industries as well as therewith closely related suppliers are often medium-high and high-tech oriented and their knowledge is

highly specialised. In addition, more service-oriented branches have been developed, including in particular industry related services such as ICT, media, industrial design, maintenance of energy production systems, and welfare services. In general, the RTDI sector in Ostrobothnia is clearly business-oriented. Companies in Ostrobothnia are predominantly SMEs but also many big international companies are located there. Especially the industry sector is shaped by large enterprises supported by clustered supply chains of often dependent SMEs. However, although SMEs are involved in R&D processes mostly large enterprises are responsible for research and innovation actions. That suggests the assumption that the regional research and innovation system is shaped by larger enterprises.

The innovativeness of Ostrobothnia´s superior region Länsi-Suomi (NUTS-2 level) in relation to the other Finnish regions, measured by the number of patents applied at the EPO, ranks in the 2nd place. In addition, even in European terms the region is a strong player with respect to patenting. In 2007, the employment in R&D (FTE) was equivalent to 2.5% of the overall Finnish R&D personnel. The R&D personnel (FTE) per 1,000 employees amount to 16.7. This figure is below the national (23.3) but well above the EU-27 (11.0) average. Regarding the business orientation of both the R&D expenditures and the R&D personnel (FTE) (90.1%, >80.0%), the region´s RTDI sector clearly excels the national average (81.7%, 58.4%) and the EU-27 mean (63.7%, 52.1%; in 2007) (cf. EUROSTAT 2011).

In 2009, the Ostrobothnian per capita spending on R&D was below the national average. However, there was a rise of 72% in this figure in comparison to the year 2000 and the region´s R&D centre Vaasa excels both the national and European average. The region´s R&D intensity accounts for 2.55%, thus, again, being far below the national average (3.9%) but well above the EU-27 average (1.85%, in 2007). The regional R&D productivity amounts to 0.26, thus being above-average compared to the Finnish standard (0.24) but slightly below the EU-27 average (0.27) (cf. EUROSTAT 2011).

1. Socio-economic Characteristics

In 2008, the regional GDP in Ostrobothnia amounted to about €5.9b, accounting for a share of about 3.2% of the Finnish GDP. The regional GDP per capita was about €32,000, which represents 94.3% of the Finnish and 127.7% of the EU-27 average, respectively. Moreover, it ranks second after Pirkanmaa in comparison between the five regions of Länsi-Suomi. Between 1995 and 2008, the Ostrobothnian economy grew by 3.9% p.a. which is slightly above-average regarding the national (3.7%) figure and in line with the EU-27 average (3.9%) (cf. EUROSTAT 2011; STATFI 2011). Comparing the economic performance of Ostrobothnia with that of the other AMCER regions, the region ranks in the 2nd place (see App. Tab. 3). As shown, Ostrobothnia is a quite prosperous European region. Largely, this dynamism has been caused by growth in the industry sector. Especially the production of electronics and machinery devices for environmentally friendly energy production is thereby a central growth engine.

In 2009, the regional labour force amounted to about 88,400, representing 3.3% of Finland´s total labour force (2.68m). Among the Western Finland regions Ostrobothnia has the smallest labour force. The regional employment rate of the 20-64 year-olds lies at 70.7%, which is above-average compared to the national average of 69.9% and among the best in Finland (cf. EUROSTAT 2011; RCO 2010). Nevertheless, taking the employment rate target of 75% defined by the "Europe 2020 Strategy", the Ostrobothnian employment rate is still too low (cf. EC 2011).

In 2008, 6.3% of the employees worked in the agricultural sector, 32.0% in the industry, and 60.8% in the service sector. Comparing the region´s economic structure with both the national average (3.7%, 23.9%, 71.6%) and the EU-15 average (3.5%, 26.2%, 69.7%) profound can be observed. Particularly striking is that in Ostrobothnia the agricultural sector and particularly the industry sector appear to play a much more important role, whereas the ser-

vice sector is of comparatively less relevance (cf. EUROSTAT 2011; RCO 2011a). However, although the region´s share of industry is comparatively high, Ostrobothnia shifted very much towards the service sector in recent years. Nevertheless, comparing the economic structure of Ostrobothnia with that of the other AMCER-regions, in terms of its industry sector share the region still ranks in the 2nd place after Catalonia, regarding the service sector share it ranks in the last place (see App. Tab. 4). In Ostrobothnia, both the industry and the service sector are often medium-high and high-tech or knowledge-intensive oriented (see below).

The average annual regional unemployment rate accounted for 5.0% in Ostrobothnia in 2008, coming from 7.5% in 2005. The regional trend is thus following the national development, where the unemployment rate decreased from 10.6% (2005) to 7.6% (2009) (cf. RCO 2010). Both the Ostrobothnian and the national unemployment figures are below the EU-27 average of 8.2% in 2008. This is a favourable development against the background that the unemployment dramatically increased during the 1990s and even in the phase of slight recovery at the beginning 2000s always remained above the European mean. However, in 2009, when the already in 2007/2008 begun financial crisis seemed to start to impact the regional economy, the unemployment rates started to increase again and rose to 5.9%, in 2009. At the beginning of 2011, the unemployment accounted for 6.4%. Nonetheless, even though the surge was noticeable it remained moderate. Comparing the unemployment rate of Ostrobothnia with that of the other AMCER-regions, the region has the second-lowest value after Flanders (see App. Tab. 5). Taking the youth unemployment (15-24 year-olds) Ostrobothnia ranks in the midfield. Both figures reveal a relatively well functioning labour market. On the other hand, however, the relatively high long-term unemployment share must be considered critical. At the moment the share of long-term unemployed is about 21% of all unemployed people. This figure does not change very much over time. This reflects still existing inflexibilities in the labour market, which makes reforms necessary.

Finland generally exhibits distinctive disparities concerning the geographic distribution of socio-economic aspects. In 2009, four NUTS-3 regions (Helsinki, Southwest Finland, Pirkanmaa, and Northern Ostrobothnia) bundled about 60% of both the national GDP and total population, with Helsinki in both cases accounting for a bulk. Generally speaking, in Finland the GDP is predominantly produced in urban regions (cf. OECD 2005). This picture remains similar when looking at intra-regional disparities within Ostrobothnia. The rural areas are losing jobs in agriculture and also in traditional industries (e.g. paper mills, etc.) whereas the urban areas are growing mostly based on the service sector and more innovative industries (e.g. electronics, environmental technologies, etc.). However, some rural areas also have advantages from the growth in nearby towns through sub-urbanisation. The capital Vaasa is the central spot in the region, having the highest GDP per capita with the highest growth rates and the largest population with the highest growth rates. Followed with distance by the sub-regions Jakobstad and Syd-Österbotten. The weakest sub-region within Ostrobothnia is Kyrönmaa (cf. EUROSTAT 2011; RCO 2010, 2011a).

Although the overall contribution of the agricultural sector is low, it still has a comparatively great importance as described above. In this context especially greenhouse cultivation must be pointed out, because a vast proportion of vegetables (e.g. tomatoes and cucumbers) traded in Finland come from Ostrobothnia. The most important sector in Ostrobothnia is the renewable energy branch that includes bio energy and wind power. The region actively supports ‘green’ industries and wants to be a worldwide leading pioneer when it comes to production and utilisation of renewable energy. Another major branch is the sea cluster. It has a centuries-long tradition and includes boat manufacture and technical appliances for ships. Further sectors of significance are metal industry, plastic industry, and environmental technology. Those have deep connections with the energy cluster, which is highly concentrated in and around the sub-region Vaasa. The renewable energy industries as well as therewith

closely related suppliers are often medium-high and high-tech oriented and their knowledge is highly specialised. Forest and wood industry is divided to sub branches like mechanical wood industry and construction industry. The Ostrobothnian food industry has development potential. In addition, more service-oriented branches have been developed, including in particular industry related services. Those include, for instance, ICT, media, industrial design, maintenance of energy production systems, and welfare services. Companies in Ostrobothnia are predominantly SMEs but also many big international companies like ABB are located there. Especially the industry sector is shaped by large enterprises supported by clustered supply chains of often dependent SMEs. However, although SMEs are involved in R&D processes mostly large enterprises are responsible for research and innovation actions (see below). That suggests the assumption that the regional research and innovation system is shaped by larger enterprises.

Ostrobothnia is in many respects characterised as an open economy and strongly trade-oriented. In 2010, the exports amounted to €3.6b which means that in relation to its population Ostrobothnia was one of the most export-oriented regions in Finland. In Ostrobothnia 97.8% of the exports was export of industrial goods (national average 82.0%). Moreover, more than 60% of the Ostrobothnian industrial production is exported. The volume of imports at the same year was only €1.1b. Exports from Ostrobothnia have grown quite rapidly within the last decade, excluding the year 2009 when the economic decline resulting from the financial and economic crisis pushed the value of exports slightly downwards. Most important and most rapidly growing industrial branches with large shares of exports were related to environmental technologies, metal industry, electronics, machinery, shipbuilding and businesses related to them. Particularly the region´s renewable energy branch is of extraordinary trade orientation. The share of export there amounts to 70%. The enterprises produce and trade products like diesel engines, electric motors, power plants, frequency converters, electrical systems, and various applications for the wind power industry (cf. STATFI 2011; RCO 2010, 2011b).

2. RTDI Characteristics

2.1 R&D Efforts and Input into the Process of Knowledge Generation

Within Ostrobothnia a vast proportion of the research and innovation competences and resources are bundled in Vaasa. The Ostrobothnian GERD amount to €165.3m in 2009, thus contributing 2.4% to the Finnish total and about one-tenth to Länsi-Suomi´s R&D expenditures. There was a rise of 72% in this figure in comparison to the year 2000. The fastest growth in this period was from 2006 to 2009. The R&D expenditures per capita amounted to €934. Vaasa, the region´s top R&D location had per capita expenditures of about €1,619 and the Finnish mean lies at €1,271. When expressed as a percentage of GDP, the GERD is used to indicate the overall R&D intensity of a country or region. This measure unfolds the emphasis placed on R&D activities within a given economy. In 2008, R&D expenditures per GDP were about 2.55%, thus far below the national average (3.9%) but above the EU-27 average (1.85%, in 2007) (cf. EUROSTAT 2011). However, although the trend is quite positive, until now, the regional R&D expenditure per GDP quota is still not meeting the target of 3% defined by the "Europe 2020 Strategy" (cf. EC 2011; STATFI 2011). Comparing both the R&D expenditures per capita and per GDP of Ostrobothnia with that of the other AMCER-regions, the region ranks in the 2nd place after East of England (see App. Tab. 6).

In 2009, the FTE employment in R&D amounts to about 1,387, which is 2.5% of the overall Finnish R&D personnel and again about one-tenth of Länsi-Suomi´s R&D personnel. The R&D personnel (FTE) per 1,000 employees amounted to 16.7. This figure is below the Finnish standard (23.3). However, in comparison with the EU-27 average (11.0, in 2007) the Ostrobothnian figure is far above-average. Moreover, regarding it in comparison to the other

AMCER-regions, Ostrobothnia ranks again in the 2nd place after East of England (see App. Tab. 6) (cf. EUROSTAT 2011; STATFI 2011).

The R&D sector can be subdivided into the BES, the GOV, the HES, and the PNP. Their relative importance varies greatly across regions, however, generally reflecting different economic or research structures and traditions, respectively. With regard to the innovation system approach, the proposition of BERD is considered as an indicator of the overall innovative capacity of a region. Although, this should not be over-interpreted, because the other sectors also provide important stimuli to the process of knowledge and technology production.

The RTDI sector in Ostrobothnia is clearly business-oriented. The BERD amounts to 90.1% (€136.1m) of the overall GERD, in 2008. Moreover, more than 80% of the regional overall R&D personnel work in the BES. Regarding the business orientation of both the R&D expenditures and the R&D personnel (FTE), the region´s RTDI sector clearly excels the national average (81.7%, 58.4%) and the EU-27 mean (63.7%, 52.1%; in 2007). Comparing the same aspects among the AMCER-regions, Ostrobothnia ranks in both cases in the 1st place (see App. Tab. 6). Moreover, about 50% of all Finnish companies and about 80% of large companies told that they had ongoing research and innovation processes within past two years (2006-2008), underpinning a relatively high research and innovation propensity. Ostrobothnian figures are supposed to be in line with these national values due to the region´s emphasis on technological sophisticated sectors and enterprises (cf. EUROSTAT 2011; STATFI 2011).

Both the HES and the GOV play a comparable subordinated role in terms of R&D expenditures and personnel (FTE). In the HES the shares of R&D expenditures amount to 9.3%. Accordingly, the shares of R&D expenditures in the GOV are 0.7% (€1.1m). In general, Ostrobothnia´s innovation environment can be considered as being strong. The core of research and innovation is performed by enterprises from the new energy sector and therewith closely related industries. However, as mentioned above, most of the R&D conducting actors come from the cluster in and around of Vaasa. Although, as stated trough the figures, the public sphere accounts for only a relatively small proportion, particularly the HES is of high importance for the Ostrobothnian research and innovation system. The region´s system of higher education covers universities and universities of applied sciences, some of them having an internationally well-known reputation. They are part of the national and international network of education, research and development and often co-operate with the BES. They bring international know-how and use it for the benefit of the area in their development projects. The system includes the University of Vaasa, Hanken School of Economics, Åbo Akademi University, Vaasa and Novia universities of applied sciences, Western Finland's design centre Muova and Vaasa Energy Institute. Many of those institutions are situated to the same campus in Vaasa. It has made possible e.g. a joint research laboratory (cf. STATFI 2011).

2.2 Human Capital Endowment

In 2009, HRSTC in Länsi-Suomi[7] amounted to 0.6137m, representing 22.4% of national total (0.612m) and 20.8% of the economically active population. With this share of knowledge workers Länsi-Suomi ranks in the 2nd place in comparison with the other AMCER regions (see App. Tab. 7). Since Ostrobothnia is one of the dominating sub-regions of Länsi-Suomi the data should be sufficient (cf. EUROSTAT 2011).

Moreover, in 2009, Länsi-Suomi[8] had a stock of 21,586 employees working in high-tech industries and knowledge-intensive services, i.e. 15.5% of national total and 3.6% of total employment in the region. Therewith, Länsi-Suomi´s share in total employment is below the

[7] Since there are no statistics available for Ostrobothnia (NUTS-3 level) data from Länsi-Suomi (superior NUTS-2 level) have been used.

[8] Since there are no statistics available for Ostrobothnia (NUTS-3 level) data from Länsi-Suomi (superior NUTS-2 level) have been used.

Finnish standard (5.7%) (cf. EUROSTAT 2011). In comparison with the other AMCER regions Länsi-Suomi ranks in the upper midfield (see App. Tab. 7).

The education level of the human capital forms the basis for productive and innovative activities in developed countries and regions. In 2009, Ostrobothnia had about 11,900 students in the secondary education level (ISCED 2-4), i.e. 67.6 students per 1,000 inhabitants. Thus, regarding the Finnish standard (110.6), this is below-average. Overall, 38.3% of the Ostrobothnian population older than 15 years has an upper secondary education attainment (ISCED 3), in 2009. This is roughly in line with the national average (38.6%) and towards the EU-27 standard (46.8%, 25-64 year-olds) well below-average. Considering the tertiary education level (ISCED 5-6), the region had about 12,200 students in that field, in 2009, i.e. 69.5 students per 1,000 inhabitants. Regarding the Finnish average (55.7), the Ostrobothnian figure is above-average. Altogether, 26.1% of the population older than 15 years has a tertiary education attainment (ISCED 5-6). This is below the national average (38.1%) but slightly above the EU-27 mean (25.9%, 25-64 year-olds). The proportion of the 30-34 year-olds with a tertiary education attainment amounts to 45.7% in Manner-Suomi[9] (Belgium: 45.7%; EU-27: 33.6%), thus the region already meets the 40%-target defined by the "Europe 2020 Strategy" (cf. EC 2011; EUROSTAT 2011; STATFI 2011). Comparing the Ostrobothnian figures of secondary and tertiary level students per 1,000 inhabitants with those in the other eight AMCER regions the region ranks in terms of secondary level students in the lower third and in terms of tertiary level students clearly in the 1st place (see App. Tab. 7).

Regarding the early leavers from education and training, which can be interpreted as at least temporarily lost human capital, in the education vintage 2010, they account for 10.3% in Manner-Suomi[10]. This is a minus of 1.3 percentage points compared to the year 2000 and thus suggesting a positive trend. In addition, this result is in line with the national average and far better than the EU-27 standard (14.1%) (cf. EUROSTAT 2011). Moreover, the regional proportion of early school leavers does almost meet the maximum target of 10% defined by the "Europe 2020 Strategy" (cf. EC 2011). Compared to the other AMCER regions Manner-Suomi´s proportion ranks among the lowest (see App. Tab. 7). Although, in general, the Ostrobothnian figures are in many respects promising, however, against the backdrop of the aging regional society (see section 4.1 below), high reintegration costs, increasing pressure for innovation, productivity, and competitiveness, the region should try to reduce further the quota.

Because the technological progress is increasingly challenging developed countries and regions and therewith requirements to education are steadily rising, further education of adults is playing an increasingly important role in knowledge- and innovation-driven economies in general and for aging societies in particular. The region´s[11] participation share of adults aged 25-64 in education and training amounts to 21.7%, in 2010, therewith being below the Finnish (23.0%) but far above the EU-27 average (9.1%). The regional figure ranks clearly in the 1st place compared to the other AMCER regions (see App. Tab. 7) (cf. EUROSTAT 2011).

Altogether, despite some weaknesses the region´s engagement in the formation of a solid human capital basis can be assessed as comparably successful. This is underpinned by the OECD's international assessment of student performance (PISA). Finland has consistently been among the highest scorers worldwide; in 2003, Finnish 15-year-olds came first in reading literacy, science, and mathematics; and second in problem solving, worldwide. The World

[9] Since there are no statistics available for Ostrobothnia (NUTS-3 level) or Länsi-Suomi (superior NUTS-2 level) data from Manner-Suomi (superior NUTS-1 level) have been used.

[10] Since there are no statistics available for Ostrobothnia (NUTS-3 level) or Länsi-Suomi (superior NUTS-2 level) data from Manner-Suomi (superior NUTS-1 level) have been used.

[11] Since there are no statistics available for Ostrobothnia (NUTS-3 level) data from Länsi-Suomi (superior NUTS-2 level) have been used.

Economic Forum ranks Finland's tertiary education first in the world. Ostrobothnia is no exception to this.

2.3 Potential for Innovation

In the course of this work the number of patent applications at the EPO is taken as an indicator for the potential for innovation, thus depicting the production of knowledge and technologies. Although in the innovation process patents are somewhere between inventions and innovation and therefore covering only a part of the whole innovation process, they are among the most widely used innovation indicators (cf. GRUPP 1997; FRIETSCH et al. 2008).

Since R&D processes are mostly conducted by large enterprises in Ostrobothnia, it´s likely that they are also responsible for the bulk of innovations. Between 2000 and 2003 in Länsi-Suomi[12] a number of 1,385 patents were applied at the EPO, accounting for 26.1% of the national total. Between 2004 and 2007 the number of patent applications amounted to only 1,195 (26.2% of national total), a decrease of about 14.1%. At the same time the patent applications per million inhabitants dropped from 1050, in 2000-2003, to 897, in 2004-2007 (-14.6%). Regarding the overall patent output, among the Finnish regions Länsi-Suomi ranks in the 2nd place after Etelä-Suomi (cf. EUROSTAT 2011). In comparison to the other eight AMCER regions, regarding absolute patent application figures the region ranks in the lower third, however, taking the relative figures it ranks the 1st place, underpinning the innovative strength of the region (see App. Tab. 8).

Since patents are in most cases the result of extensive R&D activities, it is possible to determine the R&D productivity (measured as EPO patent applications per million R&D expenditures in 2005). Moreover, this indicator unveils how effective the money spent on R&D is utilized in the process of knowledge generation. The regional[13] R&D productivity amounts to 0.26, thus being above-average compared to the Finnish standard (0.24) (cf. EUROSTAT 2011). Moreover, compared to the other AMCER regions, the region´s R&D productivity ranks in the upper midfield (see App. Tab. 8).

Concerning the technically more challenging high-tech patents, Länsi-Suomi[14] accounted for 506 applications at the EPO between 2004 and 2007. Between 2000 and 2003 the region´s high-tech patent applications only amounted to 588, a decrease of -13.9% and thus in line with the above-described trend regarding the overall patent applications (see above). The high-tech patent applications per million inhabitants come to 380 in the period of 2004-2007. For the same period, the proportion of high-tech patent applications to all patent applications amounted to 42.3%. Since Ostrobothnia is pretty much in line with the overall regional average (i.e. Länsi-Suomi), the high share of high-tech patent applications reflects the already above addressed fact that the regional actors are highly active in medium-high and high-tech as well as knowledge-intensive fields. Among the Finnish regions Länsi-Suomi ranks in the 2nd place after Etelä-Suomi again. Comparing the region´s performance with that of the other AMCER-regions, it ranks in absolute terms in the lower midfield, however, taking the relative figures it ranks the top position again (see App. Tab. 8). Anyway, these results again clearly reflect the above-mentioned circumstance that the region is to a high degree high-tech oriented (see section 2.1) (cf. EUROSTAT 2011).

In the period 2004-2007, according to national patent figures the most Ostrobothnian patent applications have been made in the fields of electronics (28.9%), machinery (19.7%), work

[12] Since there are no statistics available for Ostrobothnia (NUTS-3 level) data from Länsi-Suomi (superior NUTS-2 level) have been used.

[13] Since there are no statistics available for Ostrobothnia (NUTS-3 level) data from Länsi-Suomi (superior NUTS-2 level) have been used.

[14] Since there are no statistics available for Ostrobothnia (NUTS-3 level) data from Länsi-Suomi (superior NUTS-2 level) have been used.

and transport (18.4%), and physics (11.8%). These figures are not divided by technological orientation; however, they illustrate the above-mentioned industrial specialisation of the region. Moreover, since the R&D conducting actors are often active in technological sophisticated fields, it can be assumed that in the region applied patents are also often medium-high or high-tech aligned.

3. RTDI Governance and Innovation Policy

3.1 Governance

Generally, "the Finnish political system was and still is characterized by a strong central state" (SCHIENSTOCK et al. 2004:127). However, regional innovation policy structure in Ostrobothnia is based on connections between participants from various kinds of advantage groups. Municipalities, state governmental units, development agencies and companies have their representation in the group responsible for designing regional innovation policy. Wide participation is an advantage in collecting information from various sources. However, it has also led to a situation where it has sometimes proven to be difficult to find a common approach and to form a functional innovation strategy. Wide range of different perspectives makes strategic decision making difficult – in this situation determining exact strategic targets for regional innovation policy is difficult. However, the participants have found a consensus which easily allows discussion-decision making, commitment and forming innovation policy is more challenging.

The Regional Council of Ostrobothnia works as the authority for regional development. Its target is to promote regional development initiatives and regional balance, and thereby promoting environmentally sustainable development. The Regional Council takes care of planning and in parts also of the implementation of regional policy. Vaasa Regional Development Company VASEK develops operational preconditions for companies and coordinates cooperation between municipalities and between education, research and economic life. South Ostrobothnian Centre for Economic Development, Transport and the Environment develops economic life by giving guidance, expert services, education and financing. It works as the local unit of TEKES (the Finnish Funding Agency for Technology and Innovation) and the Ministry of Employment and the Economy. In addition, the innovation agent of the National Board of Patents and Registration of Finland and of the Foundation for Inventions is located there. Other important actors in the innovation system are financiers like state owned Finnvera and regional investment trust Wedeco Group. Other important actors in the R&D are technology centre Merinova, Vaasa Science Park, Concordia, Yritystalo Dynamo and Viexpo.

Regional development agencies like VASEK and Merinova, the Chamber of Commerce, the Regional Council, the State Regional Administration (ELY) and the State Development Agency (TEKES), universities and polytechnics are major participants of the public sphere. However, a Triple-Helix approach can be found in this cooperation: public sector, research institutions and business sector are all present. Nonetheless, this work process is yet not very well structured and it does not necessarily lead to a functional strategy.

Administrations on regional and national levels have different scopes for their work and they complement each other´s work. Actions for regional development (promoting investments, etc.) are mostly funded through regional councils which also administrate ERDF funds. National administration is responsible for e.g. labour market related issues (e.g. through ESF). The borderline is actually not this clear and simple but the point is that there are no major problems between regional and national levels of administration or inside either of them.

3.2 Policy

The contents of the regional innovation policy are not clearly specified. The in section 3.1 mentioned organizations are not too committed to form a strong common regional innovation

policy. For example the companies prioritize their business networks which are not regionally formed. E.g. Vaasa sub-region is highly profiled to sustainable energy production technologies and it has been very successful in businesses related to this branch. Despite the success in this cluster in Vaasa sub-region the other sub-regions in Ostrobothnia must have some other key elements for their success.

However, the regional development plan 2040 for Ostrobothnia is one of the most important strategic plans. It sets the long-term objectives for regional development – like being a knowledge-based and multi-cultural area with high-level of wellbeing and strong sense of community. The foundation of this development is in energy technology and other knowledge based industries. Regarding this, cluster approaches play an important role. Other guidelines (for other levels of administration) are based on shorter perspective and they support the key-elements of this document.

4. Trends, Challenges, and Assessment

4.1 Trends and Challenges which are not specific to the R&D Sector

The long-term economic development of Ostrobothnia in the period of 1995-2008 was above-average compared to the national mean and in line with the European average. Much of this growth was industry-driven. If the region further succeeds to stay attractive for environmentally oriented and therewith closely related sectors this development has the chance to continue.

The region, like others in Europe, faces the problem of relatively high economic concentration in urban centres (especially Vaasa). Despite there are in some cases examples observable which illustrate that also rural area can profit from economic developments in urban areas, however, Ostrobothnia needs to address this trend in order to spread wealth more evenly within the region.

The population development and especially the aging figures of a population are crucial for innovation related purposes, because the youth of a population virtually determines its dynamism and innovativeness and therewith its future viability. In 2010, the Ostrobothnian population reached its present maximum of about 178,000 (cf. RCO 2011a). Since 2005, the regional population thus grew by 2.5%. With its population size the region is the smallest among the sub-regions of Länsi-Suomi. However, although the Ostrobothnian population experienced growth throughout the last decades and this trend is likely persist on a low level until 2030 due to slightly above-average fertility figures compared to the European average and in-migration, like in most areas of Europe the demographic change will be very challenging in near future. At the end of 2008, 17.4% of the regional population was younger than 15 years, 64.1% were between 15 and 64 years, thus representing the population of working age and about 18.5% were 65 years or older (retirement age). In the future, the age cohorts entering the labour market are getting smaller. At the same time number of those retiring is getting higher. Projections assume that in 2040, the share of people which is 65 years and older will already account for about 25.8% in Ostrobothnia, showing the economic and social challenges the region is confronted in the future (cf. EUROSTAT 2011; RCO 2010). Therefore effect is dual. More people are needed for the care of the elderly and there will be lack of labour. As less people enter the labour market the lack of labour will be inevitable. Against this backdrop the quota of early leavers, which is doubtless already comparably small, becomes more relevant. The region is challenged to further decrease the number of people without or very low levels of education. In order to solve the problem of a shrinking proportion of the population of working age there are only few solutions. Increasing migration is one of them but also improving effectiveness through high technology and more efficient working methods are possible. All these options require investments in education. The immigrants need training to be able to work in Finland and using more high technology innovations requires higher level of

education too. Other ways of increasing the labour supply are finding ways to employ e.g. disadvantaged and other groups of people which have not been active in the labour market so far.

4.2 Trends and Challenges which are specific to the R&D Sector

Ostrobothnia has many advantages regarding RTDI aspects. The region is shaped by R&D activities from the BES but also universities are important actors. This trend is likely to continue due to the region´s relatively well-developed research infrastructure and economic structure.

Since it has sometimes proven to be difficult to find a common approach and to form a functional innovation strategy the Triple Helix model and the overall efficiency should be further developed and increased, respectively. Otherwise, in the long run the region runs danger to lose important competitive advantages.

Currently, most of the research and innovation competences and resources are concentrated in and around of the regional capital Vaasa. Given the assumption that regions without enough competences and capacities in R&D will face difficulties in participating in and gaining from a knowledge-driven economy it is likely that regional economic disparities will sharpen in the future. Against this backdrop the region will face the challenge of supporting the dispersion of R&D-intense activities within Ostrobothnia without stalling regional economic dynamism and evolved cluster structures.

Although SMEs are of great importance for Ostrobothnia´s economy and some are active in research and innovation processes, most of those activities are performed by large, often international enterprises. In order to broaden further technological sophistication within the BES, the region is challenged to increase further the participation of SMEs in research and innovation.

4.3 Assessment of the regional R&D System

4.3.1 Governance Dimension

Concerning the governance dimension Ostrobothnia has a *network R&D system* with *dirigiste features* due to the strong Finnish central state. The support of knowledge and technology creation and transfer takes place on different levels (e.g. local, regional, or national) and is based on connections between municipalities, state governmental units, development agencies and companies. Funding is mostly determined, guided and assessed centrally, with decentralized units located in the region. The Ostrobothnian research competences are broad in nature, covering basic, applied and experimental research. This is due to the extended region´s private and public research landscape. However, since the R&D system is highly business-oriented and the BES contributes the most to the overall research and innovation activities, it must be said that applied and experimental research are in the focus. Due to the high number of involved actors in the Triple Helix model, the need for coordination can be assessed as very high. The region´s degree of specialization with respect to its governance and policy characteristics is rather flexible. Administrations on different levels have different scopes for their work and they complement each other´s work.

4.3.2 Business Innovation Dimension

Regarding the business innovation dimension, the Ostrobothnian R&D system is rather close to an *interactive* system with *globalised features*. The region´s R&D system is dominated by large companies of those many are active internationally and supported by clustered supply chains of often dependent SMEs. Generally, the research and innovation system is quite strongly specialized in environmental friendly technologies and energy production. Moreover, most activities are concentrated in the capital Vaasa. Although SMEs constitute the main pillar of regional employment, their potential for innovation is often comparatively limited. The

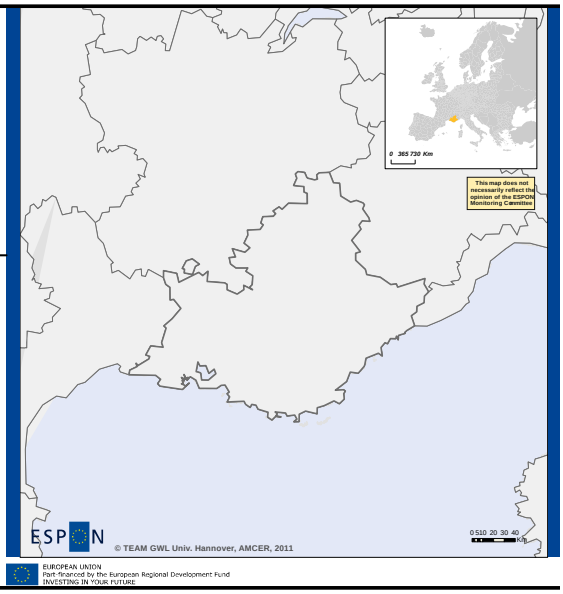
region hosts a mix of public and private research institutions, regional headquarters of larger firms and a national and regional administration keen to promote innovation. Although, the HES is of high importance for the Ostrobothnian research and innovation system the R&D system is pretty much dominated by private rather than public research activities. However, the public and private actors often cooperate with each other, whereby both spheres benefit from knowledge transfers. The overall degree of association can be assessed to be very high and the policy is actively supporting co-operations, networks and clusters.

VIII. Region Provence-Alpes Côte d'Azur (PACA)

FRANCE

Region Provence-Alpes-Côte d'Azur

NUTS Code FR82 (NUTS-2-Level)



Introduction:

PACA is a region in the southeast of France. It is bordering on the French regions Languedoc-Roussillon and Rhône-Alpes to the west and north, respectively, the Italian regions Piemonte and Liguria to the east, and the Mediterranean Sea to the south.

PACA has a surface of 31,399 km² and a population of about 4.9m. The region has a population density of 157 per km², in 2010, which means that it is densely populated regarding both the French standard (102) and the EU-27 average (116, in 2008). The regional capital is Marseille with about 851,000 inhabitants in its core and 1.35m inhabitants in the metropolitan area (cf. CANTNER et al. 2008; EUROSTAT 2011; PELLEAU 2007; RIM 2011g).

National/EU context:

PACA is among the most important regions in France regarding economy and population, although the region Île de France is by far the most important and dominating region within France. The regional GDP per capita is below the French but above the European mean. PACA is mostly oriented towards services.

In general, most parts of the region do not have a special industrial or scientific heritage. Its industry consists of both traditional and technologically sophisticated sectors. There are well-known locally concentrated potentials for research and innovation due to a relatively broad public research infrastructure as well as the presence of large extra-regional and foreign enterprises from medium-high and high-tech sectors. Major region´s research and innovation spots are Marseille and the Sophia Antipolis science park, which is located near Nice. Nonetheless, generally, the region faces low innovation content among the regional production system, resulting from a gap between research and the overall economic sector. Regarding various RTDI indicators in comparison to the national level, in general, the region achieves below average values. Compared to the European level, however, the region often obtains above average results.

PACA's current core R&D sectors are food research and processing, marine science and technologies, ICT, biotechnology and life sciences, aerospace, pharmacy, new materials as well as energy and gas. The RTDI sector in PACA is business-oriented but also very much influenced by public actors.

The region´s innovativeness in relation to the other French regions, measured by the num-

ber of patents applied at the EPO, ranks in the 3rd place. In European terms the region achieves below average values. In 2007, the employment in R&D (FTE) was 6.9% of the overall French R&D personnel. The R&D personnel (FTE) per 1,000 employees amount to 14.1. This figure is below the French (14.6) but above the EU-27 (11.0) average. Regarding the business orientation of both the R&D expenditures and the R&D personnel (FTE) (58.0%, 50.1%), the region has lower values than both France (63.0%, 57.0%) and the EU-27 (63.7%, 52.1%) (cf. EUROSTAT 2011).

In 2007, PACA´s per capita spending on R&D ranks in the upper third compared to the other French regions. The region´s R&D intensity accounts for 1.93%, thus being slightly below the national average (2.07%) but above the EU-27 average (1.85%). PACA´s R&D productivity amounts to 0.22, thus being slightly below both the French (0.23) the EU-27 average (0.27) (cf. EUROSTAT 2011).

1. Socio-economic Characteristics

In 2008, the regional GDP in PACA amounted to about €140.3b, accounting for a share of about 7.2% of the French GDP, therewith forming the 3rd strongest regional economy after Île de France (28.7%) and Rhône-Alpes (9.6%). The regional GDP per capita was €28,600, which represents 94.1% of the French average and 113.9% of the EU-27 average, respectively. Moreover, the region has productivity levels above the national mean, what is mainly due to highly capitalistic industries and a high level of qualification. However, the below-average wealth level results from high social transfer payments due to job losses in the traditional industries and low value added service jobs (see below). Between 1995 and 2008, PACA´s economy grew by 4.1% p.a., which is above-average regarding the national figure (3.8%) and slightly below-average taking the EU-27 (4.5%) (cf. EUROSTAT 2011; PELLEAU 2007). Comparing the economic performance of PACA with that of the other AMCER-regions, the region ranks in the upper midfield (see App. Tab. 3).

In 2010, the regional labour force amounted to 2.16m, representing 7.4% of France´s total labour force (29.13m). Therewith, the region´s labour force size ranks in the 3rd place among the French regions after Île de France and Rhône-Alpes. The regional employment rate of the 20-64 year-olds lies at 67.1%, which is below-average compared to the national average of 68.8% (cf. EUROSTAT 2011). Taking the employment rate target of 75% defined by the "Europe 2020 Strategy", PACA´s employment rate is still too low (cf. EC 2011).

In 2008, 3.3% of the employees worked in the agricultural sector, 17.3% in the industry, and 79.4% in the service sector. In comparison to the national average (3.1 %, 23.3%, 73.6%) one can see profound differences, where the region´s industry sector is less and the service sector much more accentuated. Taking the EU-15 average (3.5%, 26.2%, 69.7%), where the more developed countries of the European Union are considered, the same findings can be observed, underpinning PACA´s service-orientation. The decline of traditional industries and building trade (since mid 1970s), and the parallel rise in various services as well as in new technologies, combined with dynamic employment policies, strengthened the relevance of the tertiary sector in PACA´s economy. Between 2000 and 2008, the service sector grew above-average regarding the national mean. "The impressive expansion of services in the region is attributable not only to its population size and the steady inflow of migrants, but also to its leading role in the tourist industry. This potential in household services is coupled with a high level of business and financial services, in line with the importance of its economic and administrative structures" (POR 2004d). Comparing the economic structure of PACA with that of the other AMCER-regions, in terms of its industry sector share the region ranks in the last place, regarding the service sector share it ranks in the 1st place (see App. Tab. 4) (cf. EUROSTAT 2011; PELLEAU 2007; RIM 2011g; POR 2004c, 2004d).

Between 2006 and 2008 a strong recovery of the unemployment occurred with rates declin-

ing from 11.6 to 8.2%. However, since 2009, the average annual regional unemployment rate has increased, going up to 10.2% in 2010. The regional development is thus following the national trend, where the unemployment rate rose from 7.8% (2008) to 9.7% (2010) (cf. EUROSTAT 2011). Both PACA´s and the national unemployment figures are slightly above the EU-27 average of 9.6% in 2010. The upsurge in unemployment is mainly due to the impact of the financial crisis on the regional economy (see main economic sectors below). Comparing the overall as well as the youth unemployment figures of PACA with that of the other AMCER-regions, the region ranks in both cases among the worst performers. Moreover, the relatively high long-term unemployment share must be considered critical (see App. Tab. 5). Despite the region managed to reduce unemployment temporarily and the current upsurge is at least partly due to the effects of the crisis, nonetheless, the region shows a great need for labour market reforms. Those should especially address structural problems with respect to long-term and youth unemployment.

PACA´s economy exhibits some intra-regional disparities as indicated through the coefficient of variation of several indicators stated in Tab. 9. In PACA relatively huge differences can be observed in terms of economy and population. The vast proportion of the region´s population, economic activities, and employment are concentrated "around to two urban areas: in the west, around the urban areas of Avignon, Marseille, Aix-en-Provence and Toulon, and in the east along the coast of the Cote d'Azur. There is a big difference between these two areas and the rest of the territory of the region, which has a low population density, is alpine and is endowed with a great variety of protected natural areas" (POR 2004b). The biggest conurbations are Marseille-Aix-en-Provence, Nice, and Toulon. Due to structural changes, in general, the unemployment is also more pronounced in the urban areas (cf. POR 2004b, 2004c, 2004d).

Table 9: Intra-regional socio-economic Disparities in PACA (selected Indicators)

Coefficient of variation of GDP per capita 2008 (in %)	Coefficient of variation of the yearly average GDP per capita growth rate 1998-08 (in %)	Coefficient of variation of the unemployment rate 2009 (in %)	Coefficient of variation of the population dynamics 2000-09 (in %)
11.20	12.39	14.86	24.58

Remark: disparity calculations based on NUTS-3 level data

(Source: own creation and calculations; based on data from EUROSTAT 2011)

PACA's economy employed about 1.9m people in 2010. The region's primary sector is comparatively insignificant regarding its overall contribution to the GDP, but due to contrasting geography and the mild climate some products such as fruits, vegetables, flowers, wine, olives as well as perfume, aromatic and medical plants are with high value-added. However, the regional economy is very much shaped by the service sector namely tourism and therewith closely related sectors, financial services, trade as well as wholesale and retail. Trade and related activities are of significance for PACA since Marseille-Fos is a strategic logistic hub at the crossroads of Europe and Mediterranean and the major French port. In the course of the structural change the industry sector strongly lost in importance during the last decades. Traditional industries still active in PACA are e.g. paper and wood, chemistry, petroleum, shipbuilding, and metal. However, enterprises from these industries further lose their economic weight, because they often face pressure due to strong international competition, particularly from emerging countries but also from European neighbours. Moreover, their investments in research and innovation are often too low. Other sectors of certain importance are agri-food, electrical engineering and electronics sector. More modern and technological sophisticated industrial sectors are aerospace (e.g. Eurocopter, Alcatel, Dassault aviation), ICT (e.g. IBM, SAP), pharmaceutical industry (e.g. Virbac, Arkopharma), biotechnology (e.g. TRophos, Innate, Pharma), and weaponry (e.g. Thales) (cf. PELLEAU 2007; RIM 2011g; POR 2004c,

2004d).

PACA's economy is shaped by indigenous SMEs, especially by SMEs with less than 10 employees. They are representing 93.2% of local businesses (national average: 90.9%). Most of the region's SMEs are specialised in service sectors. To the contrary, SMEs only employ a fifth of PACA's industrial workers. Although the region has some important SMEs dealing with international markets and research and innovation aspects, especially in the industrial sector the region's economic and production system generally suffers from the lack of intermediate size companies. Nowhere else in France are fewer medium-sized industrial firms than in PACA, leading to disadvantages for the SMEs when it comes to internationalisation, research and innovation, and thus future prospects. The region´s industry sector is shaped by capital-intensive branches. Those are often subsidiaries concentrated in large establishments and belong to extra-regional or international enterprises, whereas their headquarters are often outside of the region (e.g. in the region of Île de France). The large enterprises are in turn served by a network of SMEs operating as subcontractors or suppliers. Due to these structures, the region's industry (which mostly conducts R&D in PACA) is highly dependent on large-scale firms as well as extra-regional factors and decisions (cf. PELLEAU 2007; POR 2004d; RIM 2011g).

Value of exports of PACA amounted at €21,1b in 2009 corresponding to 15% of the regional GDP. More than half of exports dealt with machinery and transport equipment, miscellaneous manufactured articles and special transactions (€12,0b). With €3,8b, chemical products ranked second and weighted one fifth of the exports. Imports reached €27,8b with again one-half due to machinery and transport equipment, miscellaneous manufactured articles and special transactions (€13,6b). Petroleum products reached €9,3b corresponding to one third of the imports (cf. ORT 2011).

2. RTDI Characteristics

2.1 R&D Efforts and Input into the Process of Knowledge Generation

The region has some well-known scientific competences. However, within PACA the vast proportion of the research and innovation competences and resources are bundled in Sophia-Antipolis and in Marseille. For instance, concerning the public research, half of the researchers are located in the area of Aix and Marseille (4,650 out of 9,500) while one-sixth works in the area of Nice and Sofia-Antipolis (2070). In total, four areas concentrate 94% of the public researchers (Aix/Marseille, Nice/Sofia-Antipolis, Cadarache and Avignon). However, PACA's GERD amount to €2.61b in 2007, thus contributing 6.6% to the French total. The R&D expenditures per capita amounted to €537. Therewith, PACA's per capita spending on R&D ranks in the upper third compared to the other French regions. The highest spending has Île de France (€1,359). When expressed as a percentage of GDP, the GERD is used to indicate the overall R&D intensity of a country or region. This measure unfolds the emphasis placed on R&D activities within a given economy. In 2007, R&D expenditures per GDP are 1.93%, thus being below the national average (2.07%) but above the EU-27 mean (1.85%, in 2007) (cf. CISAD 2011; CORDIS 2005; EUROSTAT 2011; POR 2004d). The regional R&D expenditure per GDP quota is still far away from meeting the target of 3% defined by the "Europe 2020 Strategy" and the developments in previous years were rather mildly than soaring (cf. EC 2011). Comparing both the R&D expenditures per capita and per GDP of PACA with that of the other AMCER-regions, the region ranks in the midfield (see App. Tab. 6).

In 2007 the FTE employment in R&D amounts to 26,111, which is 6.9% of the overall French R&D personnel. The R&D personnel (FTE) per 1,000 employees amounted to 14.1. This figure is below the French (14.6) but above the EU-27 average (11.0). Regarding the R&D personnel per 1,000 employees in comparison to the other AMCER-regions, PACA ranks in the upper midfield (see App. Tab. 6) (cf. CISAD 2011; EUROSTAT 2011).

The R&D sector can be sub-divided into the BES, the GOV, the HES, and the PNP. Their relative importance varies greatly across regions, however, generally reflecting different economic or research structures and traditions, respectively. With regard to the innovation system approach, the proposition of BERD is considered as an indicator of the overall innovative capacity of a region. Although, this should not be over-interpreted, because the other sectors also provide important stimuli to the process of knowledge and technology production.

PACA's current core R&D sectors are food research and processing, marine science and technologies, ICT, biotechnology and life sciences, aerospace, pharmacy, new materials as well as energy and gas. The RTDI sector in PACA is business-oriented but also very much influenced by public actors (see below). The BERD amounts to 58.0% (€1.513b) of the overall GERD, in 2007. However, the share of the BES in R&D employment (FTE) accounts for only 50.1% (13,095 employees) of the overall R&D employment. Regarding the business orientation of the R&D expenditures and the R&D personnel (FTE), the region has lower values than both France (63.0%, 57.0%) and the EU-27 (63.7%, 52.1%). Comparing the same aspects between PACA and the other AMCER-regions, the region ranks in both cases in the lower third (see App. Tab. 6) (cf. EUROSTAT 2011). However, although the industry's overall proportion is comparatively small it is of great relevance for the region's knowledge and technology production. Many research and innovation-conducting firms are from medium-high or high-tech sectors. Although PACA's business share in R&D is partly comparable lower, the BES achieved to increase its proportion in recent years, whereas the public actors lost. The vast proportion of the region´s business research and innovation efforts is performed by large-sized companies. SMEs account for approximately 25% of the private expenditures (against 15% in France on average). However, the private R&D specialisation does not sufficiently match the private R&D specialisation. The Community Innovation Survey 2008 emphasised that SMEs in the industry sector in PACA did innovate less between 2006 and 2008 than the French SMEs on average: 45.8% against 51.2%. As far as the technological services' sector is concerned, the same picture is observable: 61% of SMEs in PACA did innovate between 2006 and 2008 while 62.4% of French SMEs of this sector innovated. Moreover, not least because of the region's infrastructures (e.g. universities, technopoles/science parks, research centres) as well as politically subsidized measures aiming at the settlement of foreign enterprises and national players PACA hosts a wide range of medium-high and high-tech firms (cf. EUROSTAT 2011; INSEE 2008; PELLEAU 2007; RIM 2011g).

As already mentioned the HES and the GOV play an important role in the overall RTDI arena. In 2007, public R&D expenditure amounted to €1.098b (42.0% of GERD) and there were 13,017 FTE researchers (49.9%) in the public sector. The PNP plays almost no role with respect to PACA's research and innovation activities (cf. CISAD 2011; EUROSTAT 2011). In PACA are six universities with more than 400 research centres, whereof two universities are among the main French higher education poles (Aix-Marseille, and Nice). In addition, PACA hosts numerous national research institutions, namely the CNRS (Centre National de la Recherche Scientifique), CEA (Commissariat à l'Energie Atomique), INSERM (Institut National de la Santé et de la Recherche Médicale), INRIA (Institut National de la Recherche en Informatique et en Automatique), INRA (Institut National de la Recherche en Agronomie), CNETS, IFREMER (Institut Français de Recherche pour l'Exploitation de la Mer), CEMAGREFF (Institut de recherche pour l'Ingénierie de l'Agriculture et de l'environnement), INRETS (Institut National de Recherche sur les Transports et leur Sécurité), and ONERA (Centre français de recherché aérospatiale) (cf. EUROSTAT 2011; PELLEAU 2007).

Despite existing strengths especially regarding research, and although national and regional authorities developed tools, organised and/or financed organisations aiming at the support of research, innovation, technologies and knowledge transfers and the regional actors therefore benefited of various entities (university services in charge of research commercialisation, in-

cubators, technopoles/science parks, interface organisations (local, national, thematic, etc), competitiveness clusters, and the support of the national institutions and services) PACA has particularly weaknesses with respect to low innovation content among the regional production system, resulting from a gap between research and the overall economic sector or productive system, respectively. A general problem is the insufficient link between competences and the often-small size of research laboratories. A further barrier is that initiatives to promote the economic value of public research often failed, because the strategies did not "always benefit to the regional productive system, considering that the commercialisation strategy had no geographical boundaries" (PELLEAU 2007:4). Additionally, the public research system often had a limited knowledge about the technological needs of the BES. Finally, "the cultural gap between private and public sector, as well as the heaviness and bureaucratic aspect of the support system, do not contribute to overcome the problem of innovation spread within the regional production system. Although the institutions, measures and support system are quantitatively important, measures are fragmented, and the support system lack of coordination and perceptibility. Moreover, the each financing institutions have its own exigencies, which do not facilitate the SMEs access to funding for their innovation projects" (PELLEAU 2007:4).

2.2 Human Capital Endowment

In 2009, HRSTC in PACA amounted to 0.345m, representing 6.5% of national total (5.270m) and 16.0% of the economically active population. With this share of knowledge workers the region ranks in the midfield in comparison with the other AMCER regions (see App. Tab. 7) (cf. EUROSTAT 2011).

Moreover, in 2009, the region had a stock of 58,445 employees working in high-tech industries and knowledge-intensive services, i.e. 5.9% of national total and 3.0% of total employment in the region. Therewith, PACA´s share in total employment is below the French standard (3.9%) (cf. EUROSTAT 2011). In comparison with the other AMCER regions PACA ranks in the midfield again (see App. Tab. 7).

The education level of the human capital forms the basis for productive and innovative activities in developed countries and regions. In 2010, PACA had 447,208 students in the secondary education level (ISCED 2-4), i.e. 90.9 students per 1,000 inhabitants. Thus, regarding the French standard (92.0), this is slightly below-average. Overall, 40.5% of PACA's population of working age (25-64 year-olds) has an upper secondary education attainment (ISCED 3), in 2010, which is compared to both the French mean (41.8%) and towards the EU-27 standard (46.8%) below-average. Considering the tertiary education level (ISCED 5-6), the region had 150,597 students in that field, in 2010, i.e. 30.6 students per 1,000 inhabitants. Regarding the French average (33.8), the region´s figure is again below-average. Altogether, 27.7% of the population of working age had a tertiary education attainment (ISCED 5-6). This is compared to France as a whole (29.0%) below the mean but in comparison with the EU-27 average (25.9%) above-average. The proportion of the 30-34 year-olds with a tertiary education attainment amounts to 35.4% in the NUTS-1 region "Méditerranée"[15] (France: 43.5%; EU-27: 33.6%), thus the French Mediterranean region does not meet the 40%-target defined by the "Europe 2020 Strategy" (cf. EC 2011; EUROSTAT 2011). Comparing PACA´s figures of secondary and tertiary level students per 1,000 inhabitants with those in the other eight AMCER regions the region ranks in terms of secondary level students in the midfield and in terms of tertiary level students in the lower third (see App. Tab. 7).

Regarding the early leavers from education and training, which can be interpreted as at least temporarily lost human capital, in the education vintage 2010, they accounted for 17.2% in the French Mediterranean region[16], thus having the highest value among the French NUTS-1

[15] There were no data for PACA (NUTS-2 level) available.

[16] There were no data for PACA (NUTS-2 level) available.

regions. The extraordinary high value is extremely alarming, especially against the backdrop that the value lay around 3.0 percentage points lower in the year 2008, now reaching the level of the early 2000s. The current figure is compared to the EU-27 mean (14.1%) but also towards the national average (12.8) too high (cf. EUROSTAT 2011). Therewith, the regional proportion of early school leavers does clearly not meet the maximum target of 10% defined by the "Europe 2020 Strategy" (cf. EC 2011). Moreover, compared to the other AMCER regions, PACA's proportion ranks among the highest values (see App. Tab. 7). Anyway, against the backdrop of the aging society in the region (see 4.1 below), high reintegration costs, increasing pressure for innovation, productivity, and competitiveness, profound structural reforms are obviously urgent.

Because the technological progress is increasingly challenging developed countries and regions and therewith requirements to education are steadily rising, further education of adults is playing an increasingly important role in knowledge- and innovation-driven economies in general and for aging societies in particular. PACA's participation share of adults aged 25-64 in education and training amounts to 4.4%, in 2010, therewith being below both the national (5.0%) and the EU-27 average (9.1%). Additionally, the recent development shows that the share of people participating in further education decreases in recent years. The regional figure ranks in the last place compared to the other AMCER regions (see App. Tab. 7) (cf. EUROSTAT 2011).

As shown here, "[t]he average level of education and professional training of the active population and youth is not sufficient and does not enable the region to satisfy to the requisite of a knowledge driven economy. Nevertheless, the existing industrial jobs are more qualified than the national average, due to the lack of big production units and the introvert nature of regional industries (few manufacturing, and high level of automation)" (PELLEAU 2007:4).

2.3 Potential for Innovation

In the course of this work the number of patent applications at the EPO is taken as an indicator for the potential for innovation, thus depicting the production of knowledge and technologies. Although in the innovation process patents are somewhere between inventions and innovation and therefore covering only a part of the whole innovation process, they are among the most widely used innovation indicators (cf. GRUPP 1997; FRIETSCH et al. 2008).

As most of R&D is performed by large extra-regional and international enterprises, respectively, it can be assumed that they are also responsible for the vast proportion of patents (technological knowledge), meaning that SMEs play a minor role with regard to patenting. Between 2000 and 2003 in PACA a number of 1,685 patents were applied at the EPO, accounting for 5.7% of the national total. Between 2004 and 2007 the number of patent applications amounted to already 1,739 (5.8% of national total), an increase of about 3.2%. However, due to faster population than patent increases, the patent applications per million inhabitants decreased from 366, in 2000-2003, to 362, in 2004-2007 (-0.8%). Regarding the overall patent output, among the French regions PACA ranks in the 3rd place after the regions Île de France and Rhône-Alpes (cf. EUROSTAT 2011). Especially the region Île de France covers a major part of all patents, underpinning its above-mentioned central position within France. This means that even though PACA is a relatively important region its overall position must always be considered against the backdrop of a highly exposed position of the region Île de France. This becomes clear in comparison to the other eight AMCER regions. Regarding the absolute and relative patent application figure, the region ranks in the lower midfield (see App. Tab. 8). A rationale for the comparatively weak performance could be the persistent gap between research and innovation. Moreover, the region has the problem that while there are research entities of numerous prominent firms in PACA, most of them have their headquarters outside the region, leading to a headquarter bias, which may discriminate PACA.

Since patents are in most cases the result of extensive R&D activities, it is possible to de-

termine the R&D productivity (measured as EPO patent applications per million R&D expenditures in 2004). Moreover, this indicator unveils how effective the money spent on R&D is utilized in the process of knowledge generation. PACA's R&D productivity amounts to 0.22, thus being slightly below average compared to the French standard (0.23) (cf. EUROSTAT 2011). Compared to the other AMCER regions, PACA´s R&D productivity ranks in the lower midfield (see App. Tab. 8). The figures unveil that PACA's R&D system still has some inefficiencies which should be addressed.

Concerning the technically more challenging high-tech patents, PACA accounted for 710 applications at the EPO between 2004 and 2007. Between 2000 and 2003 the region's high-tech patent applications still amounted to 726, a decrease of -2.2% and a contrasting trend compared to the overall patent applications (see above). The high-tech patent applications per million inhabitants come to 148 in the period of 2004-2007. For the same period, the proportion of high-tech patent applications to all patent applications amounted to 41.8%, underpinning the regions specialisation in medium-high and high-tech R&D sectors. Among the French regions, PACA ranks in the 4th place after Île de France, Rhône-Alpes, and Bretagne. Again, although this illustrates to a certain degree the region´s relative technological sophistication, it must be considered that the region Île de France accounts for the vast proportion. Nonetheless, also here a headquarter bias must be assumed, leading to a potential underestimation of the regions performance. However, comparing the region's performance with that of the other AMCER-regions, it ranks both in absolute and relative terms in the upper midfield (see App. Tab. 8). The region´s high-tech patent applications mostly have been made in the fields of computer and automated business (48.9%), communication technologies (31.3%), aviation (8.8%), micro-organism and genetic engineering (6.0%), and semiconductors (4.9%) (cf. EUROSTAT 2011).

3. RTDI Governance and Innovation Policy

3.1 Governance

Since the Law of 13th August 2004, Regions have gained further power. France is a decentralised but not federal country, thus the regions autonomy is limited and the government system still has some centralised features (cf. MULLER et al. 2009). The first wave of decentralisation happened in the early 1980s, created fully-fledged territorial units at NUTS-2 level. The regions got an elected regional council with a wide range of competences and autonomy (e.g. tax raising, budget management). In addition, since then, the regions became self-reliant and there was no longer a need for authorisation through representatives of the national governments (i.e. prefects). However, the prefects still controlled the actions of the region. In 2004 decentralisation continued through a parallel process of deconcentration (devolution of power). Because of these processes, the French sub-national governance system became highly complex, with various political actors and overlapping responsibilities at all levels (cf. WALENDOWSKI et al. 2011). The regulation of competences between the regions and the national level as well as the different actors should actually be ensured by a contractual process ('state-region contract'). This contract determines the joined policy and financing of the territory for a period of seven years (2007-2013). Although all levels (national, provincial, and municipalities) are included in this process it remains highly complex (cf. PELLEAU 2007).

In the French governance system there are two major innovation policy types. Firstly, policies designed and implemented at the regional level, and, secondly, policies designed at the state level and implemented both at the regional and national level (cf. RIM 2011g).

However, the state level is still very present in PACA when it comes to research and innovation. The Ministry of Economy, Industry and Employment, with the Regional Directorate for Enterprise, Competition, Consumption, Labour and Employment (DIRECCTE) implements national industry policies, which affect competitiveness within the region. The Ministry

of Research and Higher Education, with the Regional Delegation for Research and Technologies (DRTT) introduces national policies fostering innovation at the region level. OSEO, the French innovation agency, also has a regional office in Brittany. The agency is placed under the supervision of the ministry in charge of industry, the ministry in charge of SMEs and the ministry in charge of research. Its fields of activity include innovation, enterprise growth, internationalisation, and enterprise succession and transfer. The Environment and Energy Management Agency (ADEME), a further national actor which is active in the region, is an industrial and commercial public agency under ministerial supervision. In its fields of competences the agency also wants to encourage innovation and technology transfer. An important national fund management entity is the General Secretary for Regional Affairs (SGAR) (cf. PELLEAU 2007; RIM 2011g).

However, the state level is still very present in PACA when it comes to research, innovation and competitiveness. On the one hand, the Ministry of Industry with the Regional Directorate for Industry, Research and Environment (DRIRE) implements national competitiveness cluster policies. On the other hand, the Ministry of Research and Higher Education, with the Regional Delegation for Research and Technologies (DRRT) implements national policies fostering innovation within the region. The Environment and Energy Management Agency (ADEME), a further national actor which is active in the region, is an industrial and commercial public agency under ministerial supervision. In its fields of competences the agency also wants to encourage innovation and technology transfer. An important national fund management entity is the General Secretary for Regional Affairs (SGAR) (cf. PELLEAU 2007, RIM 2011g).

Amongst others, further important regional actors are Technological Centres, Innovation and Technology Transfer Regional Centres (CRITT), Technology Platforms, incubators, technopoles/science parks, and Competitiveness Clusters (cf. PELLEAU 2007).

The Regional Council and the state administration set up the 'Regional Innovation Strategy', which involves the main innovation stakeholders in the region and the consultation of entrepreneurs. The regional innovation strategy developed a new governance model in order to manage innovation, based on state-region partnership on two levels. The strategic level is formed by a Steering Committee (Strategic Committee for Innovation) between the Regional Council and the Prefecture including all regional actors, and a permanent regional conference of regional actors of innovation. The management level includes the implementation of a regional mission for innovation support actions, an experts group, and working groups. The described governance system is complemented by the regional observatory for innovation (ORION) (cf. RIM 2011g).

3.2 Policy

Like most of the French regions, in the context of the framework of the ERDF Operational Programme, PACA designed a Regional Innovation Strategy in 2009. This Strategy highlighted four policy objectives:

- Reinforcing innovation capabilities on the basis of regional clusters (PRIDES or competitiveness clusters)
- Supporting innovation within companies
- Supporting innovation in two strategic topics: "Creative economy" and "Sustainable Mediterranean"
- Increasing social and territorial innovation (cf. PACAINNO 2009).

In order to address the already mentioned weaknesses concerning the engagement of local SMEs in research and innovation processes as well as the general gap between research and the local economic sector and production system, PACA introduced two major strategic plans: the first one dealing with aspects of economic development (Schéma Régional de

Développement Econonomique), and the second one with research and higher education (Schéma Régional pour l'enseignement superieur et la recherche). The recent Regional High-Education and Research Scheme identified five strategic challenges: to facilitate studying, life and professional insertion conditions of students, to reinforce and valorise the regional scientific potential, to structure the research valorisation and technology transfer system, to reinforce dialogue between science and society, and to make the region a catalyst of mutualisation and unlocking of potentials. In order to attain this, and since the state-region contract 2007-2013 puts an emphasis on research, innovation, and economic development, "many measures are set up for skills improvement, technology and research results valorisation, marketing and transfer. All together, they constitute a kind of 'bi-level common policy' to enhance relationships between research and economic actors and to facilitate high value added projects. They also support the creation/reinforcement of regional interface actors, which encourage and spur on technologies and research results transfer" (PELLEAU 2007:8).

PACA's main regional policy dealing with SMEs and innovation is the cluster project PRIDES. PRIDES is a label which gives in addition to national funding access to regional financing. All of PACA´s above-mentioned Competitiveness Clusters obtained the PRIDES label, thus gaining from financial support concerning e.g. governance organisation of the Competitiveness Clusters, and development of the regional priorities (i.e. innovation, internationalisation, appropriation and use of technologies, formation and training of human capital, and social and environmental aspects). Further support of the region's research and innovation community is ensured by various funding measures such as support of collaborative projects between research centres and industrial actors, regional grants for innovation and higher education as well as support of scientific conferences and events aiming at research topics (cf. PELLEAU 2007).

4. Trends, Challenges, and Assessment

4.1 Trends and Challenges which are not specific to the R&D Sector

The long-term economic development of PACA in the period of 1995-2008 was above average compared to the national mean but below the European average. Nonetheless, in order to continue economic growth and ensure future perspectives the region needs to address several challenges, for instance, addressing the in section 4.1 mentioned points regarding RTDI aspects, strengthening the industrial basis and the competitiveness of traditional industries, reducing the reliance on crisis-prone services (e.g. wholesale, trade, finance) and large extra-regional and international enterprises, diminishing the extraordinary high unemployment by addressing existing structural labour market problems, and, from an intra-regional perspective, dispersing economic wealth among the sub-regions because most of the economic activities are bundled in the conurbations.

The population development and especially the aging figures of a population are crucial for innovation related purposes, because the youth of a population virtually determines its dynamism and innovativeness and therewith its future viability. In 2010, PACA´s population reached its present maximum of about 4.92m, thus being stable since 2009 (cf. EUROSTAT 2011). Since 2000, the regional population thus grew by 8.3%. With its population size the region ranks the 1st place among the French Mediterranean regions and is the third most populated in France. PACA's population is an elderly population with a higher than average share of persons older than 65. The region is traditionally quite popular for retirement. However, since the region has attracted many immigrants due to its geographical situation, throughout the last two decades the population aging has been curbed. Most of PACA's population growth can be traced back to in-migration, although the natural population development figures were also positive. In 2009, 17.2% of the regional population was younger than 15 years, 63.4% were between 15 and 64 years, thus representing the population of working age and

about 19.3% were 65 years or older (retirement age). The age distribution depicts an ageing regional population where the cohort of the young and adolescent people is markedly smaller than the cohort of the people of pensionable age. The future trends are basically the same as what is expected in Europe's countries and regions at large: reduction of the potential of natural growth and demographic ageing and uncertainty on the evolution of fertility rates and the levels of migrations flows. Accordingly, projections assume that in 2030, the share of people which is 65 years and older will already account for about 24.9% in PACA, showing the economic and social challenges the region is confronted in the future (cf. EUROSTAT 2011; GIANNAKOURIS 2010; POR 2004b).

4.2 Trends and Challenges which are specific to the R&D Sector

PACA is in comparison to the other French regions one with many advantages regarding RTDI aspects, although its relative strength must be considered against the backdrop that most French research, development, and innovation resources and competences are bundled in the region Île de France. This trend is at least likely to continue in the short- and mid-term due to path dependency and cumulative spatial advantages.

R&D activities of the BES are dominant although the public sphere plays a major role in the region´s research and innovation system. However, in recent years the trend showed a further strengthening of the BES. BERD are concentrated on a few often medium-high and high-tech oriented extra-regional or international enterprises without headquarters in the region. Moreover, public actors are very much focused on them. Due to that most local SMEs are not incorporated in the research and innovation system, resulting in the gap between research and the local production system. This also seems to affect the comparatively weak patent application performance. In the longer term this may lead to a lack of future perspectives, reduced competitiveness, and increased regional dependence on extra-regional and international business decisions. Concerning this, PACA is challenged to broaden the participation of indigenous firms, especially by those of intermediate size. Moreover, the region needs to overcome the existing gap between research and the regional (indigenous) production system. Therefore, it is necessary to increase the incorporation of local SMEs despite they are likely to be not as technological sophisticated as the extra-regional and international players.

In order to make further progresses in building up a knowledge-based economy PACA is also challenged to spend noticeable higher amounts on R&D. Currently, the expenditures are below the national average and recent development figures are rather mild. In this context it is also necessary to increase the average level of education, professional training of the active population and youth as well as to reduce the number of early leavers. Without considerable efforts the region will face problems such as high reintegration costs, and a lack of innovativeness, productivity and competitiveness.

Currently, most of the research and innovation competences and resources are concentrated in Sophia-Antipolis and in Marseille. Given the assumption that regions without enough competences and capacities in R&D will face difficulties in participating in and gaining from a knowledge driven economy it is likely that regional economic disparities will sharpen in the future or already high social transfer payments increase further with a corresponding impact on the overall regional wealth level. Against this backdrop the region will face the challenge of supporting the dispersion of R&D-intense activities within PACA without stalling regional economic dynamism.

4.3 Assessment of the regional R&D System

4.3.1 Governance Dimension

Concerning the governance dimension PACA has a *network R&D system* with *dirigiste features* due to the former strong French central state which increasingly retreated within the last decades. Institutional support takes place on different levels (e.g. regional or national) and is

based on connections between regional and state governmental units, development agencies, intermediaries and companies. The regulation of competences between PACA and the national level as well as the different actors is ensured by the state-region contract. This contract determines the joined policy and financing of the territory for a period of seven years (2007-2013). Although PACA thus has a certain degree of autonomy, the state level is still very present in PACA when it comes to research and innovation. PACA's research competences are quite broad in nature, thus covering basic, applied and experimental activities. Basic research is mainly due to universities and public (often national) research entities, whereas applied and experimental research activities are concentrated in the BES. However, since the R&D system is highly influenced by the BES it is shaped by applied and near-market competences. Since the contractual process ('state-region contract') involves actors from all levels (national, provincial, and municipalities) the regional governance system is highly complex with a high degree of coordination. The region's degree of specialisation with respect to its governance and policy characteristics is rather flexible, proven by the evolution of changing regional political emphases on questions concerning the further development of the research and innovation system.

4.3.2 Business Innovation Dimension

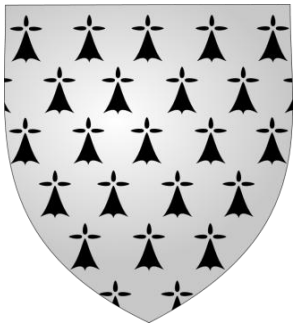
Regarding the business innovation dimension, PACA's R&D system can be classified as a *globalised system*. The region's R&D system is highly dominated by large extra-regional and often foreign enterprises, supported by a network of SMEs operating as subcontractors or suppliers. The actors are specialized in medium-high and high-tech activities and highly spatial concentrated. Most SMEs have rather limited abilities to participate in research and innovation activities and the region generally lacks SMEs of intermediate size. Although, research and innovation is largely internal and private rather than public, the public sphere as well as its infrastructure is of great importance for the overall attractiveness of the region. The degree of association can be assessed as high between research and innovation conducting firms and public actors supporting them, whereas between the public and private research and innovation actors and the broad mass of the business sphere (mainly SMEs) a persistent gap exists. Since the region is aware of weaknesses regarding the research and innovation activities of indigenous SMEs and the thereof resulting gap between research and the overall economic sector or production system, respectively, it developed measures in order to address these problems.

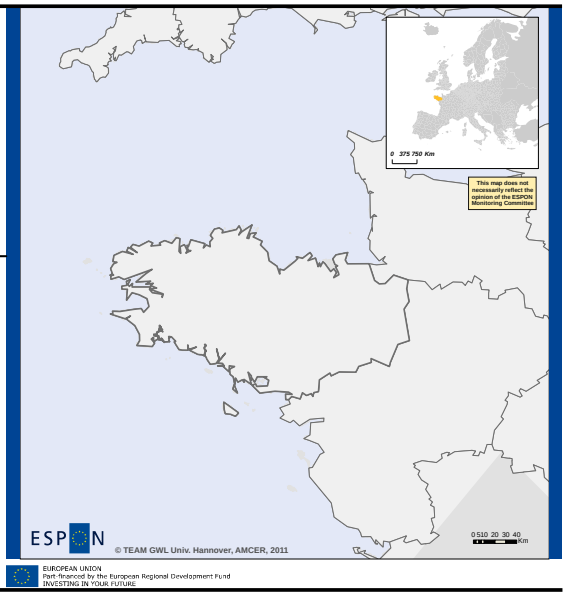
IX. Region Bretagne

FRANCE

Region Bretagne

NUTS Code FR52 (NUTS-2-Level)





Introduction:

Bretagne, or Brittany, is a peninsular region in the northwest of France, on the Atlantic coast, bordering on the French regions Basse-Normandie and Pays de la Loire to the northeast and southeast, respectively.

Brittany has a surface of 27,208 km² and a population of about 3.2m. The region has a population density of 117 per km² in 2010, which means that it is slightly more densely populated with respect both to the French (102) and to the EU-27 average (116, in 2008). The regional capital is Rennes with about 206,000 inhabitants in the city itself and 550,000 inhabitants in the metropolitan area (cf. EUROSTAT 2011; INSEE 2011; POR 2004e; RIM 2011h).

National/EU context:

Brittany´s regional GDP per capita is below the French but above the European average. In the early 1960s, Brittany was one of the poorest regions of the country and among the most rural ones. Although the situation improved in the following decades thanks to the efforts of the government aimed at industrialisation and modernisation, the region still belongs to some extent to the structurally weaker French regions. Brittany is one of the major agricultural regions, agrofood is the most important industrial sector, and the services sector has been growing strongly in the recent years.

Despite its economic weaknesses, it is important to stress that the region benefits from a highly skilled labour force, a well-developed training policy as well as strong public research resources. As a result, employment in high-tech industries and knowledge-intensive services is significant in some innovative fields. Nonetheless, regarding RTDI aspects in comparison to the national and European level the region generally achieves rather below average values.

The four current main R&D fields in Brittany are ICT, marine-related sciences and technologies, agriculture and the food industry, and healthcare-related sciences and technologies. R&D activities in the health and environmental fields have grown significantly in the recent years. Furthermore, chemistry and human and social sciences are considered as research fields with great potential. In 2008, Brittany was ranking 3rd among the French regions with respect to scientific production in electronics, ICT, agro-food, and marine biology/ecology as well as the applications for patents in electronics and electricity. The RTDI sector in Brittany is business-oriented, although public actors also play an important role within the research and inno-

vation system. However, RTDI activities in Brittany are characterised by some lack of diversity, with business research and innovation efforts mainly concentrating on ICT and electronics and, simultaneously, showing a limited participation of the service sector.

Brittany´s innovativeness in relation to the other French regions, measured by the number of patents applied at the EPO, ranks in the fourth place. In European terms the region achieves slightly above average values. In 2007, the employment in R&D (FTE) was 3.9% of the overall French R&D personnel. The R&D personnel (FTE) per 1,000 employees amount to 12.0. This figure is well below the French (14.6) but above the EU-27 (11.0) average. Regarding the business orientation of both the R&D expenditures and the R&D personnel (FTE) (63.6%, 58.5%), the region has higher values than both France (63.0%, 57.0%) and the EU-27 (63.7%, 52.1%) (cf. EUROSTAT 2011).

In 2007, Brittany´s per capita spending on R&D ranks in the midfield compared to the other French regions. The region´s R&D intensity accounts for 1.65%, thus being below the national (2.07%) and the EU-27 average (1.85%). The region´s R&D productivity amounts to 0.35, thus being well above-average compared to the French standard (0.23) and the EU-27 average (0.27) (cf. EUROSTAT 2011).

1. Socio-economic Characteristics

In 2008, the regional GDP amounted to about €83.6b, which puts Brittany as the 6th French region. The regional GDP per capita was €26,500, which represents 87.2% of the French and 105.6% of the EU-27 average. Brittany's GDP amounted in 2008 to 4.3% of the national French GDP (3.9% in 1990), which is less than the region's weight in demographic terms (5.1%) or in employment (4.9%). Between 1995 and 2008, Brittany´s GDP has grown by 4.3% p.a., which is above-average with respect to the national growth rate (3.8%) and slightly below-average with respect to the EU-27 growth rate (4.5%) (cf. EUROSTAT 2011). Comparing the economic performance of Brittany with that of the other AMCER-regions, the region ranks in the pre-last place (see App. Tab. 3).

In 2010, the regional labour force amounted to 1.38m, which ranks the region 7th among the French regions. The employment rate of the 20-64 year-old lies at 69.9%, which is slightly above-average compared to the national average of 68.8% (cf. EUROSTAT 2011). Nevertheless, taking the employment rate target of 75% defined by the "Europe 2020 Strategy", Brittany´s employment rate is still low (cf. EC 2011). The productivity growth rate had been 1.1% p.a. between 2000 and 2006, it decreased in 2007 (-1.1%) and strongly recovered in 2008 (+2.9%) (cf. INSEE 2011).

In 2008, 6.1% of the employees worked in the agricultural sector, 23.6% in the industry, and 70.3% in the service sector. In comparison to the national average (3.1%, 23.3%, 73.6%) one can see profound differences, with the region´s agricultural sector being significantly more and the service sector less accentuated. The industry share is almost in line with the national value. Taking the EU-15 average (3.5%, 26.2%, 69.7%), where the more developed countries of the European Union are considered, the same finding can be observed with regard to agriculture, whereas Brittany´s industry sector proportion is comparatively low and that of the service sector is similar pronounced. As already emphasised, Brittany thus remains one of the main agricultural regions in France. Nonetheless, agricultural employment has considerably fallen in the last decades, while the service sector has been the main provider of new jobs (in particular personal services, and ICT) followed by industry due to late industrialisation and modernisation (automotive sector in the 1960's); however, the share of jobs in industry has slightly diminished since 2000. Comparing the economic structure of Brittany with that of the other AMCER-regions, the region ranks in the lower midfield with respect to the share of jobs in industry, and it ranks in the upper midfield regarding the share of jobs in the service sector (see App. Tab. 4) (cf. EUROSTAT 2011; INSEE 2011; RIM 2011h; POR 2004f, 2004g).

Between 2000 and 2008, the unemployment rate declined significantly from 7.7% to 5.6%. However, due to the crisis, it climbed to 5.9% in 2009 and 7.2% in 2010; the recent upsurge in unemployment has mainly affected the manufacturing sector and construction. The regional unemployment trends have been similar to the national ones, except that Brittany's unemployment rate has constantly remained below the national average (10.2% in 2000, 7.8% in 2008, 9.5% in 2009 and 9.7% in 2010) (cf. EUROSTAT 2011) and below the EU-27 average. The structural features of unemployment are similar to the French ones: high youth unemployment and importance of long-term unemployment. In comparison with the AMCER-regions, Brittany´s unemployment ranks in the midfield, although it should be mentioned that youth unemployment is markedly more pronounced (see App. Tab. 5). Despite some comparatively good features, in general, the figures illustrate that the region shows a great need for labour market reforms. Those should especially address structural problems with respect to long-term and youth unemployment.

There are some intra-regional disparities in Brittany as indicated through the coefficient of variation of several indicators stated in Tab. 10. Although Brittany is generally attractive in terms of population migrations, this is particularly true of the *département* of Ille-et-Vilaine where the regional capital and major city Rennes (demographic growth: +1.2% p.a. against a regional average of +0.9%) is located. Ille-et-Vilaine's population is also the largest and the less aged (population over 60: 20.2% against a regional average of 24.4%) of all Brittany departments. The recent upsurge in unemployment has been less important in Ille-et-Vilaine. In 2007, 71.5% of the regional population were living in predominantly urban areas. Brittany is characterised by a network of mid-sized cities, most of them located on the seaside, with the exception of the regional capital, Rennes. The capital benefits from a strong demographic dynamism and higher average wages and salaries, whereas the highly rural area of central Brittany is experiencing a population exodus with the associated socio-economic effects (e.g.: reduction of the basic services to the population, lower income and wages). The economic development of the recent decades has particularly favoured the south-eastern part of Brittany, especially the urban areas of Rennes and Vannes, where industrial and service activities are concentrated. The north-western part (from Lannion to Brest) is lagging behind the regional average economic growth, well-known tourist sites like Auray (south-east) and Saint-Malo (north-east) have grown significantly, while the south-west part has an intermediate position (cf. INSEE 2011; POR 2004e).

Table 10: Intra-regional socio-economic Disparities in Brittany (selected Indicators)

Coefficient of variation of GDP per capita 2008 (in %)	Coefficient of variation of the yearly average GDP per capita growth rate 1998-08 (in %)	Coefficient of variation of the unemployment rate 2009 (in %)	Coefficient of variation of the population dynamics 2000-09 (in %)
11.51	5.42	6.86	37.27

Remark: disparity calculations based on NUTS-3 level data

(Source: own creation and calculations; based on data from EUROSTAT 2011)

Brittany´s economy employed about 1.28m people in 2010. As mentioned above, the region´s primary sector still has a comparatively high importance in the regional economic fabric. The mild climate favours agricultural activities. However, Brittany has very much focused on the mass production of traditional products with a relatively low added value, namely cattle, pig, and poultry farming (livestock production), milk production, and fishing (including shellfish, in particular oysters). Brittany also benefits from the presence of a powerful agrofood sector, specialised in milk and meat, canning and in the production of animal foodstuff. A third of the regional industrial production units are operating in the agrofood sector which employs almost 70,000 people (12% of agrofood jobs in France). The other important industrial sectors are the automotive industry, shipbuilding, electronics and ICT; together with agrofood, these

sectors account for about two-thirds of industrial employment. However, currently all of these sectors are facing considerable challenges with a need for restructuring due to difficulties regarding competitiveness. The construction sector employs more than 80,000 people and Brittany is ranking 7th for the number of business units and 6th for the number of jobs in this sector at national level. In the service sector, tourism plays an important role due to the region's natural and cultural heritage: its development has entailed a number of job creations. The growth of the tourism sector has been higher than the national average in recent years (cf. INSEE 2011; POR 2004f, 2004g; RIM 2011h).

Brittany's economy is shaped by indigenous SMEs, especially by SMEs with less than 10 employees. They are representing about 90% of local businesses (national average: 90.9%). Most of the region´s SMEs are specialised in service sectors. To the contrary, the region's industry sector is very much characterised by numerous medium-sized firms. The business units employing 100 people or more are to be found mainly in the agrofood and automotive sectors, commerce, and healthcare. There are relatively few foreign firms and few foreign investors in Brittany, wherefore the region has one of the lowest participation shares of foreign investors in industrial sites in France (cf. INSEE 2011; POR 2004g; RIM 2011h).

Brittany is one of the last French regions concerning the relative importance of international trade (it is ranking 19th in 2010). The regional trade balance has shown a surplus in the last past years, albeit with a reduction of about 66% in 2009 compared to 2008. The surplus amounted to €332m in 2009. Brittany's exports amounted to €7.93b in 2009 and mainly concerned meat (€1.28b) and automotive devices (€1.18b – in strong diminution); imports amounted to €7.6b, mainly machinery and equipment and pharmaceutical products. The trade situation widely differs among the *departments*: Finistère and Côtes d'Armor have a large surplus (due to foodstuffs), while exports and imports are only balanced in Ille-et-Vilaine (due to the diminution of exports of the automotive sector). Brittany exports first to Spain and Germany (around 12% of total exports for each). Imports come first from China (12.1% of total imports) (cf. INSEE 2011).

2. RTDI Characteristics

2.1 R&D Efforts and Input into the Process of Knowledge Generation

Within Brittany, the major part of the research and innovation competences and resources are located in Rennes. However, there are three other poles of higher education and research in the region: Brest-Quimper-Roscoff (western part), Saint-Brieuc-Lannion (northern part), and Lorient-Vannes (southern part). Beside the 4 universities (Universities of Rennes 1 and 2, University of Western Brittany, and University of Southern Brittany), and with respect to public research, regional units of practically all national research institutions are present in Brittany, and there are also schools of engineers carrying out research activities.

However, Brittany´s GERD amount to €1.34b in 2007, thus contributing 3.4% to the French total. The R&D expenditures per capita amounted to €428. Therewith, Brittany´s per capita spending on R&D ranks in the midfield compared to the other French regions. The highest spending has Île de France (€1,359). When expressed as a percentage of GDP, the GERD is used to indicate the overall R&D intensity of a country or region. This measure unfolds the emphasis placed on R&D activities within a given economy. In 2007, R&D expenditures per GDP were 1.65%, thus being below the national average (2.07%) and the EU-27 mean (1.85%, in 2007) (cf. CISAD 2011; EUROSTAT 2011). There was a decline in R&D expenditures per GDP at the beginning of the 2000s; however, currently the trend turns thus showing positive signs. Nonetheless, the regional R&D expenditure per GDP quota is still far away from meeting the target of 3% defined by the "Europe 2020 Strategy" (cf. EC 2011). Comparing both the R&D expenditures per capita and per GDP of Brittany with that of the other AMCER-regions, the region ranks in the lower midfield (see App. Tab. 6).

In 2007, the FTE employment in R&D amounts to 14,950, which is 3.9% of the overall French R&D personnel. The R&D personnel (FTE) per 1,000 employees amounted to 12.0. This figure is well-below the French mean (14.1) but above the EU-27 average (11.0). Regarding the R&D personnel per 1,000 employees in comparison to the other AMCER-regions, Brittany ranks in the lower midfield (see App. Tab. 6) (cf. CISAD 2011; EUROSTAT 2011).

The R&D sector can be sub-divided into the BES, the GOV, the HES, and the PNP. Their relative importance varies greatly across regions, however, generally reflecting different economic or research structures and traditions, respectively. With regard to the innovation system approach, the proposition of BERD is considered as an indicator of the overall innovative capacity of a region, although this should not be over-interpreted, because the other sectors also provide important stimuli to the process of knowledge and technology production.

The RTDI sector in Brittany is business-oriented, although public actors also play an important role within the research and innovation system (see below). The BERD amounts to 63.6% (€0.849b) of the overall GERD, in 2007. Moreover, the share of the BES in R&D employment (FTE) accounts for 58.5% (8,752 employees) of the overall R&D employment. Regarding the business orientation of the R&D expenditures and the R&D personnel (FTE), the region has higher values than both France (63.0%, 57.0%) and the EU-27 (63.7%, 52.1%), stressing the general importance of the BES. Comparing the same aspects between Brittany and the other AMCER-regions, the region ranks in the midfield with respect to both the share of BERD in GERD and researchers in business research (see App. Tab. 6) (cf. CISAD 2011; EUROSTAT 2011).

As already mentioned, the public research sector plays however an important role in the field of RTDI. In 2007, public R&D expenditure amounted to €486m (36.4% of GERD) and there were 6,199 FTE researchers (41.5%) in the public sector. The PNP seems to play no role with respect to Brittany's research and innovation activities (cf. CISAD 2011; EUROSTAT 2011).

Apart from the region's four universities, diverse graduate schools as well as training centres, Brittany hosts a number of public research institutions, such as INRIA/IRISA (computer sciences), IFREMER (marine research), INSERM (health and medical sciences) CEMAGREF (environmental sciences), CNRS (40 units in a wide range of scientific fields), INRA (agricultural and food research), and IRD (development). This broad public powerhouse, with its highly skilled labour force (see below), provides in principle a strong research basis for the development of technologically sophisticated enterprises in a region without a longstanding industrial tradition. However, RTDI activities in Brittany are characterised by some lack of diversity, with business research and innovation efforts mainly concentrating on ICT and electronics and, simultaneously, showing a limited participation of the service sector. It must be noted that firms carrying out research and innovation activities are often active in the medium-high and high-tech fields (see below) (cf. RIM 2011h).

The four current main R&D fields in Brittany are ICT, marine-related sciences and technologies, agriculture and the food industry, and healthcare-related sciences and technologies. R&D activities in the health and environmental fields have grown significantly in the recent years. Furthermore, chemistry and human and social sciences are considered as research fields with great potential. In 2008, Brittany was ranking 3rd among the French regions with respect to: scientific production in electronics, ICT, agro-food, and marine biology/ecology; the applications for patents in electronics and electricity; mathematics.

The major weaknesses identified regard: the still insufficient linkage between higher education and research and the region-based innovative clusters ('poles of competitiveness'); the difficulties encountered in carrying out research activities of a level of excellence in smaller higher education and research poles; the lack of international opening up of the research system; the fact that large-scale businesses which are carrying out research activities in the re-

gion have their headquarters outside of it (cf. STRATER BRETAGNE 2011).

2.2 Human Capital Endowment

In 2009, HRSTC in Brittany amounted to 0.256m, representing 4.9% of national total (5.270m) and 18.2% of the economically active population. With this share of knowledge workers the region ranks in the upper third in comparison with the other AMCER regions (see App. Tab. 7) (cf. EUROSTAT 2011).

Moreover, in 2009, the region had a stock of 39,956 employees working in high-tech industries and knowledge-intensive services, i.e. 4.0% of national total and 3.0% of total employment in the region. In addition, high-tech employment records a reasonable positive development in recent years. Nonetheless, so far, Brittany´s share in total employment is below the French standard (3.9%) (cf. EUROSTAT 2011). In comparison with the other AMCER regions Brittany ranks in the midfield (see App. Tab. 7).

The education level of the human capital forms the basis for productive and innovative activities in developed countries and regions. In 2010, Brittany had 291,552 students in the secondary education level (ISCED 2-4), i.e. 91.9 students per 1,000 inhabitants. Thus, regarding the French standard (92.0), this is almost in line. Overall, 48.8% of Brittany´s population of working age (25-64 year-olds) has an upper secondary education attainment (ISCED 3), in 2010, which is compared to both the French mean (41.8%) and the EU-27 standard (46.8%) above-average. Considering the tertiary education level (ISCED 5-6), the region had 100,160 students in that field, in 2010, i.e. 31.6 students per 1,000 inhabitants. Regarding the French average (33.8), the region´s figure is below-average. Altogether, 28.1% of the population of working age had a tertiary education attainment (ISCED 5-6). This is compared to France as a whole (29.0%) below the mean but in comparison with the EU-27 average (25.9%) above-average. The proportion of the 30-34 year-olds with a tertiary education attainment amounts to 41.0% in the NUTS-1 region "Ouest"[17] (France: 43.5%; EU-27: 33.6%), thus the French Western region does meet the 40%-target defined by the "Europe 2020 Strategy" (cf. EC 2011; EUROSTAT 2011). Comparing Brittany´s figures of secondary and tertiary level students per 1,000 inhabitants with those in the other eight AMCER regions the region ranks in terms of secondary level students in the upper midfield and in terms of tertiary level students in the lower midfield (see App. Tab. 7).

Regarding the early leavers from education and training, which can be interpreted as at least temporarily lost human capital, in the education vintage 2010, they accounted for 9.8% in the French Western ('Ouest') region[18], thus having the second-lowest value among the French NUTS-1 regions after the South-western ('Sud-Ouest') region. Compared to the year 2000 there is hardly any change noticeable (+0.1 percentage points), and the figures are steadily fluctuating around this value throughout the period. Despite there being is a stagnation observed, the current figure is compared to the EU-27 mean (14.1%) but also towards the national average (12.8) far better (cf. EUROSTAT 2011). Therewith, the regional proportion of early school leavers does almost exactly meet the maximum target of 10% defined by the "Europe 2020 Strategy" (cf. EC 2011). Moreover, compared to the other AMCER regions, Brittany's proportion ranks among the lowest values (see App. Tab. 7). Despite this positive situation, the region should try to further reduce the proportion of early leavers, because of the high reintegration costs, increasing pressure for innovation, productivity, and competitiveness, in a context of aging regional population (see section 4.1 below).

Because the technological progress is increasingly challenging developed countries and regions and therewith requirements to education are steadily rising, further education of adults is playing an increasingly important role in knowledge- and innovation-driven economies in

[17] There were no data for Brittany (NUTS-2 level) available.

[18] There were no data for Brittany (NUTS-2 level) available.

general and for aging societies in particular. Brittany's participation share of adults aged 25-64 in education and training amounts to 5.6%, in 2010, therewith being above the national (5.0%) but below the EU-27 average (9.1%). Additionally, the recent development shows that the share of people participating in further education decreases in recent years. The regional figure ranks in the pre-last place compared to the other AMCER regions ahead of PACA (see App. Tab. 7) (cf. EUROSTAT 2011).

2.3 Potential for Innovation

Within the framework of the present work, the number of patent applications to the EPO is taken as an indicator of the potential for innovation, thus depicting the production of knowledge and technologies. Although in the innovation process patents are somewhere between inventions and innovation and therefore covering only a part of the whole innovation process, they are among the most widely used innovation indicators (cf. GRUPP 1997; FRIETSCH et al. 2008).

It has already been stressed that private research plays an important role in Brittany with respect to both BERD and researchers. It must be added that private research is mainly carried out by large-scale enterprises: the PSA group in the automotive sector (as illustrated in the pole of competitiveness '*Pôle Automobile Haut de Gamme*'), France Telecom/Orange, Alcatel-Lucent, TDF in the ICT sector (pole of competitiveness '*Images & Réseaux*'), the DCNS group for shipbuilding (pole of competitiveness '*Mer*'). These groups are responsible for a large proportion of patents (technological knowledge), while SMEs play only a minor role with regard to patenting.

Between 2000 and 2003, there were 1,248 applications for patents to the EPO, accounting for 4.2% of the national total. Between 2004 and 2007 the number of patent applications amounted to 1,382 (4.6% of the national total), showing an increase of about 10%. At the same time the patent applications per million inhabitants rose from 420, in 2000-2003, to 448, in 2004-2007 (+6.7%). Regarding the overall patent output, Brittany ranks in the fourth place among the French regions, behind Ile de France, Rhône-Alpes, and Provence-Alpes-Côte-d'Azur (cf. EUROSTAT 2011). Brittany is thus performing rather well at national level in terms of patenting, taking account of the fact that Ile de France, the capital region, occupies a special position, due to its widely predominant share in GERD and the number of researchers at national level. Regarding the absolute and relative patent application figure in comparison to the other eight AMCER regions, the region ranks in the midfield (see App. Tab. 8).

Since patents are in most cases the result of extensive R&D activities, it is possible to determine the R&D productivity (measured as EPO patent applications per million € R&D expenditure in 2004). Moreover, this indicator unveils how effective the money spent on R&D is used in the process of knowledge generation. Brittany´s R&D productivity amounts to 0.35, thus being well above-average compared to the French standard (0.23) and even compared to the other AMCER regions, Brittany ranks in the first place (see App. Tab. 8) (cf. EUROSTAT 2011), thus showing that the region already has a comparatively efficient R&D system.

Concerning the technically more challenging high-tech patents, Brittany accounted for 784 applications to the EPO between 2004 and 2007 (752 applications between 2000 and 2003, i.e. an increase of 4.3% for the period 2004-2007), thus following the overall trend regarding patenting (see above). The high-tech patent applications per million inhabitants amounted to 255 in the period 2004-2007. For the same period, the proportion of high-tech patent applications in all patent applications amounted to 56.7%, thus underpinning the region's specialisation in medium-high and high-tech R&D sectors. Among the French regions, Brittany ranks in the third place after Ile de France, and Rhône-Alpes. Again, although this illustrates to a certain degree the region´s relative technological sophistication, it must be considered that the region Île de France accounts for the vast proportion. In comparison with the other AMCER regions, Brittany's performance places it in both absolute and relative terms in top positions

(see App. Tab. 8). Nonetheless, and although Brittany undoubtedly performs well with regard to high-tech patents, one has to take into account that the region´s patent applications are very much concentrated in two fields, namely ICT and electronics. The region's high-tech patent applications mostly have been made in the fields of communication technologies (76.3%), and computer and automated business (19.7%). This underpins the above-mentioned circumstance that Brittany´s research and innovation activities are lacking diversity. This concentration is related to the role played in the pole of competitiveness '*Images & Réseaux*' by France Telecom/Orange and Alcatel-Lucent. However, it must be noted that the overall regional economic fabric does not really reflect this technological strength (cf. EUROSTAT 2011).

3. RTDI Governance and Innovation Policy

3.1 Governance

Since the Law of 13th August 2004, Regions have gained further power. France is a decentralised but not federal country, thus the regions autonomy is limited and the government system still has some centralised features (cf. MULLER et al. 2009). The first wave of decentralisation happened in the early 1980s, created fully-fledged territorial units at NUTS-2 level. The regions got an elected regional council with a wide range of competences and autonomy (e.g. tax raising, budget management). In addition, since then, the regions became self-reliant and there was no longer a need for authorisation through representatives of the national governments (i.e. prefects). However, the prefects still controlled the actions of the region. In 2004 decentralisation continued through a parallel process of deconcentration (devolution of power). Because of this processes, the French sub-national governance system became highly complex, with various political actors and overlapping responsibilities at all levels (cf. WALENDOWSKI et al. 2011). The regulation of competences between the regions and the national level as well as the different actors should actually be ensured by a contractual process ('state-region contract'). This contract determines the joined policy and financing of the territory for a period of seven years (2007-2013). Although all levels (national, provincial, and municipalities) are included in this process it remains highly complex (cf. PELLEAU 2007).

In the French governance system there are two major innovation policy types. Firstly, policies designed and implemented at the regional level, and, secondly, policies designed at the state level and implemented both at the regional and national level (cf. RIM 2011h).

However, the state level is still very present in Brittany when it comes to research and innovation. The Ministry of Economy, Industry and Employment, with the Regional Directorate for Enterprise, Competition, Consumption, Labour and Employment (DIRECCTE) implements national industry policies, which affect competitiveness within the region. The Ministry of Research and Higher Education, with the Regional Delegation for Research and Technologies (DRTT) introduces national policies fostering innovation at the region level. OSEO, the French innovation agency, also has a regional office in Brittany. The agency is placed under the supervision of the ministry in charge of industry, the ministry in charge of SMEs and the ministry in charge of research. Its fields of activity include innovation, enterprise growth, internationalisation, and enterprise succession and transfer. The Environment and Energy Management Agency (ADEME), a further national actor which is active in the region, is an industrial and commercial public agency under ministerial supervision. In its fields of competences the agency also wants to encourage innovation and technology transfer. An important national fund management entity is the General Secretary for Regional Affairs (SGAR) (cf. PELLEAU 2007; RIM 2011h).

At the regional level, Brittany's Regional Council supports research and innovation for a large part through its contribution to the CPER and the ERDF Operational Programme, and for a minor part through its own actions. It thus supports regional technology transfer and innovation support bodies such as Technological Centres, Innovation and Technology Trans-

fer Regional Centres (CRITT), Technology Platforms, incubators, technopoles/science parks, and poles of competitiveness (ITD-EU/TECHNOPOLIS 2008).

The Regional Council and the State administration have set up together in 2008 a 'Regional Innovation Scheme', thus anticipating the regional innovation strategies that all French regions had to elaborate in 2009 (cf. SRI 2008). The elaboration of the SRI has involved the main regional innovation stakeholders, including businesses. The SRI designed a new governance model in order to manage innovation and to address the problems resulting from a regional innovation system characterised by a multiplicity of organisations (about 90 bodies expected to bring together R&D and business). The new governance system is based on 2 levels: strategic (and funding) with the COSI (Committee for innovation strategic orientation), composed by 20 representatives of the regional council, the State, the private sector, intermediary agencies, and public research; operational with the agency 'Bretagne Innovation' relying on the Brittany Innovation Network (cf. RIM 2011h).

3.2 Policy

Brittany's regional policy in order to support research is currently concentrated on the funding of research infrastructure, scientific equipment as well as the 'animation' of scientific thematic networks and research programmes. In addition to this, the regional policy supporting innovation provides resources for the development of technology transfer projects, collaborative projects (in particular within the framework of the 4 region-based poles of competitiveness) and innovative projects. Measures and policies encompass also direct and indirect support of business R&D by grants and loans as well as through the assistance to the creation and development of technology-based and innovative firms. Moreover, several regional agencies and organisations supported by the Region participate to the Brittany Innovation Network.

The Regional Innovation Scheme, as a policy blueprint, marked an important step in the structuring of the regional support to innovation (cf. RIM 2011h). It defines 3 priority axes: supporting innovation for improving the competitiveness of existing businesses; diversifying the regional economic fabric by supporting the emergence of new activities and the creation of new businesses; supporting the internationalisation of the innovation actors (business, research, intermediary bodies and agencies). Additional initiatives focus on the monitoring of innovation policies at regional level through the creation of a regional innovation index, and the development of an enhanced innovation culture by reinforcing the innovation management within SMEs (cf. RIM 2011h; SRDE 2006).

4. Trends, Challenges, and Assessment

4.1 Trends and Challenges which are not specific to the R&D Sector

In economic terms, the main challenges are the predominance of the agricultural and agrofood sector with a low added value, an insufficient development of business services, a weak access to emerging markets, the exposition to international competition in low added value sectors, and the dependency of the economic fabric – apart from agrofood – on a few large-scale enterprises (e.g. automotive sector, ICT). With respect to the 'sea' sector (in the broadest meaning), if tourism stays for the moment a profitable activity, the reduction of fishing resources constitutes a serious threat which has to be mitigated by the innovative activities developed through the pole of competitiveness 'Sea'.

The main challenges concerning the governance of the R&D system are of three sorts: The first challenge concerns the very high number of 'interfacing' bodies and organisations – technopoles and science parks, technological centres, CRITT, technology platforms, poles of competitiveness, development and innovation agencies (about 90) – which are often overlapping and/or in more or less open competition. This situation is not specific to Brittany (it is rather general in the EU), but it is particularly marked in the region. The 2008 Regional Innovation Scheme has set up a governance system (see above) which intends to give readability

to the regional R&D system, thus addressing a clear demand of the business sector. The rationalisation of the governance system is based on the networking of the existing actors.

The second challenge is related to the recent national reform of universities (2007). The regional universities had already started a process of coordination with the creation of the European University of Brittany (UEB) before the current reform. UEB has been turned into a Pole of Research and Higher Education (PRES), the new institutional figure created in 2007, which is grouping 23 universities and higher education institutions, research organisations, and university hospitals. The ambition of UEB is to be among the 12 major poles of excellence in France and the 40 in Europe. The challenge for the PRES is to provide an effective and efficient coordination of its 23 members, in particular in the field of commercialisation of research ('*valorisation*') to the benefit of regional SMEs and in the field of internationalisation of the Brittany R&D and innovation system.

The third challenge is common to all French regions which benefit from the presence of research units and laboratories belonging to the national research organisations. It is however particularly relevant in Brittany due to the importance of the agricultural and agrofood sector: research in this field is mainly carried out in national research organisations such as INRA (relatively little research is carried out in universities) which are more focused on their national priorities than on regional concerns, in spite of real improvements in the recent years.
It remains to be seen if, in the next incoming years, the COSI (see above section 3.1: Committee for innovation strategic orientation) will be in a position to address successfully these different challenges to the benefit of innovation across the region and its economic fabric.

The population development and especially the aging figures of a population are crucial for innovation related purposes, because the youth of a population virtually determines its dynamism and innovativeness and therewith its future viability. In 2010, Brittany´s population reached its present maximum of about 3.17m, thus being stable since 2009 (cf. EUROSTAT 2011). Since 2000, the population has grown by 8.4%. If we take a more long-term view, the annual average growth rate has been 0.7% between 1998 and 2003. The fertility rate was in 2002 the 12th strongest among the EU regions. At the same time, the indicator of aging puts Brittany among the relatively more aged regions in comparison to the national and EU averages. Brittany is one of the French regions with the most important demographic growth in the two last decades. This demographic growth results for the three-quarts from a positive migratory balance, in contrast with the national demographic growth which mainly results from the natural balance. Brittany, as the French Southern regions and its neighbour Pays de la Loire, is an attractive region. Migrants are mainly active people with a university degree and retired people coming in majority from the Paris metropolitan area. The future trends are a reduction of the potential of natural growth due to ageing, and uncertainty concerning the evolution of fertility rates. Accordingly, projections assume that in 2030, the share of population over 65 will account for about 25.2%, a serious challenge for the future (cf. EUROSTAT 2011; INSEE 2011; GIANNAKOURIS 2010; POR 2004b). The demographic dynamics is reinforcing the growing unbalance between the hinterland and the littoral where there are more and more inhabitants and touristic activities (including second homes) (cf. ERDF OP 2007). Another territorial challenge is the concentration of activities in the capital city, Rennes, which has imperatively to play the role of a gateway to the rest of the region.

4.2 Trends and Challenges which are specific to the R&D Sector

In the last 15 years, Brittany has globally maintained its position in terms of GERD among the French regions. However, a distinction has to be made between public R&D expenditure for which there was a highly positive trend (index 100 in 1997 and 145 in 2003), and business R&D expenditure which, although important and related to large-scale enterprises as already stressed, has grown at a more modest rate (index 100 in 1997 and 112 in 2003) (cf. ERDF OP 2007).

The main challenges which have been identified are (SRI 2008): developing a culture of innovation; strengthening the link between public research and enterprises; better accompanying SMEs in their innovation efforts; ensure an appropriate financial engineering for innovation; favouring the internationalisation of innovative SMEs; promoting a dynamic and innovative image of the regional economy. In other words, the key is bridging the gap between public research (which has strongly developed in the recent years) and SMEs (in particular but not only in the agrofood sector) and helping the SMEs to develop a culture and practices of innovation and opening up to world markets. Large-scale enterprises have been so far a quite separate world: they are carrying out their own R&D activities which have not diffused to SMEs, with some exceptions.

4.3 Assessment of the regional R&D System

4.3.1 Governance Dimension

Concerning the governance dimension Brittany has a *network R&D system* with *dirigiste features* due to the former strong French central state which increasingly retreated within the last decades. RTDI promotion takes place on different levels (e.g. regional or national) and is based on connections between regional and state governmental units, development agencies, intermediaries and companies. The regulation of competences between Brittany and the national level as well as the different actors is ensured by the state-region contract. This contract determines the joined policy and financing of the territory for a period of five years. Although Brittany thus has a certain degree of autonomy, the state level is still very present in Brittany when it comes to research and innovation. Brittany's research competences are relatively broad in nature, thus covering basic, applied and experimental activities. Basic research is mainly performed by universities and public (often national) research institutions, whereas applied and experimental research activities are concentrated in the BES. Since the contractual process ('state-region contract') involves actors from all levels (national, provincial, and municipalities) the regional governance system became highly complex, with a high degree of coordination due to various political actors with overlapping responsibilities. The region's degree of specialization with respect to its governance and policy characteristics is rather flexible, proven by the evolution of changing regional political emphases on questions concerning the further development of the research and innovation system.

4.3.2 Business Innovation Dimension

Regarding the business innovation dimension, Brittany's R&D system can be classified as a *localist system*. The region's R&D system is highly dominated by a few large indigenous enterprises from the automotive, ICT, electronics, and shipbuilding sector, whereas foreign enterprises play hardly any role. Moreover, SMEs mostly have rather limited abilities to participate in research and innovation activities. The actors are specialized in medium-high and high-tech activities and work spatially concentrated in four major poles. However, in general, the innovation culture of the BES within Brittany is not very great and a major weakness is the still insufficient linkage between the HES and the BES as well as the region-based innovative clusters ('poles of competitiveness'). Furthermore, the regional BES faces the problem of a lack of international openness and that large-scale businesses conducting RTDI activities within Brittany do not have their headquarters within the region. Since the region is aware of the afore-mentioned weaknesses with respect to the R&D system, it developed measures in order to address these problems.

General Conclusion

The regions show 3 main types of governance structures, with some being more centrally-led (e.g. Ostrobothnia, East of England, Brittany, PACA), others with federal characteristics (Lower Saxony, Flanders) or a mixture of both (Andalusia, Catalonia, Tuscany). By dependence on these structures, all regions follow some kind of RTDI policy support programmes. However, in general, the different structures are accompanied by different RIS approaches with specific characteristics as well as related trends and challenges:

Lower Saxony: RIS exhibits a network governance dimension and a mixture of a globalised and an interactive business innovation dimension. RTDI support takes place on different levels. Funding is guided and assessed by various actors, research competences are quite broad in nature and the private business sector provides most of the overall research activities. In this effort, however, it is supported by a broad mix of public and private research institutes. The business sector is highly dominated by large, local companies from the automotive or related sectors. Of those, most have their headquarters in the region but are active globally and are supported by clustered supply chains of rather dependent SMEs. However, since the region is aware of the need for SME strengthening and sector diversification in order to sustain long-term growth, the regional policy initiatives are often addressed to SMEs and high-tech sectors apart from automotive.

Tuscany: RIS exhibits a grassroots governance dimension and a localist business innovation dimension. Knowledge and technology transfer processes are generated and organized mainly on the local level, funding is highly diffuse in origin and shaped by a very low supra-local or national coordination. Research competences are rather limited in the business sector and highly developed in the public sector. The business sector is dominated by a vast proportion of local SMEs from traditional sectors with a quite low research reach and low research resources. A few major local public research institutions have relatively high research resources and capabilities. However, co-operations between both spheres are difficult, because there is a mismatch between the industrial sector structure, its capabilities for research and innovation, and the fields in which the public research institutions are active. However, the region tries to improve a) the linkage between the traditional sectors and the research actors´ needs, and b) the creation of firms in advanced sectors, capable of innovations and research co-operations.

East of England: RIS shows a mixture of a network and a dirigiste governance dimension and a combination of a globalised and an interactive business innovation dimension. Institutional support is initiated mainly at the regional level, however, the regional level has no legislative power and its responsibilities regarding innovation and research are limited. Most research and innovation related policies are developed and implemented at the national level, with some national innovation policies delivered regionally via EEDA and its diverse subcontractors. Nevertheless, the national and the regional actors are highly connected and cooperate on a regular basis. Funding is largely determined centrally, with decentralized units in the region. Research competences are quite broad in nature, due to the extended regional private and public research landscape. The region is clearly business oriented. Although many global and large companies conduct their R&D activities in the region, the proportion between large firms and SMEs active in that field is rather balanced. Even though the business sector contributes by far the biggest share in research and innovation, the public sector is of great importance for the region. The East of England captures significant levels of public investments into R&D and is the location for several centres of international research excellence. In order to strengthen further the region’s favourable position, the political actors aim

to increase both the existence and foundation of network initiatives.

Andalusia: RIS has a network governance dimension with some grassroots features, and a localist business innovation dimension. The support of RTDI activities takes place on different levels. Funding is guided and assessed by numerous public and private actors. The region's research competences are relatively broad in nature, although the output is comparatively low. Andalusia is highly dependent on a few major local public research organisations with relatively high research resources. The business sector currently is not capable to participate in R&D. It is dominated to a large degree by local SMEs with insufficient research reach and resources. In general, Andalusian firms are rather process- than product innovation oriented. Technology production is strongly concentrated on a small number of enterprises and capable universities. There is a mismatch between the industrial sector structure, and its capabilities for research and innovation and the fields in which the public research institutions are active. There is a clear need for a greater involvement of the private sector in the governance of the regional R&D system, especially at the level of research and technology infrastructures and facilities, where public-private cooperation should act as a driver. As for business association, Andalusia has already shown some development. However, in order to further enhance the association among the public research sector and the wider business sphere, there is a need to a) improve the link between the traditional sectors and the research actors and, b) accelerate the formation of medium- and large-sized firms from modern sectors, capable of innovations and research co-operations.

Catalonia: RIS exhibits a network governance dimension with some grassroots features, and an interactive business innovation dimension with globalised traits. Governmental support happens on different levels, funding is guided and assessed by various actors. Research competences are relatively broad in nature. The private business sector provides most of the overall research activities. The region has a dense community of SMEs, often forming local production systems, but also an active presence of MNEs. Catalonia´s local production systems contribute significantly to the knowledge and technology production, although this is limited to rather incremental and low-tech oriented activities. Nevertheless, most technologically advanced research and innovation activities are conducted by a small group of firms (often larger enterprises or MNEs) in only a few sectors. Universities are the most important public research and innovation actors but, due to their focus on knowledge generation rather than its exploitation and their problems in conducting knowledge transfers, their overall influence is limited and could be improved. Although the Catalonian output ranks at the top of the Spanish regions, it is comparatively low in international comparison. In the end, the gap between the HES and the BES - between research and innovation - explains the region´s comparatively weak performance, although the infrastructure is well developed. In order to address the weak points, the political actors try to influence the existence and foundation of network initiatives.

Flanders has a RIS with a networked governance dimension and a mixture of globalised and interactive business innovation dimension. The initiation of RTDI measures takes place on different levels, funding is guided and assessed by numerous public and private actors and the research competences are broad in nature. The region has an extended private and public research landscape, with the BES shaping R&D activities. The BES is highly dominated by large companies of those most are active globally and supported by clustered supply chains of often dependent SMEs. Although SMEs are the main providers employment in the region and the public innovation structure also aims to support knowledge and technology production in SMEs, their potential for innovation remains limited. Flanders is active in a broad field of

sectors and is eager to further develop its economic and sectoral structure in order to stay competitive in the long-term and to ensure future prospects.

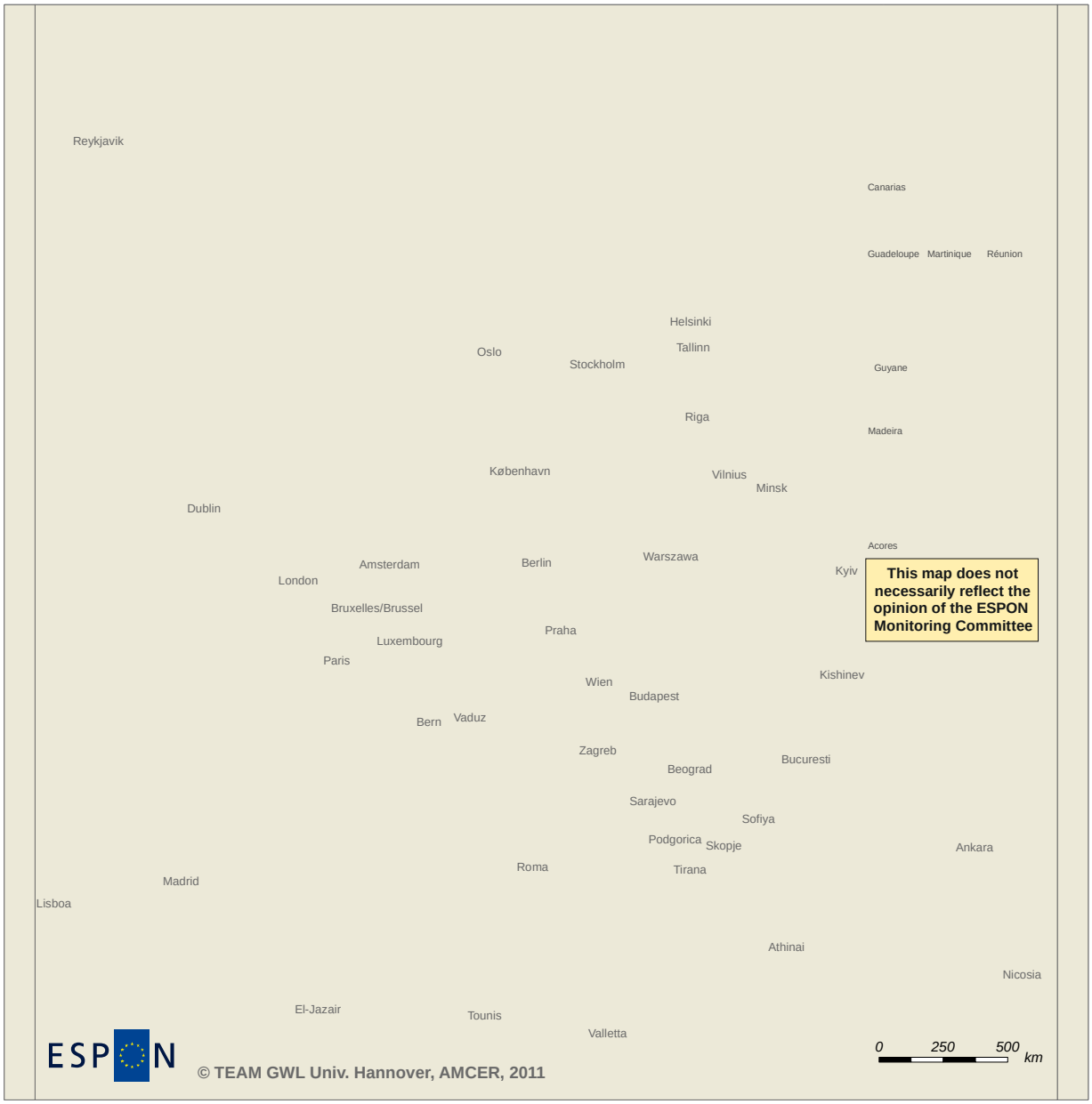
Ostrobothnia: RIS exhibits a network governance dimension with dirigiste features and an interactive business innovation dimension with globalised traits. RTDI measures are initiated on different levels and funding is mostly determined, guided and assessed centrally, with decentralized implementation units located in the region. The Ostrobothnian research competences are broad in nature, due to the extended region's private and public research landscape. R&D is highly shaped by the BES, however, especially the HES is of high importance for the Ostrobothnian RTDI activities. The R&D activities are dominated by large companies. Many of those are active internationally and supported by clustered supply chains of often dependent SMEs. Generally, the research and innovation system is quite strongly specialized in environmental friendly technologies and energy production. Moreover, most activities are concentrated in the capital Vaasa. Although SMEs are the main providers of employment in the region, their potential for innovation is often comparatively limited.

PACA: RIS shows a network governance system with dirigiste features and a globalised business innovation dimension. RTDI support takes place on different levels. The regulation of competences between PACA and the national level, as well as the role of the different actors, is ensured by the state-region contract. Although in this way PACA has a certain degree of autonomy, the state level is still very active in the region in research and innovation. PACA's research competences are quite broad in nature, but R&D activities are highly influenced by the BES. The BES, however, is highly dominated by large extra-regional and often foreign enterprises, supported by a network of SMEs operating as subcontractors or suppliers. The actors are specialized in medium-high and high-tech activities and highly spatially concentrated. Most SMEs have rather limited abilities to participate in research and innovation activities and the region generally lacks SMEs of intermediate size. Although research and innovation is largely internal and private rather than public, the public sphere as well as its infrastructure is of great importance for the overall attractiveness of the region. However, the region suffers from a persistent gap between R&D actors (public and private) and the wider business sphere. The regional authorities are aware of the weaknesses in terms of research and innovation activities of the local SMEs. Therefore, they have developed measures in order to address these problems and the resulting gap between research and the overall economic sector or production system.

Brittany: RIS exhibits a network governance dimension with dirigiste features and a localist business innovation dimension. RTDI support takes place on different levels. The regulation of competences between Brittany and the national level, as well as the role of the different actors is ensured by the state-region contract. Although in this way Brittany has a certain degree of autonomy, the state level is still very active in the region in research and innovation. Brittany's research competences are relatively broad in nature, however, the region's R&D system is highly dominated by a few large indigenous enterprises from only a few sectors, whereas foreign enterprises play hardly any role. Most SMEs have rather limited abilities to participate in research and innovation activities. The actors are specialized in medium-high and high-tech activities and are spatially concentrated in four major clusters. In general, the innovation culture of the BES within Brittany is not considerable and there is the still insufficient linkage between the HES and the BES, as well as the region-based innovative clusters ('poles of competitiveness'). Furthermore, the regional BES lacks international openness. Finally, the large-scale businesses conducting RTDI activities within Brittany do not have their headquarters located within the region.

Appendix (Appendixes of Figures and Tables)

Appendix Figure 1: Location of the AMCER Project Regions



(Source: own creation)

Appendix Table 1: RIS Types by Governance Dimension

RIS Type	Primary Source of Initiative	Primary Source of Funding	Predominant Competences	Degree of Coordination	Degree of Specialization
Grassroots	Locally organized (e.g. town or district level)	Diffused locally	Applied and near-market	Supra-local degree of coordination is likely to be low	Likely to be low and problem-solving likely to be generic than significant
Network	Multi-level	Guided by agreements among banks, government agencies and firms	Pure, applied, exploration, exploitation	Assumed to be quite high, due to existence on many actors	Rather flexible than dedicated
Dirigiste	Mainly from outside and above the region itself	Centrally determined, with decentralized units located in the region	Basic or fundamental, often to the needs of larger, stated-owned firms	Likely to be very high, because state-run	Likely to be high

(Source: own creation; based on COOKE 1998a and 2004)

Appendix Table 2: RIS Types by Business Innovation Dimension

RIS Type	Enterprise Domination	Research Reach	Associationalism
Localist	Tend to have few or no large indigenous firms and relatively few large branches of externally-controlled firms	- Business innovation culture is not very great, although there may be local research organizations capable of combining with industry clusters within the region - Will probably have few major public innovation or R&D resources, but may have smaller private ones	Reasonably high degree of association among entrepreneurs and between them and local or regional policymakers
Interactive	Balance between large and small firms	- Varies between numerous instances of access to regional research resources - Mix of public and private research institutes and laboratories is balanced, reflecting the presence of larger firms with regional headquarters and a regional government keen to promote the innovation base of the economy	Above-average
Globalized	Dominated by global corporatios, often supported by clustered supply chains of rather dependent SMEs	Largely internal and private rather than public, although a more public innovation structure aimed at helping SMEs may have developed	Normally greatly influenced by the needs of large-sized enterprises, and conducted to a significant extent to their terms

(Source: own creation; based on COOKE 1998a and 2004)

Appendix Table 3: Economic Performance of the nine AMCER-Regions

Region	GDP in Billions of EUR (2008)	GDP per capita (2008)	GDP per capita in % of the EU-27 average (2008)
Flanders (Belgium)	199.3	32,200	128.3
Ostrobothnia (Finland)	5.9	32,000	127.7
Tuscany (Italy)	106.1	28,700	114.3
Provence-Alpes-Côte d'Azur (France)	140.3	28,600	113.9
East of England (United Kingdom)	159.5	28,000	111.6
Catalonia (Spain)	202.8	27,900	111.2
Lower Saxony (Germany)	211.8	26,600	106.0
Bretagne (France)	83.7	26,500	105.6
Andalusia (Spain)	149.0	18,400	73.3

(Source: own creation; based on data from EUROSTAT 2011 and STATFIN 2011)

Appendix Table 4: Economic Structure of the nine AMCER-Regions

Region	Share of agriculture sector in employment in % (2008)	Share of industry sector in employment in % (2008)	Share of service sector in employment in % (2008)
Catalonia (Spain)	2.0	33.1	65.0
Ostrobothnia (Finland)	6.3	32.0	60.7
Tuscany (Italy)	3.0	31.2	65.8
Lower Saxony (Germany)	3.0	28.3	68.7
Flanders (Belgium)	1.9	26.7	71.3
Bretagne (France)	6.1	23.6	70.3
Andalusia (Spain)	7.5	23.2	69.3
East of England (United Kingdom)	1.8	21.5	76.5
Provence-Alpes-Côte d'Azur (France)	3.3	17.2	79.3

(Source: own creation and calculations; based on data from EUROSTAT 2011 and RCO 2011a)

Appendix Table 5: Unemployment in the nine AMCER-Regions

Region	Unemployment rate in % (2010)	Long-term unemployment share in % (2009)	Youth unemployment rate (15-24 year-olds) in % (2009)
Flanders (Belgium)	5.1	30.4	15.7
Ostrobothnia (Finland)	5.9*	28.0	15.9
Tuscany (Italy)	6.1	34.3	17.8
Lower Saxony (Germany)	6.5	46.7	10.3
East of England (United Kingdom)	6.6	22.3	16.5
Bretagne (France)	7.2	25.4	15.5
Provence-Alpes-Côte d'Azur (France)	10.2	36.1	24.8
Catalonia (Spain)	17.8	23.8	37.1
Andalusia (Spain)	28.0	24.9	45.0

* data available for 2009

(Source: own creation; based on data from EUROSTAT 2011 and STATFIN 2011)

Appendix Table 6: R&D-related Aspects in the nine AMCER-Regions

Region	R&D expenditures per capita in EUR (2007)	R&D expenditures per GDP in % (2007)	R&D personnel (FTE) per 1,000 employees (2007)	Share of R&D personnel (FTE) in the business sector in % (2007)	Share of business expenditures on R&D in GERD in % (2007)
East of England (United Kingdom)	1417.8	4.4	18.1	65.7	82.3
Ostrobothnia (Finland)	934.0*	2.55*	16.7**	>80.0**	90.0*
Lower Saxony (Germany)	644.6	2.5	11.5	61.9	69.0
Flanders (Belgium)	631.2	2.0	13.3	60.8	68.9
Provence-Alpes-Côte d'Azur (France)	536.8	1.9	14.1	50.1	58.0
Bretagne (France)	427.9	1.7	12.0	58.5	63.6
Catalonia (Spain)	410.5	1.5	12.3	52.9	62.8
Tuscany (Italy)	288.2	1.0	9.2	33.3	40.5
Andalusia (Spain)	186.7	1.0	6.9	26.0	37.1

* data only available for 2008. ** data only available for 2009

(Source: own creation and calculations; based on data from CISAD 2011; EUROSTAT 2011 and STATFI 2011)

Appendix Table 7: Human Capital Endowment in the nine AMCER-Regions

Region	Share of HRSTC in economically active population in % (2009)	Share of employment in high-tech industries and knowledge-intensive services in % (2009)	Secondary level students (ISCED 2-4) per 1,000 inhabitants (2010)	Tertiary level students (ISCED 5-6) per 1,000 inhabitants (2010)	Early leavers from education and training in % (2010)	Participation of adults aged 25-64 in education and training in % (2010)
Bretagne (France)	18.2	3.0	91.9	31.6	9.8**	5.6
East of England (United Kingdom)	16.3	5.7	92.9	30.0	16.2	19.6
Lower Saxony (Germany)	14.4	2.6	110.1	22.8	13.9	6.7
Andalusia (Spain)	14.5	2.4	75.6	35.4	34.9**	10.2
Catalonia (Spain)	16.6	3.7	60.8	34.4	29.8**	9.9
Flanders (Belgium)	21.7	4.4	116.0	33.6	9.6	8.2
Ostrobothnia (Finland)	20.8*	3.6*	67.6***	69.5***	10.3**	21.7*
Tuscany (Italy)	12.0	2.3	65.5	39.0	14.8**	7.2
Provence-Alpes-Côte d'Azur (France)	16.0	3.0	90.3	30.6	17.2**	4.4

* data available for Länsi-Suomi (superior NUTS-2 region), ** data available for the respective superior NUTS-1 region, *** data available for 2009

(Source: own creation and calculations; based on data from EUROSTAT 2011 and STATFI 2011)

Appendix Table 8: Patent Applications at the EPO in the nine AMCER-Regions

Region	Aggregated patent applications at the EPO, absolute figures (2004-2007)	Patent applications at the EPO per million inhabitants (2004-2007)	Productivity of R&D (EPO patent applications per million R&D expenditures) 2005	Aggregated high-tech patent applications at the EPO, absolute	High-tech patent applications at the EPO per million inhabitants (2004-2007)
Ostrobothnia (Finland)	1195*	897*	0.26*	506*	380*
Lower Saxony (Germany)	4957	620	0.32	708	89
Flanders (Belgium)	3492	576	0.27	903	149
East of England (United Kingdom)	2947	531	0.14	878	158
Bretagne (France)	1382	448	0.35**	784	255
Provence-Alpes-Côte d'Azur (France)	1739	362	0.22**	710	148
Tuscany (Italy)	999	277	0.26	69	19
Catalonia (Spain)	1816	265	0.21	174	25
Andalusia (Spain)	202	26	0.06	31	4

* data only available for Länsi-Suomi (superior NUTS-2 region), ** data available for 2004, Remark: patent figures are rounded

(Source: own creation and calculations; based on data from EUROSTAT 2011)

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