ESPON

Ulysses

Using applied research results from ESPON as a yardstick for cross-border spatial development

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Annex I – Methodology of the

Multi-thematic Territorial Analysis

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1. Methodology of the multi-thematic and multi-scale analysis

1.1. Summary

1.1.1. Objectives

The general aim of this analysis has been to do a multi-thematic and multi-scale analysis of the different Cross Border Regions.

For this, the regions' behaviour regarding two major dimensions was analysed: territorial profile and territorial performance. The territorial profile refers to indicators of the four major ESPON themes (polycentric development, urban-rural relationship, accessibility & connectivity and demography). The territorial performance refers to their capacity in achieving the Lisbon/EU 2020 and Gothenburg strategy goals. Besides the individual analyses of each topic, these two dimensions were also subjected to a more detailed analysis in order two identify causal relations between them.

1.1.2. Main outputs

- A territorial profile of each cross-border area, based on the different themes under analysis;
- An evaluation of the territorial performance based on Lisbon/EU 2020 and Gothenburg objective indicators;
- Analysis of the relations between the territorial performance and the territorial profile;
- Analysis of the most relevant drivers that influence the regions behaviour regarding the different themes;
- A methodological report that gives a hint on how to interpret the different outputs.

1.1.3. Main challenges

The main challenge for this analysis was the quality of the data:

- Information is being collected in many different ways across the countries meaning that, although the amount of data is available for each side of the border is often large, data that is comparable is very scarce;

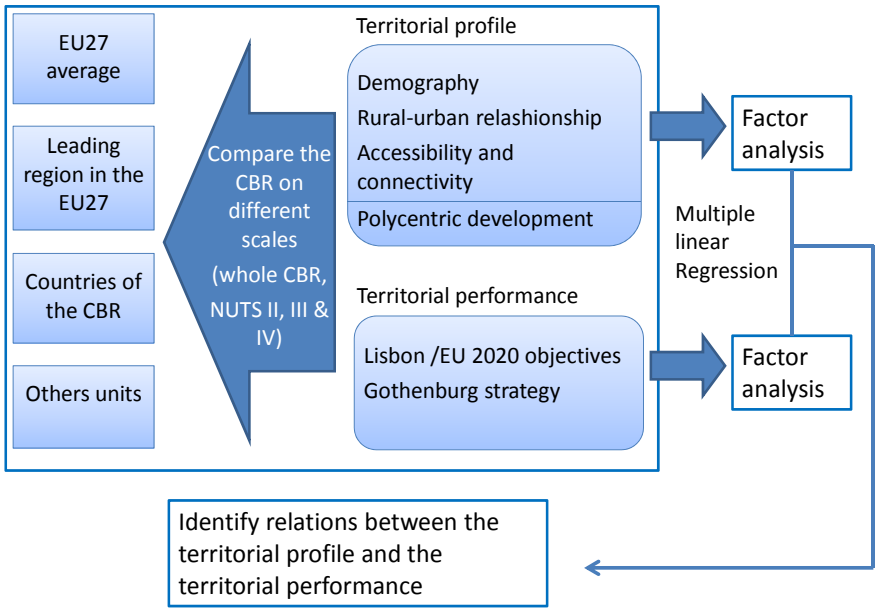
- The inclusion of regions in countries that are outside the European Union and therefore follow criteria that are far from the European norms (Russia and Switzerland);
- Many of the more complex indicators that were produces for specific ESPON projects have not been updated and are therefore only available for a no longer prevailing NUTS 3 delimitation (1999 or 2003 versions);
- Some ESPON indicators are based on complex methodologies and, as the metadata is not always explicit on the precise procedure, difficult to interpret;
- Often, the ESPON indicators are better suited for a EU wide analysis then for local or even regional scales.

1.1.4. Contingency methods

- Search for data in different sources (this was forcibly done to a limited extent, as it is very time-consuming);
- Use of different (but similar) indicators for different regions;
- Use of different geographical units;
- Estimate missing data by means of a function that correlates a missing variable with other variables in a large number of similar regions;
- Adapt the interpretation of the results (interpret results as an indication and not a scientifically sound analysis).

1.1.5. Procedure

The analysis followed the following steps:



The **territorial profile** groups indicators that relate the four major themes of the ESPON. It intends to describe the territorial situation of each cross-border area in the broader context in a clear and synthetic way. The **territorial performance** groups indicators that can be understood as expressing the regions' capacity to reach the Lisbon/EU 2020 and Gothenburg objectives.

1.1.6. Multi-scale analysis

For analysing both dimensions, the indicators of each of the cross-border area were compared on **different scales**: (1) between different NUTS III (and in some cases NUTS II or IV) of the cross-border area; (2) between the cross-border area and the countries to which they belong to; (3) between different NUTS III (and in some cases NUTS II or IV) of the cross-border area regions belonging to a different country; (4) between different NUTS III (and in some cases NUTS II or IV) of the cross-border area and a reference index that can be established by the EU27 average, the leading region in the EU27, the individual countries of which the CRB are part or any other reference that might be useful to understanding the regions' performance for a specific indicator (for example, regarding total fertility rates, it is useful to evaluate the regions according to the renewal of their population: total fertility rate of 2,1).

The comparison between different scales had two main purposes. The first one was to understand the regions' behaviour in context, as many indicators are not easy to interpret in absolute terms. The second one was to contribute in understanding the effect of the border on

the regions' behaviour. For example, a comparison of one side of the border of a cross-border area to the national average as well as the other side of the border might help to evaluate whether a region's performance is more influenced by its border position or by the realities of the countries it belongs to.

1.1.7. Factor analysis

The different themes were also be subjected to different statistical analysis in order to identify causal relations between the relative performances of each cross-border area and the territorial profile, as well as the main drivers behind the different performances.

For this, two different factor analyses were made: one for the territorial profile and one for the performance indicators. These factor analyses were made using data on a NUTS 3 scale for all the EU 27 countries. The polycentricity indicators were excluded, because they are not suited for the NUTS 3 level at which the analysis was performed. Also, and since the intention was to establish a causal relation between general aspects that characterize the regions and their performance, some of the indicators that are typically related to the Lisbon/Europe or the Gothenburg Strategy where included in the first set of indicators. This was the case, for example, for the ESPON climate indicators. These indicators relate the regions' sensitivity to potential climate change (e.g. the amount of flood prone areas) with elements of their spatial layout (e.g. population density, presence/absence of susceptible economic infrastructures). In this sense these indicators do not really reflect a regions capacity in reaching the Gothenburg goals, but are more related to their general exposure which is, to a high extent, a consequence of their geographical position or historic evolution.

1.1.8. Regression analysis

After the factor analysis, several multiple regressions were made, having as independent variables each factor of the performance indicators and as dependent variables all the factors of the territorial profile. Essentially, this analysis distinguished the influence of the regions' characteristics on its capacity to develop itself in a sustainable and cohesive way.

1.2. Demographic Analysis

The main objective of this analysis is to identify the cross-border area's behaviour regarding demography. Namely, to try to answer the questions: how is the border affecting settlement patterns? are the border regions growing faster or slower than non-border regions? is their population ageing more or less rapidly?

1.2.1. Data

The indicators that were used for this analysis were the following:

Indicator	Geographical scale	Source	Time frame
Population density	NUTS 3, Lau 1/2	EUROSTAT, National Statistical Institutes	2000-2009
Net migration, natural growth, total growth	NUTS 3	EUROSTAT, ESPON DB/Demipher Project	2000-2009
Demographic potential	Lau 1/2	Own calculation	2008
Commuters to other countries by active population	NUTS 2	EUROSTAT	2009
Commuters to other regions by active population	NUTS 2	EUROSTAT	2009
Total fertility rate	NUTS 2	EUROSTAT	1997-2009
Young age dependency rate	NUTS 3	EUROSTAT	2009
Old age dependency rate	NUTS 3	EUROSTAT	2009
Ageing index	NUTS 3	EUROSTAT	2009
Foreigners requesting residents permit	Lau 1/2	National Statistical Institutes	2008

Given the regularity at which demographic indicators are updated (even if through estimations) and that the ESPON demographic indicators are essentially built on EUROSTAT data, the data for demography comes majorly from this source. Data from the Demipher (ESPON) project was also use in order to fulfil occasional data gaps.

1.2.2. Methods

Most of the demographic analysis is based on standard indicators. These indicators essentially refer to the evolution of the population, the cause of this evolution (natural growth, migration rates), the age structure and, when available, commuting data.

Besides the straightforward indicators, two additional analyses were performed for the CBA for which local data and shapefiles were readily available: the impact of the border distance on population growth and the demographic potential. Both of these indicators relate

population with distance. Although the distance should ideally be the actual travel time by road, here a simplified version was used based on air distance.

1.2.3. Demographic potential

The capacity of a region to develop itself does not only depend on its intrinsic characteristics but is also a function of its accessibility to other regions (Dentinho 2007). It is therefore important to understand how a region is positioned in the whole network of other regions, namely how far it is from other major poles or densely populate areas. For this analysis, the demographic potential was calculated, whenever population on a LAU 1 and adequate shapefiles where made available.

The demographic potential of a given point i relative to j can be obtained through the following formula:

$$V_j = \sum_j \frac{P_j}{d_{ij}}$$

V_j = potential in j, P_j = population in j and d_{ij} = distance between j e i

The regions' own potential is included by dividing its population by one fourth of its perimeter (calculated through the area of the region and not its actual perimeter). In this case the population and distances between all the Lau 1 of the cross-border area, as well as the NUTS 3 in the rest of the countries were considered.

1.2.4. Border effect on population growth

There is a common tendency to relate border regions with geographical, demographical and economic remoteness. At a first glance this seems certainly true for some of the cross-border area (e.g. Extremadura-Alentejo cross-border area). But what exactly is the border effect on the actual evolution in the settlement patterns? To answer this question a simply relation between demographic growth and border distance is not enough, as population growth it is very dependent on population density.

This means that, in order to actually be able to evaluate whether the population growth is related to the border effect, a function that considers population density as well as the distance to the border was applied. This function can be described by the following formula:

$$Growth\ Rate = A + a_{db}db + a_d d + \varepsilon$$

Where db is the distance to the border of the region's centroid and d is the density of a given region.

1.3. Policentricity

The main objectives of this chapter are to identify tendencies in the structure of the city network in the CRB: is the urban network more or less dense than in non-border regions? do the amount and size of the urban centres deviate from the rank-size distribution of the ESPON space? if so, in what sense (more polycentric, less polycentric)?

Naturally, the distinction between monocentric or polycentric areas cannot be made area in a dichotomous manner, and polycentricity should be measured by scoring an area with a value ranging from more monocentric to more polycentric.

According to the ESPON 1.1.1, polycentricity has a twofold feature:

- Morphological, laying out the distribution of urban areas in a given territory;
- Relational, based on the networks of flows and cooperation between urban areas at different scales/levels.

While there is some data available regarding morphology, the dynamic aspects of the city systems are very poorly covered. Although some attempts to differentiate FUA according to their functional specialization have been made, the analysis of how the different urban agglomerations articulate themselves and interact with their surroundings cannot be soundly made on a broad scale. Most of the ESPON data therefore focuses on the morphological aspects.

1.3.1. Data

Indicator	Geographical scale	Source	Time frame
Morphological and Functional Urban Areas	cross-border area	ESPON DB	2006
Slope rank size distribution GDP	cross-border area, ES, PT ESPON	Own production, based on ESPON DB	2006
Primacy rate GDP	cross-border area, ES, PT ESPON	Own production, based on ESPON DB	2006
Slope rank size distribution population	cross-border area, ES, PT ESPON	Own production, based on ESPON DB	2006
Primacy rate population	cross-border area, ES, PT ESPON	Own production, based on ESPON DB	2006

% population in FUA	cross-border area, ES, PT ESPON	ESPON DB	2006
% effective FUA pop change	cross-border area, ES, PT ESPON	ESPON DB	01-06
Compactness (MUApop/FUA pop)	cross-border area, ES, PT ESPON	ESPON DB	2001
Gini coefficient thiessen polygons (%)	cross-border area	Own production, based on ESPON DB	2006

The data used here was developed by the ESPON 1.4.3 and is based on the concept of Functional Urban Area (FUA) from the ESPON 1.1.1. The ESPON 1.4.3's intention was to review the ESPON 1.1.1 and to develop a methodology for defining FUA that was independent from national classifications. Their classification is done by identifying a Morphological Urban Area (MUA), which is essentially a cities' core, to which a commuter catchment area is added. The commuter catchment area is made up by adding further LAU 2 if they form a high density continuum. The final definition of whether to consider an agglomeration a FUA also takes into account its total size (please see the final report of the project for a more detailed description). This method has straighten out some inconsistencies in the former FUA definition, by eliminating many small FUA considered by the ESPON 1.1.1 not through a size criterion but by the importance that national experts gave to the FUA in question.

Further characterization of the FUA has also been done considering the data available for the NUTS of which the FUA are part or which they cover entirely.

While this approach guarantees data comparability throughout the ESPON the countries, it has the inconvenience that it only considers urban centres on a broad scale. Small urban centres are simply not taken into account, which makes it difficult to evaluate the urban systems on a national or regional level. The ESPON 1.4.3 also maintains some FUA that have a very small overall population in some countries but not in others, leading to confusion about what exactly the criterion is.

1.3.2. Geographical scale

FUA in the ESPON 1.4.3 are defined by aggregating LAU 2 in a way that they can cover several broader administrative boundaries. Thus, their inclusion in one region or another poses some difficulties when the intention is to evaluate urban systems in confined regions. In this analysis, the FUA were considered to be part of the cross-border area (defined by NUTS2) if more than 60 % of their area is overlapping with that the cross-border area or if most of their Morphological Urban Area (MUA) is within the limits of the cross-border area. The analysis of the urban systems is made on the whole cross-border area, as the concept of

policentricity as understood by the ESPON 1.4.3 is not meaningful on very low geographical scales.

1.3.3. Methods

Besides general aspects, such as the FUA's compactness, growth or numbers, some more specific analysis of the city system were developed. The first one is the **rank-size distribution of the FUA** (1). The second one was is the Gini coefficient of the **FUA's thiessen polygons** (2). And the third one is the analysis of **socio-economic characteristics** (3) of the FUA.

For the **rank-size distribution (1)**, three different procedures were performed. The first one is analyses the slope of the rank size distribution, which measures the overall level of hierarchy. For this indicator, the FUA of the regions are ranked according to their population and then the following equation is estimated:

$$\ln(pop\ or\ GDP) = a + b\ln(rank)$$

The latter is the so-called rank-size equation in the Lotka form. If the estimated relation holds, the size distribution of cities follows a statistical log-linear distribution. The slope of equation, given by the estimated β, indicates the level of hierarchy, and thus the level of polycentricity within a region: the lower the absolute value of estimated β, the higher the level of polycentricity.

The second procedure is comparing the regions' actual and expected FUA. For this exercise, rank-size coefficients are estimated considering the FUA of the whole ESPON countries (EU27 + CH + NO). The actual rank-size distribution of the relevant NUTS 2 is thereafter compared with what would be expected if the regions would follow the European distribution.

Taking the Zipf law:

$n^k P_n = A$

$\ln P_n = \ln A + k \ln n$, where A is the population of the biggest city

it is possible to adjust a regression curve to the population living in FUA in the EU-27 regions plus Switzerland and Norway:

$\ln Pn = A + k \ln n + \varepsilon$

The calculation for all the FUA produced the following parameters for the curve:

k = -1,0521, which is very close to -1, the value corresponding to the regularity known as Zipf's law.

This equation will be the pattern to which the actual FUA distribution of a given region will be compared. To perform this comparison for a given region i, first the total population of its FUA has to be estimated (PF_i). For this we assume that the weight of the region's FUA population in relation to its total population is equal to the ESPON countries average:

$$PF_i = P_i \frac{PF(UE)}{P(UE)}$$

Second, the PF_i is distributed by n FUA according to the EU pattern:

$PFn = k\ n^{1,0514}$

Where Fn is the FUA of ranking n and k is the population of the biggest FUA.Since k is unknown, it is calculated as the exact value which fits the equation $\sum PF_n = PF_i$.

It is thereafter possible to estimate the amount and size of FUA a cross-border area should have if it would follow the overall distribution to the actual amount and size of its FUA.

The third procedure was analysing the primacy rates. Primacy rates measure the degree to which the size of the largest city of the cross-border region deviates from the regression line of the rank-size distribution of the regions. If this indicator is above 1, the main city's population is above the value that would be expected according the rank-size distribution of the FUA of the region. If the primacy rate is below 1, the main FUA is smaller than the expected value. This means that, while regions in which one big city dominates the city system tend to have high primacy rates, the opposite holds true for more polycentric regions.

The largest city is excluded in this exercise in order to avoid that its effect on the equation could influence the results. If, for example, we would have a very large prime city in a small region/country, its weight could lead to a very high coefficient in the rank-size equation and therefore the primacy rate would be small (even though there is a clear dominance of one city over the region/country).

The **Gini coefficient of the thiessen polygons (2)** is a is a measure of how the FUA are spaced throughout the region: number closer to 100% mean greater inequalities in the FUA distribution while lower percentages means the FUA are more evenly spaced. For this indicator, the polygons where produced based on the ESPON 1.4.3 FUA layer (made available by the ESPON DB 2013) so that the limits of the polygons are established exactly midways between two FUA. On a national level, the Gini coefficients were produced considering the border as a limit.

The **socio-economic situation (3)** is based on the ESPON 1.4.3 indicators and includes: unemployment rates, GDP per inhabitant and value added by NACE 1.1. These indicators were obtained by crossing the NUTS 3 values which that of the FUA that do partly or totally cover them. They are therefore broad approximations that should be read with some care.

1.4. Urban-rural relationship

The original objectives of this chapter were to identify relations between urban centres and their rural hinterlands: how are different population densities related to land use patterns? is the urban-rural typology capable of explaining different evolutions in land consumption? how are these categories linked to the economic structures?

1.4.1. Data

Although the urban-rural relationship has been subjected to some study, namely in the ESPON program, there still is no data available on the EUROSTAT or the ESPON to actually evaluate the interaction between rural and urban areas (meaning the flow of people and goods as well as computer mediated communications).

The focus in this chapter was therefore on structural indicators, such as land use patterns and economic sectors. But, even if it is possible to get land cover data on a very low geographical scale from the Corine Land Cover, indicators such as employment and economical patterns are only available at a NUTS 3. The typologies established by the ESPON and by the Eurostat, are also only available at a broad scale, limiting the ability to link the indicators with rural or urban classifications any significant dimension. The focus in this chapter was therefore on the urban-rural typologies on a NUTS 3 level, highlighting some of the differences between the regions concerning the structural indicators.

The used indicators were the following.

Variable name	Geographical scale	Source	Time frame
Change urban fabric	NUTS 3	Own production, based on the CLC	2000-2006
Agricultural areas	NUTS 3	ESPON DB	1990; 2000; 2006
Urban-rural typology	NUTS 3	ESPON DB/ Eurostat	
Urbanization of natural areas	NUTS 3	Own production, based on the CLC	2000-2006
Gross value added in forestry and fishing	NUTS 3	Eurostat	1997-2008
Employment in forestry and fishing	NUTS 3	Eurostat	1997-2008

1.4.2. Typologies

The ESPON 1.1.2 typology regarding urban and rural regions is based on tree indicators: land cover, population density and the presence/absence of a FUA. According to different combinations of these indicators, NUTS 3 have been classified as having high or low human influence (population densities) and urban intervention (land cover). Although it has been included for illustrative purposes, this typology has not been use to cross with other data. The reason for this is twofold: 1) the indicator has not been updated for NUTS 3 changes; 2) the inclusion of indicators on land cover to establish the typology would lead to confusing when trying to cross these indicators with the typology.

The urban rural typology that was mainly used was a revision by the EUROSTAT of the OECD typology. This typology is established in tree steps:

1. The first on is to clusters urban grid cells with a minimum population density of 300 inhabitants per km2 and a minimum population of 5 000. All others are considered rural.
2. The second one is to group NUTS 3 regions with less than 500 km2 with some of its neighbours solely for classification purposes, i.e. all the NUTS 3 regions in a grouping are classified in the same way.
3. The third one is to classify the NUTS 3 regions based on the share of population in rural grid cells. All that have more than 50 % of the total population in rural grid cells are considered predominantly rural. All between 20 % and 50 % in rural grid cells are considered to be intermediate. And all with less than 20 % in rural cells are considered to be predominantly urban (Eurostat 2010: 249).

Further, some regions that are predominantly rural are considered intermediate in the presence of a city with more than 200 000 inhabitants and intermediate regions with cities of over 500 000 inhabitants are considered as urban.

1.5. Accessibility and connectivity

The main goal of this chapter is to evaluate the accessibility and connectivity levels of the cross-border area. The more specific questions to be answered are how are general accessibility levels of the cross-border area regarding different modes of transportation? what is their communication infrastructure like?

1.5.1. Data

Most of the data for accessibility available at the ESPON database is very outdated and available mostly for the 1999 NUTS version. The use of NUTS 1999 delimitations is specially limiting since changes in the coding systems and the actual boundaries of the regions have occurred in almost all of the countries in Europe. Nonetheless, the potential accessibility by different modes of transportation has been updated in 2006 and re-calculated for fitting the then ruling NUTS 3 delimitation retroactively for 2001 and is therefore available for two comparable years. This is particularly useful as this indicator does not limit itself to measuring the transport network, but synthesizes the overall accessibility of the regions by relating the travel time (impendence function) with the population that can be reached (activity function).

As for connectivity, there is normally a great lack of information. Even straightforward indicators, such as internet connections by household, are often difficult to come by, as the Internet Service Providers are reluctant to share this type of strategic information. Another issue is that the data is often not disaggregated at the regional level, only allowing international comparisons. Therefore, only two indicators on connectivity were included in this report: a composite indicator on the internet infrastructure was collected from the ESPON database and the percentage of households with broadband internet connection from the 5th Cohesion Report.

Variable name	Geographical scale	Source	Time frame
Potential accessibility road, rail, air indexed to ESPON average	NUTS 3	ESPON DB	2001;2006
Potential accessibility road, rail, air indexed to cross-border area average	NUTS 3	ESPON DB	2001;2006
Potential accessibility road, rail, air index change 2001-2006	NUTS 3	ESPON DB	2001;2006
Households with broadband connection	NUTS 2	European Comission 5th Cohesion	2009
Composite indicator on the Internet infrastructure	NUTS 2	ESPON DB	2008

1.5.2. Methods

Accessibility is forcefully a relative concept: a region's accessibility is not and inherent trait, but a consequence of its relative position in the broader territory. As Walter Hansen puts it, "accessibility is a measurement of the spatial distribution of activities about a point, adjusted for the ability and the desire of people or firms to overcome spatial separation" (Hansen,1959:73).

In the ESPON 1.2.1 Final Report, the potential accessibility is an indicator that relates the activities to be reached with the travel time it takes to reach them. Its function is as follows:

$$A_i = \sum_j W_j^\alpha \exp(-\beta c_{ij})$$

where A i is the accessibility of area i, Wj is the activity W to be reached in area j, and c ij is the generalised cost of reaching area j from area i. Ai is the total of the activities reachable at j weighted by the ease of getting from i to j. The interpretation is that the greater the number of attractive destinations in areas j is and the more accessible areas j are from area i, the greater is the accessibility of area i." (ESPON 2006: 276)

For each NUTS 3 of the ESPON space the potential accessibility was obtained by relating the travel time between the centroids through different modes of transportation with the population (road, train and air). Regarding the travel time by air, the exact methodology wasn't available at the metadata of the ESPN DB or the ESPON project's final report, but other modes of transportation are forcefully included.

The multimodal accessibility has also been calculates as an overall indicator that synthesizes all the different modes. According to the ESPON project, multimodal accessibility is "a logsum accessibility potential aggregating over road, rail and air" Ibid: 131. This essentially means that the individual accessibilities are aggregated in a way that balanced regions will have greater multimodal accessibilities than regions with very high results in some modes and very low results in others.

As the potential accessibility was produced for two different years, it is possible to see the evolution of the infrastructure in this period. Here, the index change of accessibility was used. For this indicator, "the accessibility values of 2001 are standardised to the ESPON average of that year and those of 2006 to the average of that year, each ESPON average is set to 100 and the regional values are transformed accordingly. The map then shows the differences of the index values, i.e. the change of the position of the regions relative to other regions. Positive values express an improvement of the relative locational quality, while negative values express a loss in relative locational quality" (Spiekermann & Wegener 2007: 9).

1.6. Gothenburg and Lisbon/Europe 2020 strategy

The main objective of this chapter is to measure the regions' performance regarding the Gothenburg and Lisbon/Europe 2020 Strategy goals.

The common framework set for the future development of the European Union is essentially based on three pillars: an economic one, a social one and an environmental one (added to the original goals of the Lisbon Strategy by the Gothenburg Council in 2001). In the centre of these three pillar is the often cited goal of making the European Union "the most competitive and dynamic knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion" (Lisbon European Council

conclusions, March 2000). The pursuit of this goal is envisaged through a broad set of reform which range from the labour market to the Green House Gas emissions.

1.6.1. Data

In order to monitor how the different countries are adapting themselves to the goals of this strategy, a battery of indicators has been agreed to by the member states for each of these main pillars. This battery of indicators has been used as a reference in this chapter, although changes were made for two reasons. The first one was that not all the indicators that have been selected at the national level are available at the regional one (e.g. energy intensity of the economy, greenhouse gas emissions). The second, was that some other indicators are available that are helpful in shedding a light on the regions' capacity for developing itself in a sustainable way.

For analytical purposes, these indicators were divided into four different categories: economy and employment, innovation and research, social cohesion and environment.

Variable name	Geographical scale	Source	Time frame
Economy and employment			
GDP per capita Catching up analysis Indexed to leader Coefficient of deviation	NUTS 3	EUROSTAT, Russian Statistical Institute	1997-2009
Gross value added by NACE	NUTS 3	Eurostat	1997-2008
Employment by NACE	NUTS 3	Eurostat	2000-2008
Innovation and research			
GERD, HERD, BERD	NUTS 2	Eurostat	2007
Employment in medium and hich tech manufacturing	NUTS 2	ESPON DB (Regional Innovation Scoreboard)	2004
EPO Patents by per million of inhabitants	NUTS 2	Eurostat	2007
Social cohesion			
Long term unemployment	NUTS 2	Eurostat	2009
Unemployment rate	NUTS 3	Eurostat	2010
Youth unemployment rate	NUTS 3	Eurostat	2010
Population at risk of poverty after social transfer	NUTS 3	Eurostat	2008
Environment			
Share of Natura 2000 areas	NUTS 3	European Commission's 5th Cohesion Report	2009
Solar energy resources	NUTS 3	EC 5th Cohesion Report	1981-1990
Wind energy potential	NUTS 3	EC 5th Cohesion Report	2000-2005
Ozone concentration exceedances	NUTS 3	EC 5th Cohesion Report	2008
Urban waste water treatment	NUTS 2	EC 5th Cohesion Report	2007
Soil sealed area	NUTS 3	EC 5th Cohesion Report	2006

Regional sensitivity to climate change (cultural, economic, environmental, cultural)	NUTS 3	ESPON DB	1961-1990; 2071-2100

1.6.2. Methods

Besides the direct interpretation of the indicators, some calculations were performed to give further insights regarding economic performance and inequalities. The environmental data of the ESPON Climate project also needs some methodological clarification, as it is obtained in a rather complex way.

Economic performance and inequalities

The analysis of the regions' wealth was made from a threefold perspective: to evaluate the regional inequalities in wealth distribution; to point out the regions' actual position in the European context; to understand their relative performance over the last decade. The data used for this analysis was the GDP per for the years 1997 and 2008.

The **regional disparities** were evaluated by the coefficient of deviation of the GDP per capita. This indicator is obtained by calculating the ratio of the standard deviation to the mean, and therefore a good way to compare the distribution of geographical units which differ greatly on their average. As a reference the coefficient of deviation was included for the countries of which the cross-border area is part as well as for the whole NUTS 3 and NUTS 0 of the ESPON space (EU7+CH+NO for the N0 and only EU7 for NUTS 3).

$$Coefficient\ of\ deviation = \frac{Standard\ deviation}{Average}$$

The **regions' position and performance** was evaluated by two procedures:

A1- To compare each NUTS III with the leader, in terms of GDP per capita, trough index numbers;

A2- to establish the relative performance of each NUTS III to the leading region, exploring the notion of territorial catching-up.

In theory, for both analyses, A1 and A2, the value of reference for GDP per capita would be the highest value among all NUTS III, pertaining to the Inner London West region. However, at this territorial level, GDP per capita can be affected by several factors, such as high population fluctuations and significant mismatches between jobs (and wealth production) and the place of residence. In fact, in economically central places (for which London is a good example), there normally is a steady flow of migrant workers, as well as commuters from other NUTS III, and so the GDP per capita of the economic centre is seriously overestimated. For that reason, instead of simply considering the GDP per capita of the Inner London West NUTS III, the whole Greater London NUTS II was used as a reference for this analysis. The

results are presented bellow and the mathematical operations can be analyzed in the annexed Excel file.

A1 – GDP indexed to the leading region

This analysis involves the indexation of GDP per capita in each NUTS III to the value of the leading region in 2008 referred to above, which is by definition 100,0. The concerned computation is represented in the following expression:

$$Index\ GDP_\alpha = \left(\frac{GDP_\alpha}{GDP_L}\right) \times 100$$

where GDP_α is the GDP per capita of a given NUTS III and GDP_L is the GDP per capita of the London NUT II.

A2 - Catching up analysis

This analysis intends to evaluate the speed of catching-up with the leading region, through a standard logistic process. In the present exercise the catching-up process analysis sets the relative position of each NUTS III and its relative trajectory up to the level of 95% of the GDP of the leading region in 50 years. The difference of performance of each region in comparison to the leading region is, in the present analysis, measured in years needed to reach the level assumed above.

According to these assumptions, the logistic function which describes the problem is represented as follows:

$$X = 0{,}95\,\bar{X} = \frac{\bar{X}}{1 + ke^{-at}} \qquad (1)$$

As in the former case, all regions with a performance 95% or higher when compared to the leader region where considered leading regions. The analysis distinguishes converging from diverging regions, and the different levels of catching-up performance. Leading regions are the ones who already have a GDP close to that of the London NUTS 2. Fast converging regions have a growth rate which allows them to reach the leader in no more than 20 years, steady catching-up regions between 21 and 50 years, slow catching-up regions between 51 and 100 and slow converging between 101 a 250 years. Non converging region have great distances in terms of GDP and are growing at a rate equal or slightly superior to the leader and diverging regions are growing less than the leader.

Environment

For the environmental analysis, two sets of indicators are available. On one hand, the indicators from the European Commission's 5th Cohesion Report. And on the other hand,

indicators from the ESPON Climate Project regarding the region's sensitivity for climate change.

While the environmental data from the 5th Cohesion Report is easily understood the data of the ESPON Climate project is obtained through a fairly complex methodology. The indicators that were used here are the regions sensitivity to climate change.

The sensitivity is defined by the project as being the "degree to which a system is affected, either adversely or beneficially, by climate related stimuli" (pp.4). The climate change data was obtained from the CCLM climate model, which compare the future period 2071-2100 to the reference period 1961-1990 for the scenario A1B.

The combination of the different impacts the climate change has on a regional level, comes from relating these impacts on characteristics of the affected areas. For physical sensitivity, the amount of buildings and infrastructures that as susceptible to extreme weather events (such as to river floods and coastal storm surges) were considered. Social sensitivity relates the positive or negative effects on human populations. The economic sensitivity considers the impact on economic activities that are strongly dependent on climate conditions (especially tourism and energy). Environmental sensitivity focuses on entities that are highly sensitive to climate changes, such as sensitive soils or protected areas. And cultural sensitivity considers the impact on assets like museums and internationally recognised historic sites.

1.7. Factor analysis

The different themes were also be subjected to different statistical analysis in order to identify causal relations between the relative performances of each cross-border area and the territorial profile, as well as the main drivers behind the different performances. For this, two different factor analyses were made: one for the territorial profile and one for the performance indicators.

Data was used on a NUTS 3 scale for all the EU 27 countries. Some of the overseas areas of Portugal, France and Spain where excluded since data was missing for many of the variables. The year of reference for most data was 2008, since this is a year for which data is available for most countries. This means that the data does not reflect the impact of the financial crisis, which is especially meaningful for volatile indicators such as migration rates or unemployment rates or the per cent of the Gross Value Added by different economic sectors.

In case of missing values, several procedures where adopted:

1) Search for data in different sources - this method was forcibly used to a very limited extend, as it is very time-consuming;
2) Use of a different time reference;
3) Use of different geographical units - this is especially relevant for the performance indicators where data is often only available for NUTS 2, leading to clustered results;

4) Estimation through SPSS' EM procedure[1].

Two sets of indicators were established: one for territorial profile variables and one for performance variables.

The first set considered variables linked to overall characteristics of the different regions on the themes that where considered in the **territorial profile** (accessibility, rural-urban relationship and demography). Polycentricity was excluded at this point, because it is a concept that makes no sense on a NUTS 3 level at which the analysis was performed. On the other hand, indicators that are normally associated with the Lisbon/Europe 2020 and Gothenburg objectives at the input level (such as R&D investment, active population with tertiary education and so forth) were also included, since the differentiation was made between dependent and independent variables and not merely based on thematic categories.

This was the case, for example, for the ESPON climate indicators. These indicators relate the regions' sensitivity to potential climate change (e.g. the amount of flood prone areas) with elements of their spatial layout (e.g. population density, presence/absence of susceptible economic infrastructures). In this sense these indicators do not really reflect a regions capacity in reaching the Gothenburg goals, but are more related to their general exposure which is, to a high extent, a consequence of their geographical position or historic evolution.

Unlike most studies on innovation, the EPO patent applications have also been included at this level. This is because, although they can be understood as an output of innovation, innovation in itself is an input of economic performance.

Indicator	UNITS	Year	Geographical unit
Population density	inhabitant/km2	2009	NUTS 3
Crude rate of pop increase	per 1000	2008	NUTS 3
Crude rate net migration	per 1000	2008	NUTS 3
Crude rate of natural increase	per 1000	2008	NUTS 3
Young age dependency	%	2008	NUTS 3
Old age dependency	%	2008	NUTS 3
Total fertility rate		2008	NUTS 2
Commuters to other region	per 1000	2009	NUTS 2
Rural typology	nominal	2008	NUTS 3

[1] "For the EM procedure, a distribution is assumed for the partially missing data, and inferences are based on the likelihood under that distribution. Each iteration consists of an E step and an M step. The E step finds the conditional expectation of the "missing" data, given the observed values and current estimates of the parameters. These expectations are then substituted for the "missing" data. In the M step, maximum likelihood estimates of the parameters are computed as though the missing data had been filled in. "Missing" is enclosed in quotation marks because the missing values are not being directly filled, but, rather, functions of them are used in the log-likelihood." MaryAnn Hill / SPSS Inc (1997), "SPSS Missing Value Analysis™ 7.5", pp. 41

Percent_agric_area	%	2006	NUTS 3
Annual growth rate 90-06 agricultural areas	per 10000	1900-2006	NUTS 3
Net formation of urban fabric by total area 00-06	per 10000	1900-2006	NUTS 3
Potential accessibility by air index	%	2006	NUTS 3
Potential accessibility by rail index	%	2006	NUTS 3
Potential accessibility by road index	%	2006	NUTS 3
Change of the standardized rail index	%	2001-2006	NUTS 3
Change of the standardized road index	%	2001-2006	NUTS 3
Change of the standardized air index	%	2001-2006	NUTS 3
Share of employment in agriculture and fishing (A_B)	%	2008	NUTS 3
Share of employment in industry (except construction) (C-E)	%	2008	NUTS 3
% employment in construction (F)	%	2008	NUTS 3
% employment in wholesale and retail trade; hotels and restaurants; transport (G-I)	%	2008	NUTS 3
% employment financial intermediation; real estate (J_K)	%	2008	NUTS 3
% employment in public administration and community services; activities of households (L-P)	%	2008	NUTS 3
Agriculture; fishing (A_B)	%	2008	NUTS 3
Industry (except construction) (C-E)	%	2008	NUTS 3
Construction (F)	%	2008	NUTS 3
Wholesale and retail trade; hotels and restaurants; transport (G-I)	%	2008	NUTS 3
Financial intermediation; real estate (J_K)	%	2008	NUTS 3
Public administration and community services; activities of households (L-P)	%	2008	NUTS 2
Total intramural R&D expenditure by GDP	%	2007	NUTS 2
Intramural R&D expenditure of business enterprise sector by GDP	%	2007	NUTS 2
intramural R&D expenditure government sector by GDP	%	2007	NUTS 2
intramural R&D expenditure higher education sector by GDP	%	2007	NUTS 2
EPO patents per million of inhabitants by GDP	%	2007	NUTS 2
Employed persons in high and medium tech manufacturing activities by total workforce (EU 25 = 100)	%	2004	NUTS 2
Population aged 25-64 with tertiary education	%	2010	NUTS 2
Physical sensitivity to climate change	rate	n/a	NUTS 3
Social sensitivity to climate change	rate	n/a	NUTS 3
Environmental sensitivity to climate change	rate	n/a	NUTS 3
Cultural sensitivity to climate change	rate	n/a	NUTS 3
Economic sensitivity to climate change	rate	n/a	NUTS 3

A total of 11 factors were identified for the territorial profile analysis. The extraction method was a Principal Component Analysis. Rotation Method was Varimax with Kaiser Normalization. Rotation converged in 12 iterations

The second set considered variables linked to the performance of the regions concerning indicators related to the Lisbon/Europe 2020 and Gothenburg indicators at the output level (**Performance**).

Indicator	UNITS	Year	Geographical unit
Unemployment rate	%	2008	NUTS 3
Long-term unemployment rate (>=12 months)	%	2009	NUTS 2
Youth unemployment rate, per labour force aged 15-24	%	2008	NUTS 3
Infant mortality rate	%	2008	NUTS 2
GDP per capita indexed EU average	%	2008	NUTS 3
Catching-up	nominal	1997-2008	NUTS 3
Natura 2000 area	%	2006	NUTS 3
Ozone concentration exceedance, per year	%	2008	NUTS 3
Waste water treatment capacity	%	2007	NUTS 2
Soil sealed area	%	2006	NUTS 3

A total of 4 factors (components) were identified for the performance analysis. The extraction method was a Principal Component Analysis. Rotation Method was Varimax with Kaiser Normalization. Rotation converged in 4 iterations

1.8. Regression analysis

Several multiple regressions were made, having as independent variables each factor of the performance indicators and as dependent variables all the factors of the territorial profile. Essentially, this analysis distinguished the influence of the regions' characteristics on its capacity to develop itself in a sustainable and cohesive way. But this does not mean that the territorial profile and the territorial performance are not relevant *per se*: the relations between different indicators are not necessarily marked by unique and clear-cut causal relations and relevant indicators of the territorial profile may have no significance to the territorial performance.

2. Methodology of the cross-border governance analysis

The institutional analysis differentiates two dimensions: On the one hand, the **structural dimension** means the overall framework that can hardly be influenced by the partners of inter-regional cross-border cooperation. The **activity dimension** addresses the intensity and continuity of institutionalised cross-border cooperation on the regional level.

2.1. Structural dimension

2.1.1. Political Status of the border

The political status of the border is an important context for regional cross-border development that cannot fundamentally be influenced (see table below for an overview). Firstly, the territorial governance in cross-border regions is strongly influenced by the political status of the border: The historicity and the degree of liberalization play an important role. The indicator "EU membership/historicity" allows categorising the borders into four groups: EU12/15, EU 25/others and external borders. Switzerland is considered as a category of its own as it is a non-member-state, but takes part in the Schengen agreement and is a particular active player in cross-border issues for decades now. These groups are assigned to a ordinal scale; this scale is weighted (factor 2). This categorisation is mainly based on the ESPON projects Typologies (pp. 26ff) and Geospecs (see Interim Report map 13).

Secondly, the status of the Schengen regulations within a border area is an additional framework to the overall political status. In this context, not the complete juridical matter is taken into account but only the travel zone in which border controls of *persons* are phased out. This is in particular an interesting aspect with regard to Switzerland, not being an EU member state, but participating in the Schengen system; it is also of particular relevance for the cases of Karelia and Bulgaria.

2.1.2. Planning system

Secondly, the political and planning system of each country can be very different to the neighbouring countries. Depending on the differences between the planning systems, the border effects are more or less stronger with regard to territorial development. The indicator

for this border effect is if the countries on either side of the borders are considered to be part of the same "planning family" in the existing studies on planning systems. Depending from the perspective, some countries are always considered to be part of the same family, others only in some studies or even in none of them. The studies considered here comprise the ESPON 2006 project on Governance, Newman 1996, CEC 1997 and Nadin & Stead 2008.

These assessments are 'translated' into a numerical scale that, again, makes up four categories of more or less strong border effects. As this factor seems to be the most crucial one for territorial development, factor 3 in weighting stresses its influence.

2.1.3. Physical status

Moreover, the physical status of the border is taken into account: It is true that physical features do not *determine* political processes; but the fact that – just for example – Poland and Sweden do not share a common land border should not be ignored. This is why three categories differentiate fundamental geomorphological features (sea border, alpine border, and other borders as rivers, low mountains and green borders).

These three domains are combined in a synthesis score that allows saying if the borders function as *separation, interface* or even as a *link*.

The categorisation is mainly based on the ESPON study from 2006 "ESPON Interact cross-border cooperation" (p. 18 of the final report).

2.1.4. Languages

Language barriers do not only hinder everyday life and *socio-economic* integration in border areas, but it is also for *political* processes not easy to overcome these barriers. In some regions no linguistic border exists at all, in others the barrier is very high. In this analysis, the language barrier is assessed following the categorisation of language families (see e.g. Beekes 1995; for a simplified mapping see also the English Wikipedia site for the notion 'Indo-European languages').

Dimension	Indicators	Quantification	Main Sources	Weighting
Political status of the border	EU membership / historicity	Ordinal scale 4 = EU 12/15	ESPON Typologies	2

		3 = CH 2 = EU 25/27 1 = external borders (NB: highest score country counts)	(pp. 26 ff.) ESPON Geospecs (Interim Report map 13)	
	Schengen status	2 = participating in free travel zone 1 = not participating in free travel zone		1
Physical status of the border	Geomorphology	Ordinal scale 3 = other borders 2 = mountainous (dominant of the high mountains classification) 1 = sea border	EPON Interact cross-border cooperation (18 final report)	1
Institutional status: Planning culture	Being mentioned as member of the same planning culture families in different studies	Numerical scale 0 = strong differentials 0,1-1,0 1,1-2,0 2,1-3,5 = weak differentials	ESPON 2006/2.3.2; Newman 1996; CEC 1997; Nadin/ Stead 2008	3
Language barrier	To what extent is language barriers existing in the area	Ordinal Scale 3 = Same language 2 = Similar language (semi-communication possible) 1 = Very different language	Literature, e.g. Beekes 1995	1

Methodology to assess the territorial character of the border (structural dimension)

2.2. Activity dimension

The scheme for the activity dimension takes into account six domains (see table below). The first four domains address cross-border *cooperation in general*. The next two indicators go beyond cross-border cooperation in general and, instead, address more in detail the policy of *spatial development.* The last two indicators address then the *transport* policy (see table below).

2.2.1. Historicity of cross-border cooperation in general

The importance of the historicity of cross-border cooperation lies in the assumption that a joint experience facilitates to handle current challenges as the mutual trust and knowledge serves as a good basis.

It is true that cross-border cooperation has not begun only in the last years or decades, but that today's situation can only be explained by taking into account the longer history going back to medieval times. This study, however, limits the focus to the post war cooperation, as the technical and institutional setting with regard to multilateral and European regulations can be seen as the relevant era.

Thus, the earliest post-war funding date of an interregional cross-border institution is seen as evidence for the historicity of cross-border cooperation.

2.2.2. Maturity of cross-border cooperation

Without any doubt, cross-border cooperation has fundamentally been influenced by European politics. In particular the INTERREG (A) programmes and the pre-accession funding have played a major role. The INTERREG programme is based on both a top-down and a bottom-up approach: So even if the overall programme framework is to a large extent defined on the European and multi-national level, the involvement of (border) regions is still a clear sign for commitment and a functioning cooperation. Considering the technical and political challenges to overcome in order to ensure successful Interreg participation, the underlying capacity building is considerable.

The indicator used here is the participation in the Interreg III programme, as elaborated by the ESPON Geospecs project (Interim Report).

2.2.3. Institutional thickness in cross-border cooperation

'Institutional thickness' is a notion from political and economic geography and describes the presence of many institutions that are involved in a certain thematic and that are located near to one another. Institutional thickness is not only the *outcome* a high and dynamic activity. It is, at the same time, seen as a *precondition* for regional innovation capacity and dynamic development.

The relevant institutions are considered for the overall analysis on the European and regional level, and they are also mapped in a cartographic sense. Showing the respective perimeters does not only illustrate the current situation in an instructive way, but it is also an important basis for the later link to socio-economic analyses.

With regard to cross-border policy, only the cross-border cooperation on the (inter-) regional level is taken into account. This approach leaves out two other kinds of cooperation forms: On the one hand, bi- or multi-*national* cooperation (e.g. the Council of the Baltic Sea States). This form of cooperation is left out is it does not necessarily say a lot about the interregional cooperation, though it might influence the regional development intensively. On the other hand, all programme structures – like in particular ERDF eligibility areas – are not taken into account either. Though these perimeters (like PAMINA in the Upper Rhine or POCTEFA in the Pyrenees) are of high importance, they are linked to a very limited period of time and can change fundamentally. Moreover, the pure existence of eligibility perimeters does not prove automatically intensive cross-border cooperation.

Thus, the *number* of non-temporary cross-border institutions on the regional level is taken as the quantitative indicator for the institutional analysis.

2.2.4. Current activity (EGTC)

With the indicator for "current activity" this analysis takes into account that cross-border cooperation depends to a large extent on personal engagements and particular constellations in the border areas which can change due to political dynamic etc.

As the indicator for current activity, the number of EGTCs (European Groupings of Territorial Cooperation) is taken. EGTCs have been developed as a governance tool by the European Commission in 2006 (European regulation 1082/2006): After implementation of the respective framework on the national levels (art. 16/17), a series of border-regions have implemented this tool for a large variety of contexts. The EGTCs are high on the European agenda and their adaptation in the different regions demands a considerable effort with regard to juridical clarification and political coordination.

It is true that also before the EGTC regulation a series of Governance tools on the European as on the multi-lateral level has supported cross-border cooperation in many ways (e.g. the Council of Europe's *European Outline Convention on Transfrontier Co-operation* from 1980/95, the *Convention of Karlsruhe* from 1996 between Germany, Luxembourg, Switzerland and France).

The particular features of an EGTC is that it

- is applicable in the same way in all European member states
- is open to all public bodies (local and regional authorities as well as member states)
- can have a strong mandate if assigned by the respective superior levels
- has a legal personality (i.e. can employ their own staff, can lead a European programme, launch public procurement procedures or conclude conventions with

private actors).

As the EGTC tool can only be applied to EU member states, this indicator seems problematic with regard to the Karelia region where it cannot be implemented for juridical reasons. This is why any alternative major institutional project would be taken into account alternatively.

The number of EGTCs that are enacted or under preparation is taken as the quantified indicator.

2.2.5. Cross-border spatial development on regional level

As the Ulysses project is focussing on territorial development, the *spatial planning* policy is of most relevance here. In particular in border regions, territorial development can hardly be driven by economic processes alone, but has to be framed and supported by planning support. Within the structural dimension, we have already taken into account the differences of the national planning *systems*. In this context, the focus lies on the concrete *activities* on the (inter-)regional level. Here, the study takes into account two indicators:

Firstly, the existence joint *tools* for spatial analyses and monitoring – e.g. cross-border GIS projects – is captured. Given the large difficulties with data availability and harmonisation, there is no complete and perfect cross-border GIS, yet. However, some projects have already brought together an interesting basis. These projects are not only a potential tool for later planning procedures, but they also bring together the relevant people on the technical and political level.

The existence of tools is captured by a binary quantification (yes/no).

Secondly, the existence of a joint territorial development strategy is taken into account. All cross-border institutions do have some kind of general agreement and in parallel, a series of programming documents for European funding has been elaborated. Some regions, however, go a step beyond the general will for ‘balanced’ and ‘sustainable’ development and have more concrete visions for the spatial allocation of future developments.

Here, both the existence and the age of the documents are taken into account.

2.2.6. Cross-border transport projects

Border studies have shown for many cases that the bottlenecks in transport infrastructure are the most pressing problems. This is true for regions with specific geographical characteristics, but also for regions with high economic development and for border crossing the former ‘iron curtain’. In this study, we take into account two indicators:

Firstly, the number of TEN corridors is a good indicator for the dynamic of the cross-border transport policy. Concretely, the top-30-priorities of the TEN-T policy are taken into account.

It is true that TEN corridors are negotiated on the European level mostly between representatives of the member states and also with the Commission. At the same time, TEN priorities are a certain evidence of the capacity to set a certain region on the European agenda. In general, this goes along with a certain support of representatives from the respective regions, so it is a speaking indicator in this context.

Still, the involvement in the TEN networks does not give the whole picture, as TEN connections can also just link metropolises that are outside the cross-border region. This is why, secondly, major transport projects (namely train infrastructure) is taken into account on the regional level if it has an explicit cross-border dimension. Also for reasons of practicability, local and regional transport projects are not considered if they do not cross the border. In some cases, the cross-border effect still might be considerable, but this study does not give the scope to go into depths of many individual projects.

Dimension	**Indicators**	**Quantification**	**Main Sources**
Maturity of cross-border cooperation	Interreg III participation	4 = Long-standing cooperation with a very high or high level of maturity 3 = Long-standing or experienced co-operation with a medium-high level of maturity 2= Experienced or more recent co-operation with a medium-low level of maturity 1= More recent co-operation with a low level of maturity	ESPON Geospecs Interim report
Historicity of cross-border cooperation in general	Earliest founding date of cross-border cooperation	4 = 1960-1990 3 = 1991-2000 2 = 2001- today 1 = none	div.
Institutional thickness in cross-border cooperation	Number of permanent institutionalisations (Euregions, city networks, Eurodistricts etc.)	4 = > 3 institutionalisations 3 = 2 institutionalisations 2 = 1 institutionalisation 1 = none	div.
Current activity	EGTC	3 = existing EGTC(s) 2 = EGTC(s) in preparation 1 = no EGTC activity	Committee of the Regions; national and regional sources
Cross-border spatial development on regional level	Joint tools	2 = yes 1 = no	Diverse regional sources
	Joint spatial development document	3 = yes, younger than 2005 2 = yes, from 2000-2005 1 = no, or older than 2000	div. regional sources
Cross-border	TEN-T corridors	Number	EU DG Transport, TEN-

transport projects	crossing a border in the perimeter of the regions		T Executive Agency
	important cross-border projects on the regional scale in preparation or established (esp. rail)	Number	div. regional sources

Indicator for the dimension "activity" in cross-border cooperation

2.3. Quantifying the qualitative data and representing the results

As the explanations above have already indicated, the indicators taken into account are combined for a synthesis analysis and for visualisation and mapping.

With regard to the structural dimension, the different aspects have been weighted in order to keep the focus on institutional issues for territorial development. The physical barriers and the linguistic challenges play an important role for every-day cooperation, but they do not determinate institutional choices and settings.

In order to allow a visual and comparable analyses, for each dimension a categorisation has been made either using existing categories from previous studies or making up new ones. The categories are all given a numeric values according to the level of integration in cross-border cooperation.

For each multi-thematic territorial analysis a numeric value is given for all the dimensions.

The synthesis of the axes is made by summing all the scores for each multi-thematic territorial analysis.

On basic of the synthesis scores a thematic map has been produced which integrates the two axes. The activity axis represented on the area/territory of the cross-border area (polygon) and the structural axis represented on the national borders (lines) within the cross-border area.

It is worth noting that this methodology can only give a general idea of the territorial governance of the respective regions. Cooperation and its success does not exclusively depend on formal institutions but also on informal, often personal connections. These cannot be assessed in the framework of this ESPON priority 2 project. Similarly, a serious of potentially relevant indicators could not have been considered for various reasons; still, the

overall framework does lead to a relevant analysis: The main objective of this analysis has been to bring together the ESPON information and building the basis for the overall analysis when being linked to the socio-economic in a next step.

3. Methodology of the integrated analysis and scenarios

3.1. The integrated analysis

The integrated analysis conducted within Ulysses has aimed at overlapping the territorial profile and performance dimensions on top of the governance aspects of the analysis. This has been mainly done relaying on a traditional **SWOT analysis** (**S**trengths, **W**eaknesses, **O**pportunities and **T**hreats). This has been the framework to analyze the territory's current status based on two axes, present/future factor, and positive/negative influence, to decide what action should be taken.

Strengths and weaknesses (combination of present factor and positive/negative influence) show the current status and were drawn upon the research done in the set of themes addressed in previous chapters. Opportunities and threats (combination of future factor and positive/negative influence) identified in the aforementioned research work were contrasted with the ESPON 3.2. Spatial scenarios and orientations in relation to the ESDP and Cohesion Policy scenarios (namely Baseline/trend scenario, Danubian Europe or the cohesion-oriented scenario and Rhine-Rhone Europe or the competitiveness-oriented scenario) and their implications for the CBA under analysis.

All this work lead to the Final Opportunities and Threats, which set the basis for the identification of the most relevant challenges of the Working Community or the Pyrenees. The results of this SWOT analysis were circulated among relevant stakeholders in the Working Community of the Pyrenees and validated in the workshop celebrated on 14th of February 2012 in Zaragoza.

3.1.1 Overview

It goes without saying that any territory (e.g. cross-border area) can be shaped under several decisions taken in various aspects. This calls for a deep knowledge of the actual situation and main challenges that the territory is actually facing in the present and will foreseeably face in the future. This has been one of the main objectives of Ulysses project itself throughout its entire life-cycle. More concretely, this heading has been at the core of the multi-thematic territorial analyses performed.

However, being these analyses detailed enough as to contribute to produce precise knowledge on the (sometimes very specific) territorial trends active within each geographical

setting, it has been perceived the need of some generalised insights on the implications that the analyses have in two respects:

- On the one hand, to present to the attention of practitioners and policy makers not only detailed and specific information on thematic specificities but also more general, summarised and prioritised challenges has been understood as an essential contribution of Ulysses by the CU, the stakeholders and the TPG.
- On the other hand, it is widely recognised that one of the priorities within the science/practice interface ought to be the achievement of integrated diagnoses that should not only constitute a separated inventory of every single element involved in the territorial issues active within any geographical context but also an integrated characterisation of such elements in a way that they can be presented to practitioners and policy makers as complex and multidimensional challenges.

As it has been said before, the proposed methodology for this twofold objective has been the creation of a SWOT analysis fed with (i) the actual results derived from the multi-thematic territorial analysis, and (ii) some clues derived from the analysis of previous ESPON scenarios.

For all these reasons, in Ulysses the SWOT is understood as a tool to analyse the territory's current status and eventually transfer the diagnosis into concrete strategies. In this regard, its main advantage derives from its ability to fulfil the two objectives listed above, thus to produce a synthetic and integrated diagnosis as a basis for the identification of applicable strategies.

3.1.2 Application

The traditional SWOT analysis is composed by two phases, a status-analysis phase and an action-decision phase. The former is sometimes called "SWOT analysis" while the latter is called "TOWS analysis" or "Cross-SWOT analysis."

The status-analysis phase provides a basis for decision making, which is actually dealt with by the second phase of the analysis. In fact, to provide a basis for decision making is the ultimate objective of the status-analysis phase.

SWOT analysis (I) Status-Analysis Phase

The status-analysis phase grasps the current cross-border area territorial status. Here, factors related to the territory have been clarified and classified into 4 categories based on two criteria:

- present factors versus future ones, and;

- factors with positive impact to the achievement of goals versus ones with negative impact.

The classification of such factors has been done using a 2x2 matrix represented below:

	positive	**negative**
present-internal	strength	weakness
future-external	opportunity	threat

Categories are named as follows, being the word "SWOT" is derived from the initial letters of them:

- Present - Positive: **S**trength
- Present - Negative: **W**eakness
- Future - Positive: **O**pportunity
- Future - Negative: **T**hreat

Present/internal territorial dimensions and factors include the territorial profiles that have been performed by the project, namely the territorial profile, the territorial performance and the governance context.

Future factors include economic trend, population/demography projections, and expected policy and economic circumstances, i.e. all the elements derived from the trends analysed by Ulysses according to the driving forces indentified by the multi-thematic territorial analysis.

SWOT analysis (II) Action-Decision Phase

This phase, which is mainly focused on the identification of potential actions addressing the challenges identified on previous phase and is often neglected by many SWOT analysis, falls at the core of Ulysses project.

Just like the status-analysis phase, a 2x2 matrix was used: the vertical axis represented opportunities and threats and the horizontal axis reflected strengths and weaknesses:

	strength	**weakness**
opportunity	SO-Strategy	WO-Strategy
threat	ST-Strategy	WT-Strategy

Following, strategies were proposed for each one of the 4 possible combinations:

- **Strength/Opportunity**: Strategies to maximize strength under the opportunity. Example: Additional investment for the expansion of strategic sectors when the cross-border area has enough technological capabilities (Strength) and market's needs are expected (Opportunity).
- **Strength/Threat**: Strategies to avoid threats by taking advantage of strength. Example: Specialization on mitigation environmental technologies when the cross-border area has high technological eco-innovation capabilities (Strength) but is located in a vulnerable area in terms of climate change (Threat)
- **Weakness/Opportunity**: Strategies to take advantage of the opportunity by complementing the weakness. Example: Technical cooperation when the cross-border area lacks technological capabilities (Weakness) while internal markets are expected to grow (Opportunity)
- **Weakness/Threat**: Strategy to face present problems in the face of foreseeable downturns. Example: Investment on alternative economic sectors when the cross-border area lacks technological and innovation capabilities (Weakness) and new competitors are expected (Threat)

3.2. The scenario overlay

ESPON project 3.2 - Spatial Scenarios and Orientations in relation to the ESDP and Cohesion Policy of 2006 has produced a number of integrated scenarios with European coverage for the year 2030. Three of these scenarios have been taken into account within the Status-Analysis Phase described above. Such scenarios are:

- Integrated baseline (trend) scenario
- Danubian Europe: Integrated cohesion-oriented scenario
- Rhine-Rhone Europe: competitiveness-oriented scenario

All three scenarios have been downscaled to every cross-border area through quantitative analysis according to the exhaustive descriptions included in the final and scientific reports of the abovementioned projects as a means to complete the future dimensions (threats and weaknesses) of the SWOT analysis.

According to this principle, the opportunities and threats derived from the territorial profiles were modified in the light of those opportunities and threats derived from ESPON scenarios. This lead to the completion of a final (synthetic) list of opportunities and threats delivered to

the Action-Decision Phase of the SWOT analysis. The criterion for doing so was based on the following principles:

- Case 1: whenever a fully coherent picture was captured from the territorial analysis and the actual trends identified for the area through one specific ESPON scenario, the final opportunities and threats were described reinforcing those shared views.
- Case 2: in those other cases where the observed trends were not found to be fully compatible with any of the three ESPON scenarios mentioned above, the focus was put on the key issues identified in Ulysses own territorial analysis, adding to this basic description some of the elements derived ESPON scenarios that seemed more compatible with the trends identified by our analysis.

The following table is illustrative of the systematic process followed in Ulysses with regard to scenario overlay:

			Preliminary diagnosis		**Baseline scenario**		**Competitiveness scenario**		**Cohesion scenario**		**Final diagnosis**	
	S	**W**	**O**	**T**	**O**	**T**	**O**	**T**	**O**	**T**	**O**	**T**
Demographic change												
Polycentric development												
Urban/rural relationship												
Accessibility and connectivity												
Lisbon Strategy												
Gothenburg strategy												
Cross-border governance												

All previous work lead to the Final Opportunities and Threats, as well as associated strategies, which set the basis for the identification of the most relevant challenges of the Working Community or the Pyrenees.

3.3. Strategy validation

Once all the abovementioned steps derived in the identification of a number of challenges and possible strategies, these potential measures were proposed for validation to the stakeholders from all cross-border areas. Concretely, the results of the SWOT analysis were circulated among relevant stakeholders and validated in a series of workshops celebrated in February 2012.

Depending of the specific number of attendants, the methodologies implemented at those workshops varied, but in all cases included two sessions devoted to the status-analysis and action-decision phases of the SWOT analysis, respectively. During those sessions, the following points were addressed:

- Presentation of the status-analysis and action-decision phases of the SWOT analysis
- Validation of the status-analysis/ action-decision phases by the stakeholders
- Introduction of agreed modifications to the SWOT

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