ADES
Airports as Drivers of Economic Success in Peripheral Regions

Targeted Analysis 2013/2/17

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List of abbreviation

ADES: Airports as drivers of economic success in peripheral regions
EU: European Union
GDP: Gross Domestin Product
DFR: Draft Final Report
SciR: Scientific Report

A   Executive summary

Are airports drivers of economic success in peripheral regions, as the title of this project suggests? Of course, the answer is neither a clear "yes" nor a blunt "no". As often in a complex world, the answer is closer to "it depends".

The main results indicate
- that accessibility in general is an important location factor;
- that for some remote regions, airports with enough scheduled flights are crucial for economic development;
- that in these cases the bottleneck usually is not lacking infrastructure but lacking scheduled flights to relevant destinations;
- that the limiting factor (or bottleneck) for economic prosperity is often not accessibility but rather the availability of qualified manpower;
- that it is better to use a larger airport in a neighbouring region than to develop an airport of its own (if accessible within some three hours);
- that not all existing airports are needed – some of them can be closed and the territory used for something more efficient;
- that the airports still needed and used can very often be improved (to make them more attractive);
- that good policy can make a difference.

This ESPON project "Airports as drivers of economic success in peripheral regions" (ADES) started in November 2011 and ended in January 2013. It was elaborated by the Department of Sciences for Architecture – University of Genoa - Italy (Lead partner), BAK Basel Economics AG - Switzerland, KiNNO Consulting LTD – Greece, and Jyväskylä University School of Business and Economics – Finland.

The project is specifically targeted to the situation and needs of three stakeholder regions: Province of Savona – Italy, Region of Western Greece – Greece and the City of Jyväskylä – Finland.

1 Introduction

It is relevant for regional policy makers to know about the role of regional airports and to what extent they can help making peripheral European regions grow. In this study we investigate the role of regional airports for regional economic development in European peripheral regions. As this issue is truly multidimensional in many ways, we apply a mix of several methods and eventually bring the results together into a coherent view.

Accessibility is generally accepted as a major factor of economic attractiveness of cities and regions. "Keep Europe Moving", the mid-term review of the 2001 White Paper on EU transport policy stressed that transport was a key factor in modern economies as it not only connects places and people but also facilitates economic growth. The Territorial Agenda of the EU (2007) claims that "Mobility and accessibility are key prerequisites for economic development of all regions of the EU".

Context_Europe
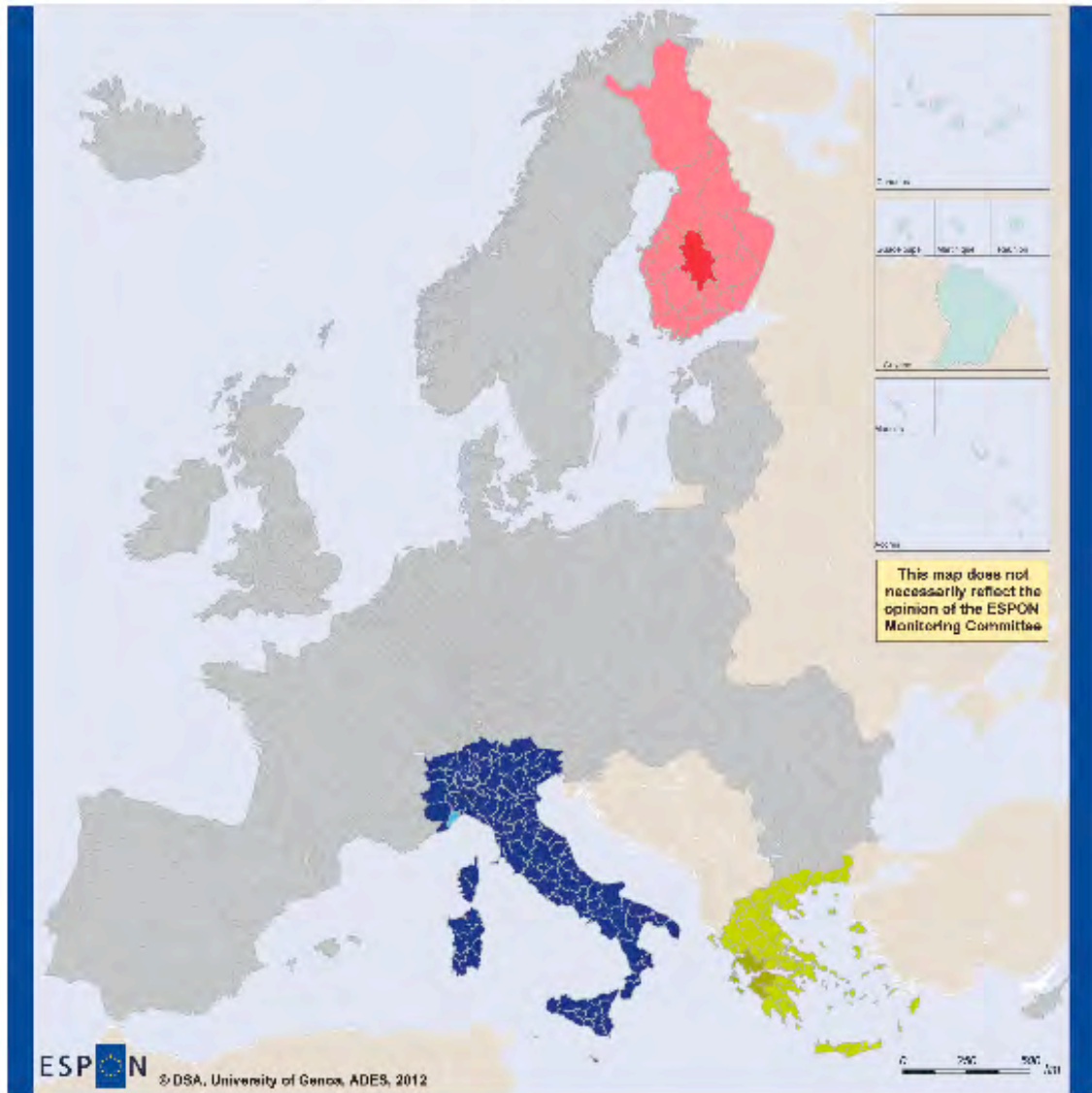
Legend

- ▮ Finland
- ▮ Central Finland
- ▮ Greece
- ▮ Western Greece
- ▮ Italy
- ▮ Provincia di Savona

Map 1: Context_Europe_Stakeholder regions

While capital and other big cities usually have excellent national and international accessibility by highways, trains and airports, the situation for smaller cities is often much more difficult. This difference in accessibility tends to increase unequal growth and the imbalance of wealth between the big metropolitan areas and more peripheral areas. To narrow this gap

(measured e.g. by GDP per capita) it seems to be essential to increase the accessibility of the more remote and less developed areas.

With growing globalisation, accessibility has changed dramatically. While for many centuries it used to be relevant to have a road to the next bigger city or a neighbouring region, it is today relevant to be connected to the whole world. Thus the role of airports has become increasingly important. To have a regional airport is an asset which may be the decisive factor for attracting companies to the region or retaining talents in the region.

However, accessibility does not only depend on air transport und airports. Highways and – in the age of high speed trains increasingly – rail links are for many regions realistic alternatives to airports (especially when they are not too far away from a big hub). Thus it is relevant to now about the role of regional airports and to what extent they can help making peripheral regions grow.

All through the history of mankind people have had the desire to be mobile, as space always played a certain role. Over time, technical abilities have made it considerably easier to move in space. Though, it is still costly both in terms of money and time to move from one point in space to another. Therefore it is relevant where in space a specific person, company or city is. It is more attractive to be close to the European economic gravity centre (which should be rather close to Cologne) than at the edge of the European continent. For the average European it is more costly to reach a Finnish or Greek province than Frankfurt or Milan. This is also the reason why accessibility is generally accepted as a major factor of economic attractiveness of cities and regions.

Of course, the mobility needs of people have changed according to the technical means, but they still stand at the cradle of each analysis on accessibility and traffic infrastructure. A simple model may illustrate the relation between the major variables (see figure 1):
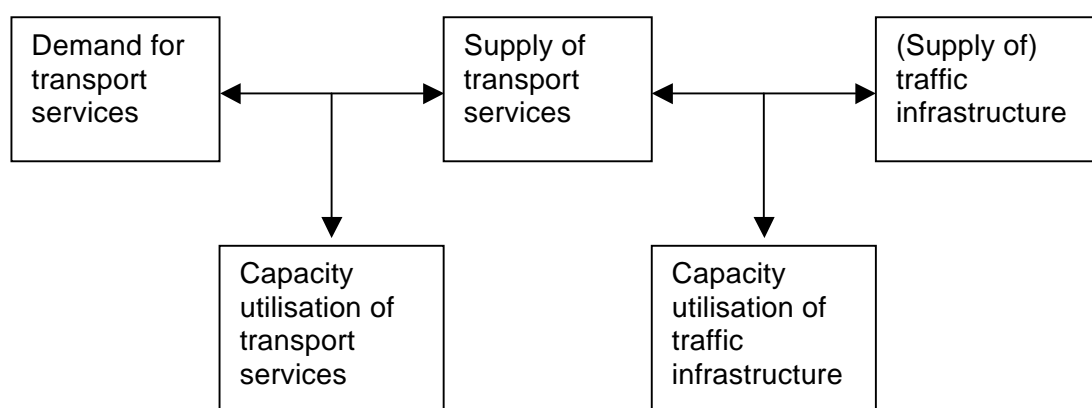
Figure 1: The markets for transport services and traffic infrastructure

The mobility needs of people (including companies, be it for themselves or for goods) are the basis for the demand for transport services. Transport

companies (e.g. air carriers) supply transport services. However, they only can provide such services as long as the (supply of) traffic infrastructure is sufficient. The supply of transport services generates at the same time the demand for traffic infrastructure. Thus there are two capacity utilisations: one on the market for transport services (e.g. the percentage of seats occupied in a passenger train) and one on the market for traffic infrastructure (e.g. percentage of free slots in totals slots on an airport).

Demand for transport services is mainly private, demand for infrastructure, however, is primarily political. In most countries highways, rail tracks and airports are either publicly owned or at least strongly subsidised. Thus there are options for regional policy to be more or less active in this field. Politicians should just bear in mind that the law of diminishing returns also applies to infrastructure. Too little may be insufficient as for accessibility, too much will be inefficient. To build a large airport in a remote desert where hardly any plane wants to fly to is just wasting money. Thus there should be an optimal amount of infrastructure, depending on the individual circumstances of each region.

The situation is even complicated by the fact that traffic infrastructure is not a homogeneous good. Thus it is not only about the optimal quantity but also about the optimal mix of airports, highways and rail tracks.

2 Objectives

The EU cohesion goal calls particularly for an improvement of the framework conditions of peripheral or remote regions. Better accessibility is one of the means to move towards this goal.

Economies of scale and agglomeration effects in favour of big conurbations (or even mega cities) are generally accepted. However, it is widely accepted that there are also diseconomies from rising costs to industry, due to increasing cost of land and labour, traffic congestion, crime etc which make smaller cities and city nets more valuable than very large cities. Measured in pure terms of GDP per capita, the effect of a polycentric territorial development is likely to be underestimated. Even when looking at growth, GDP per capita growth figures will tend to be biased in favour of larger cities as they ignore negative external effects which will prevail in large conurbations. Measures of level or changes in wellbeing would – were they widely available – clearly be in favour of smaller cities and peripheral regions, as such measures take all negative externalities into account. As a consequence, growth policy in the sense of maximising human wellbeing in Europe should focus primarily on peripheral or remote cities and regions. This will also help establishing a more balanced territorial development. Airports and accessibility may be a powerful means to reach this goal. To this end the project answers the following key research questions:

- How important is accessibility for economic prosperity?
- What is the relation between accessibility and economic performance?
- How relevant are airports in such a context?
- What type of regions do need an airport (or airports)?

- What are the limiting factors for economic success?
- What is an optimal strategy for existing airports?
- What are the strategies to transform airport infrastructures into re-activators of territories?

3 Methods used

Given the many-sidedness and complexity of the research questions, we did not use a single approach, but rather a combination of several methods. A parallel or multiple approach should best be able to answer the research questions, also given the fact that ESPON explicitly asked for case studies, which, in turn, are not able to answer the more general research questions.

In this targeted project we adopted a series of different **methods** to cope with the research questions and broad goal of the study:	
- Empirical methods:	- Panel causality tests
	- Structural regression analysis
	- Frontier analysis (DEA)
	- Benchmarking
- Case study analysis:	- Questionnaires
	- Interviews
	- Key economic indicators
- Maps:	- Descriptive maps
	- Concept maps
	- Vision maps

To better understand the relation between accessibility and economic performance, we distinguish two main transmission channels:
- Supply side effects: Good general framework conditions (including accessibility) improve the attractiveness of a region and thus attract both people and companies. Production and the supply of goods will grow. Therefore, accessibility will enhance economic performance.
- Demand side effects: When a region grows – be it more people or higher wages – the demand for traveling will usually grow. Thus, it will be interesting for suppliers of travel services to enlarge their supply. If there are bottlenecks in the infrastructure, such additional demand may lead to an improvement of the respective infrastructure. Therefore, economic performance improves accessibility.

In order to better understand ADES case study regions and to propose more appropriate strategies for future development, we analyzed them through the following characteristics (see *SciR_Chapter 3*):
- geographical localization
- landscape
- infrastructure and accessibility
- economic trends
- cultural and leisure services
- tourism

These information were supported and improved by the opinion of local actors gathered by questionnaire and interviews in local language (see

SciR_Chapter 3 and *Annex 2*). This part is supported by examples of other existing projects that transformed abandoned or obsolete airports into new urban centralities (see *SciR_Chapter 1.3c*).

METHODOLOGY

EMPIRICAL METHODS

PANEL CAUSALITY TEST
What is the direction of influence?

- Accessibility causes regional growth in some regions, but not in all.
- Regional growth causes air traffic in all regions uniformly.
- Supporting air traffic in remote regions may contribute to positive regional development.

STRUCTURAL REGRESSION ANALYSIS
Which factors are relevant and how strongly?

- Accessibility matters; there is a positive impact on economic performance.
- Regional economic activity is very relevant for airport performance.
- Regional economic activity is very relevant

FRONTIER ANALYSIS
Which are the limiting factors?

- Identify the star performers to locate best practices and identify the underperformers.
- Identify the limiting factors in terms of linking the transport system with the economic development.
- Identify possible trends and common issues that the regions examined.

STAKEHOLDERS AIRPORTS

- Strengths
- Weaknesses/Limitations
- Opportunities
- Threats

- characteristics
- geographical location
- competitiveness
- alliances
- future projections

CASE STUDIES ANALYSIS

QUADRO CONOSCITIVO

Geographical location
Infrastructure and accessibility
Economic Trends
Services
Tourism
Landscape

ISTITUTIONAL GUIDE LINE

Territorial Provincial Coordination
General Development Plan
Regional Territorial Plan
Industrial Plan

WHAT LOCAL ACTORS THINK?

Interviews
Questionnaires
SWOT Analysis
Benchmarking

STRATEGIES

STRATEGY 1_INCREASE

Goals: to potentiate the existing airport facilities and to strength it with new facilities and equipment.

Actions: expansion of the existing airport, increasing the number of flights, adding new functions to neighboring industrial and commercial

Projects: Jyväskylä and Aktion Airport

STRATEGY 2_REUSE

Goals: to merge and hybridize the airport with services connected to the local context

Actions: maintenance of airport operation, hybridization with insertion of the functions of existing activities and related to the local context surrounding integration of urban functions

Projects: Araxos and Villanova d'Albenga Airport

STRATEGY 3_RECYCLE

Goals: to leave (abandoned) the airport function in favor of a comprehensive recycling with creation of parks and public facilities

Actions: leaving the airport function in favor of a comprehensive recycling, reclaiming land from the old infrastructure of the landscape and the city's new urban development, creation of a park and public facilities

Projects: Andravida Airport

Figure 2. Methodology map

4 Principle findings and key messages

From the extensive research results obtained we can conclude:
- that supply side effects do play a certain role, especially in peripheral regions. This means that better accessibility has a positive influence on the attractiveness of a region for people and business and therefore on economic performance.
- that demand side effect are rather strong in all regions. This means that a good economic performance leads to more demand for transportation services which in turn results sooner or later in better transport infrastructure, more transport services and better

accessibility.

Summing up, supply side effects seem to be important. They are relevant particularly in the medium to long run. On the other side, demand side effects seem to be less relevant. They are rather relevant in the short term.

The airport is considered as a resource. According to that, the research also suggests strategies of *recycle* existing obsoletes infrastructure rather than the construction of new infrastructure. The REnewal operation of obsolete infrastructure that have no longer a demands of traffic explores different visions for obsolete infrastructures and takes into account new opportunities and uses of theme. It is a new concept that considers the airport *as a place to live, before a place to leave*[1].

Regarding the key research questions above, the analyses allow the following **general conclusions**:

- What is the relationship between accessibility and economic performance? Accessibility has indeed a positive impact on economic performance. In some regions, bad accessibility is even a limiting factor for further economic development. Thus, supply side effects seem to be very relevant. On the other hand, also demand side effects have certain relevance, with better economic performance leading to higher accessibility.

- How important is accessibility for economic prosperity? The impact is indeed rather strong (and statistically significant). Other relevant factors are tax burden and the availability of highly qualified manpower. The fact that the quality of transportation services is a limiting factor for economic growth in some regions proves the relevance of this issue.

- How relevant are airports in such a context? For really remote regions, airports are often the only window to the world. In that sense, airport can be really crucial.

- What type of regions do need an airport (or airports)? For remote areas (where the next good airport is more than three or four hours away by rail or road) functioning airports with enough scheduled flights are very important. When there is a good airport rather close (up to three hours), then an airport for the region of its own is much less relevant.

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[1] Ricci M., Favargiotti S., (2012). *The Re-cycle of secondary airports and new opportunities for the territory - ADES Research (ESPON 2013 Project). AIRDEV 2012*. Airport Development Conference. Conference Proceedings. Edit by Rosário Macário. ISBN: 978-989-20-3071-5.

- Which are the limiting factors for economic performance? The strongest limiting factor is the availability of highly educated manpower. But already on the second place is accessibility, indicating that insufficient traffic infrastructure and/or services are indeed limiting economic development in some regions.

- What is an optimal strategy for existing airports? The recycling of obsolete infrastructure, and the re-use in order to optimize their potentialities becomes the most sustainable and desirable solution. To re-think not only the abandoned and unused infrastructure in search of a new identity, but to recycle all those infrastructures those are already active but poorly operating and unproductive.

- What are the strategies to transform airport infrastructures into re-activators of territories? According to the diversity of the three ADES regions, the logic for intervention in various areas is obviously different,. So the three strategies proposed for development and renewal of infrastructure (incREse, REuse, Recycle) are specifically thought out for all regions in which each airport is located (see *DFR_Chapter 2*).

- What is the device that will drive the renewal strategies? The device that drives these operations is the *osmosis*[2]. The *osmotic devices* will establish a stronger relation between the infrastructure and their surrounding territories. At the same time they will gain an economic improvement and new uses for the airports (see *DFR_Chapter 3.2*).

5 Options for policy development

In general we have to distinguish between two type of regions: regions which are close (up to three or four hours way by rail or road) to a well functioning airport, and the rest.

For the former type, airport activities are not relevant for economic performance and thus airport infrastructures and activities are usually not the bottleneck. However, fast access to the "good" airport in the neighbour region often is a bottleneck. These regions do not need a functioning airport. Relevant is the time needed to relevant destinations, including the big European capital cities. To this end they need fast access to the next bigger airport with frequent scheduled flights to all relevant destinations (including all European hubs) by road and or rail.

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[2] Osmosis is the net movement of solvent molecules through a partially permeable membrane into a region of higher solute concentration, in order to equalize the solute concentrations on the two sides. It may also be used to describe a physical process in which any solvent moves, without input of energy, across a semipermeable membrane (permeable to the solvent, but not the solute) separating two solutions of different concentrations.
Cfr. *Osmosi*, www.wikipedia.org

For all other regions (which are more distant to the next well functioning airport), airport activities are relevant for economic performance. However, airport infrastructures are usually not the bottleneck; it is rather the availability of regular scheduled flights to relevant destinations. These regions do need a functioning airport. Relevant is the time needed to relevant destinations, including the big European capital cities. To this end they need an airport with adequate infrastructures, fast access to the regional airport, frequent scheduled flights to relevant destinations (among them at least one big European hub).

Regarding the three stakeholder regions, we come to the following results:

- **Jyväskylä**: The fast train to Helsinki takes some 3 and a half hours; thus, the plane is not faster on a city to city basis than the train. The plane is only faster, when people want to travel further and need to change plane in Helsinki. Thus, Jyväskylä is in the grey zone between the two types. Nonetheless, better direct flight services to a greater hub (like Stockholm or Copenhagen) should have a positive effect to economic development in the region. As such flight operations may not be profitable, national or regional subsidies to the airport or airline companies may be an effective tool to enhance the flight schedule.

- **Western Greece**: The estimated time between Patras and Athens International airport is approximately 2 and a half hours by car. So it is definitely more convenient than airplane or fast train (which takes some 3 and a half hours). However since the region is lengthy this does not apply for all places within it. Some of them will need definitely more than 4 hours to the nearest airport. To this end the airport of Aktion should increase its scheduled flights, not only in the summer time. Better direct flight services (more scheduled flights to relevant destinations such as Athens, Frankfurt or London) should have a positive effect on economic development in the region. As such flight operations may not be profitable, national or regional subsidies to the airport or airline companies may be an effective tool to enhance the flight schedule. In addition, better other traffic infrastructure (better access to other regions by rail or road, e.g. to Athens) will have a positive influence on the attractiveness of the region for people and business and therefore on economic performance. In that sense, regional efforts and investments should focus on just one regional airport with adequate flight density and public transport access: Aktion airport should be considered.

- **Savona**: The fast train from Savona to Genova just takes half an hour, to Milano and Nice it is two and half hours; thus, the train is faster on a city to city basis than the train. Thus, the province does not need an airport of its own. The existing airport in Villanova d'Albenga is not really relevant for the accessibility of (the province of) Savona. Thus, its future will hardly be an airport with scheduled flights. A renewal strategy is much more likely successful (and also effective for the region). All sort of new activities – both in aviation and in other fields – may help to overcome the current weaknesses. However, better train

links to Genova, Milano and Nice should increase the attractiveness of the region as a whole.

The political conclusion is that the improvement of accessibility may help improving the economic situation of a region. However, each region must carry out a thorough analysis what is the most efficient way to improve accessibility. In some cases (like in a remote area in Finland) this might be the strengthening of an airport (expansion of the structures and good offer of scheduled flights). In other cases (like in Greek regions), it might be the subsidy of scheduled flights to the next large hub. In few cases, it is recommended to completely abandon airport activities in order to transform it into an urban facility that will have stronger effects on the economic performance of the region. In even other cases (like in Italian regions) it might be best to integrate urban functions in the airport areas and to improve the highway or rail network system to better reach a nearby airport with a good offer of scheduled flights.

Concretely, Villanova d'Albenga is already on its way to a new future. On 30th November 2012 it was officially signed the contract for the management society with Cannes and Nice airport and with Piaggio Aero Industries S.p.A. This small airport can be **the model of airport in the territory**. Its development plan and strategies could be the model for the other ADES case studies but also for other second and third tier airports in Italy and in Europe: it could be an example of territorial integration with the industrial and agro-food sectors. It and also be an example of cross-border network with neighbouring airports (Nice and Cannes airports). The relationship with the nearest Nice and Cannes airport is crucial because they will organize a network in which an high specialization of functions will decrease the competitively in favour of a synergy between airports. This will be the firs Italian example (maybe also European) of **cross-border network** and it will create a relationship that strengthens and generates growth in a shared *European region*.

B   Report

Introduction

The EU cohesion goal calls particularly for an improvement of the framework conditions of peripheral or remote regions. Better accessibility is one of the means to move towards this goal. And regional airports are an option for improving accessibility.

Economies of scale and agglomeration effects in favour of large cities are generally acknowledged. However, it is widely accepted that there are also diseconomies from rising cost to industry, due to increasing cost of land and labour, traffic congestion, crime etc., which make smaller cities and city nets more valuable than very large cities. Measured in pure terms of GDP per capita, the effect of a polycentric territorial development is likely to be underestimated. Even when looking at growth, GDP per capita growth figures will tend to be biased in favour of larger cities as they ignore negative external effects which prevail in large conurbations.

Measures of level or changes in wellbeing would – were they widely available – clearly be in favour of smaller cities and peripheral regions, as such measures take the negative externalities into account. As a consequence, growth policy in the sense of maximizing human wellbeing in Europe should focus primarily on peripheral or remote cities and regions. This will also help establishing a more balanced territorial development.

Economic theory clearly states that **accessibility** is one of several relevant location factors. As it is quite obvious that it is hardly feasible for every region in Europe to have a large airport, the project will not only discuss the role of airports for economic and social development, but also in which cases (regions, cities) which type and quality of transport services (and infrastructure) best suit the needs of the population (airports, rail links, highways). In addition we will discuss the best use and development of existing airports.

ADES research has to deal with another relevant issue: the definition of **peripheral regions** (integrate in *SciR_Chapter 1.1*). Periphery is a condition everyday less related to a physical condition or to the distance. It is more related to the economical condition of territories. It is commonly agree that it is better to have places easier reachable. But, at the same time, it is clear that every place could reach the worldwide by a connection to the network. In that sense, the peripherality is an ambiguous condition. It is continuously mutable. A place could be peripheral in the middle of a metropolitan territory as well a place could be extremely central in the border of the connection network.

This is profoundly changing not only contexts and topics, but also the way to project infrastructures. It happens at architectonic, urban and landscape scale. It subverts the axioms of *super*-infrastructure according to three reasons:

I. The *peripherality* in the European territories today is an ambiguous condition, perhaps more a social issue than a geographical question. It depends from the development processes that are not necessarily related to the intensity of physical connections and material flows of people or things. There are peripheral areas in the heart of large metropolitan areas and it is possible to identify important centralities in remote areas. Furthermore some territories economically well developed limited their accessibility and connections: an *enclave* territory as an affirmation of local identity. For example the Alto Adige or the surrounding areas of Cuneo are the richest and most developed regions of the Italian territory but the accessibility is limited. Also some Greek islands, those suffering less the crisis, are classified as economically peripheral areas in the European Union only because they don't have a high development of infrastructures and they are far from the main flows of traffic.

II. In the European *neverending city*, the periphery as a physical space does not exist by definition. Each place can be at the same time the central or peripheral with respect to the various immaterial networks of relationships that structure the settlement around the world.

III. Somehow the physical space of the major material networks in Europe is saturated. The physical infrastructures are already built and there are no more funds for all new interventions that were planned. The European funds planned for the period 2014-2020 are geared towards the development of interconnections with the networks of corridors minute local, the creation of new hubs light to the government of the effects on cities.

Therefore questioning the nature of the infrastructure, with particular attention to airport infrastructure, becomes a key consideration in the approach to this research topic. Airport infrastructure for its dimension and relations with the territory is a catalytic agent and an activator of contexts: airports as generators of development in peripheral regions but also as generators of a new image for the area and of themselves.

1 Main results, trends, impacts

There is a special relationship between airports and economic performance in peripheral European regions. Regions with a strong airport (in the sense of frequent scheduled flights to many destinations) usually also have a strong economy (in the sense of above average production and income per capita), while regions with a weaker economy (below average production and income per capita) usually only have small airports (if at all) with only few scheduled flights. In the framework of cohesion policy we can also say that those regions in need of good accessibility often have small airports while prosperous regions often dispose of a larger airport, although it should be desirable the other way round.

In the light of these stylised facts it is relevant for policy design to know more about the relationship of accessibility and economic performance (especially for peripheral regions in Europe) on the one hand (see *Chapter 1.1*), and on

the optimal development of existing airfields in peripheral European regions on the other hand (see *Chapter 1.2*).

1.1 Relationship between accessibility and economic performance in second and third tier airports

What is the relationship between accessibility and economic performance of European regions? Why is it relevant to study this issue? Policy decisions should stand on firm theoretical and if ever possible also empirical grounds. This is especially true when policy measures are expensive as it is the case in the area of traffic infrastructure.

The **key questions** in the current context are:

- What is the relationship between accessibility and economic performance? Does better accessibility lead to higher economic performance or is it the other way round (better economic performance leading to higher accessibility)?

- How strong is the impact of accessibility on economic performance of a region? How strong is this impact relative to other factors of influence? Is such an impact statistically significant?

- Which are the limiting factors for economic performance? Is an insufficient traffic infrastructure a limiting factor for the economic development of a region?

From a theoretical point of view we can distinguish two main **transmission channels:**

(a) Supply side effects: Good general framework conditions (including accessibility) improve the attractiveness of a region and thus attract both, people and companies. Production and the supply of goods will grow. Therefore, accessibility will enhance economic performance.

(b) Demand side effects: When a region grows – be it more people or higher wages – the demand for travelling will usually grow. Thus, it will be interesting for suppliers of travel services to enlarge their supply. If there are bottlenecks in the infrastructure, such additional demand may lead to an improvement of the respective infrastructure. Therefore, economic performance improves accessibility.

Thus we can rephrase the key questions as follows: Do supply side effects or demand side effects dominate the relationship between accessibility and economic performance? As both effects are feasible from a theoretical point of view, empirical analyses shall give answer to the key questions above. In order to detect whether supply side or rather demand side effects are empirically relevant, we adopt three different empirical tools, which are briefly described in the box below (for more details see the corresponding chapters in the scientific report).

Using a common database covering several hundred regions, we use three different econometric methods to catch different dimensions of the same issue: What is the relation between accessibility and economic performance? Using various methods highlighting different aspects augments the chance to capture the relevant issues and structures in a holistic way.

(1) Causality tests focus on the question whether the direction of influence goes from accessibility to economic performance emphasising supply side elements, or whether it rather goes from economic activities to accessibility emphasising demand side elements.

(2) While these results are qualitative (though based on quantitative model estimates), the structural regressions estimate numerically the size of such influences (also based on quantitative model estimates). Thus, it is possible to see how relevant the impact of accessibility is relative to other regional location factors.

(3) The frontier analysis finally will show the degree of production efficiency of each region and highlight the limiting factors. This will answer the question of whether an insufficient traffic infrastructure is a limiting factor for the economic development of a region.

Box 1: Empirical tools applied

In the following paragraphs we shall present the results from the three different methods used to unveil the relation between accessibility of a region and its economic performance.

The **causality tests** show (for more details see the corresponding chapter in the scientific report):

> - Accessibility has a positive impact on economic performance. There is a strong positive impact from theoretical accessibility (whether used or not) both on GDP growth and employment growth. However, there is also a strong positive impact from the number of air passengers (thus the amount to which accessibility is actually used) both on GDP growth and employment growth. This means that supply side effects are indeed relevant.

> -The above findings (for accessibility and air passengers) are particularly true for peripheral regions and much less so for more centrally located regions in Europe. This means that supply side effects are more relevant for GDP and jobs in peripheral regions.

> - The impact from economic performance (both GDP and employment growth) on accessibility and air traffic, however, is only small. This means that demand side effects are less relevant.

The results present evidence of causal processes in these relationships and suggest that air transportation is more than a facilitator in remote regions. In these regions, in addition to regional growth causing airport activity, air activity appears to boost regional development. Supply side effects are, thus, important for distant regions. In core regions only the reverse is true: airport activity does not cause regional growth, but regional growth causes airport

activity.

The political implication resulting from the causality analysis is quite clear: good accessibility enhances economic performance; air activity boosts regional development in peripheral regions. Thus the message for regional policy makers is apparent: there are good reasons to defend regional airports and scheduled air services since they are important for the development in remote regions.

The **regression analysis** shows (for more details see the corresponding chapter in the scientific report):

- Accessibility matters: Accessibility is a relevant factor for explaining economic performance of European regions. There is a positive impact on economic performance. Faster transportation allows people being in more places in a given time span. Thus, better accessibility (be it by rail, road or air) improves productivity, as we would expect from economic theory. Higher productivity leads to higher GDP and thus higher GDP per capita. Higher accessibility also yields a higher participation rate in the labour market, thereby reducing (official and hidden) unemployment. This means that supply effects are indeed relevant for economic welfare.

- The positive impact of accessibility is higher for output (GDP) and labour productivity and lower for the participation rate (jobs). However, this is not surprising, as the effect on participation and on productivity add in some way to the overall effect on GDP. This means that impact of accessibility is highest for GDP.

- When dividing total accessibility into the geographical accessibility, which measures the geographical location (or remoteness) of a region, and the transport accessibility, which measures the transportation efforts (transport infrastructure and services) of the region, it turns out that the impact of geography and of transport services add up to the impact of overall accessibility, and that transport accessibility is more relevant for economic performance than geographical accessibility. This means that man-made supply side effects (i.e. transportation policy) are relevant for economic performance.

- The long term impact of accessibility on economic performance is much higher than the short term impact. This result is in line with economic theory. If there is a substantial improvement in accessibility, it is usually known quite in advance. Thus, additional economic activities (such as construction) may already start well before the opening of new transport services. On the other hand, it also may take some time until activities adjust to the new accessibility level. This means that improvements in accessibility need some time to deliver the expected results.

- The differences in accessibility between regions (from the cross section models) have a much higher impact than changes over time (from the panel data models). This effect implies that changes in accessibility over a certain period take some time for economic

activities to adjust. Thus, the estimated effect is lower. This means that the higher regional effect is likely to estimate equilibrium (and thus long term) effects.

- The positive impact of accessibility (on economic performance) in peripheral regions is only slightly bigger than in more centrally located regions in Europe. However, there is one exception: While the impact of accessibility on the participation rate is on average substantial, it is close to zero for peripheral regions. This means that remote areas profit primarily through higher productivity.

- The number of commercial passengers (thus the use of airports) is strongly affected by economic performance. The participation rate has a higher positive impact on passengers than productivity. This means, the higher the density of people working in a region, the higher the demand for flight services: Demand side effect are relevant as well.

- An interesting detail: while there is a tendency of convergence in economic performance of the regions, there seems to be a divergence effect on the airport passenger data. This means that larger airports (hubs) tend to grow faster than smaller (and peripheral) ones.

The results present evidence of a strong positive impact of accessibility on economic performance also in peripheral regions of Europe, suggesting air transportation being more than just a facilitator in remote regions. Better accessibility (which is in remote regions almost per definition by air transport) leads to an improvement of economic welfare. Air activity appears to boost regional development: supply-side effects are, thus, important for peripheral regions.

By dividing the total accessibility into geographical location (which is fate) and transportation efforts (which rely to a large extent on transport infrastructure), the latter is shown to be more important than the exogenous geographical location. This effectively means that the disadvantage of peripherality can be made up by good transport connections. This is good news as transport services can be shaped by politics, while geographical accessibility is just fate.

The political implication of the results of the structural regression analysis is quite clear: good accessibility enhances economic performance and regional development also in peripheral regions. Thus the message for regional policy makers is obvious: there are good reasons to care for good transport infrastructure (including regional airports) and good transport services (including scheduled air services) since they are important for the development in remote regions.

The **frontier analysis** shows (for more details see the corresponding chapter in the scientific report):

- Most regions are not on the efficient production frontier, but rather below. This means that they use their resources in an inefficient way. They either could produce the same output (like GDP) with less resources (input factors) or could produce with the same resources

more output.

- As the various input factors (resources) are not perfectly substitutable, some of them turn out to be limiting factors. Increasing a limiting factor in a region should result in an increase of output (e.g. GDP). The most limiting factor is highly educated labour force (people with tertiary education). The second important limiting factor over all regions is already accessibility. This means that accessibility is a limiting factor to economic growth in many regions in Europe.

- When looking at the reasons why efficiency is well below its potential, high tax rates for both, people and companies, turn out to be the most relevant factors. This means that lower tax rates can lead to a more efficient use of resources and increase efficiency.

- In all three stakeholder regions, transport accessibility seems to be a limiting factor for economic development. Also the geographical accessibility is limiting growth in two of the regions (Jyväskylä and Western Greece, but not Savona). This means that an improvement of the transport accessibility should lead to higher economic performance.

The results present evidence that accessibility is indeed a critical factor for economic development. In many regions (including our three stakeholder regions) bad accessibility is a limiting factor for faster economic growth. Apart from highly qualified labour force, accessibility seems to be the most important factor explaining why regions do not grow faster, which is particularly relevant for peripheral regions. Again, accessibility appears to limit or boost regional development: supply-side effects are, thus, important for peripheral regions.

The political implication of the results of the frontier analysis is quite clear: While geographical accessibility is exogenous (in the sense of fate), transport accessibility can be influenced by policy. As transport accessibility seems to be a limiting factor in our stakeholder regions, its improvement should help boosting economic performance. Thus the message for regional policy makers is apparent: there are good reasons to defend regional airports and scheduled air services since they are important for the development in remote regions. In other cases better surface transport links may be of more value.

Regarding the key questions at the beginning of this chapter, the three analyses allow the following **general conclusions**:

- What is the relationship between accessibility and economic performance? Accessibility has indeed a positive impact on economic performance. In some regions, bad accessibility is even a limiting factor for further economic development. Thus, supply side effects seem to be very relevant. On the other hand, also demand side effects have certain relevance, with better economic performance leading to higher accessibility.

- How strong is the impact of accessibility on economic performance of a region? The effect is indeed rather strong (and statistically

significant). Other relevant factors are tax burden and the availability of highly qualified manpower. The fact that the quality of transportation services is a limiting factor for economic growth in some regions proves the relevance of this issue.

- Which are the limiting factors for economic performance? The strongest limiting factor is the availability of highly educated manpower. But already on the second place is accessibility, indicating that insufficient traffic infrastructure and/or services are indeed limiting economic development in some regions.

Summing up, supply side effects seem to be very strong. They are relevant particularly in the medium to long run. On the other side, demand side effects seem to be less relevant. They are rather relevant in the short term. Given the results above, we can summarise our conclusions in the following table:

	Supply side effects: Accessibility enhances economic performance	Demand side effects: Economic performance improves accessibility
Causality analysis	YES, but only true for peripheral regions	YES, for all regions, but rather weak
Structural regressions	YES, mostly positive effects (especially for GDP)	YES, strong positive effects (especially for the participation rate)
Frontier analysis (DEA)	YES, it is one of the limiting factors (following qualified labour)	YES (but this seems to be less relevant)

Table 1: Summary of results of the empirical analyses

In the light of these results and under special consideration of the respective situation in the three stakeholder regions we come to the following **special conclusions**:

- Jyväskylä: The problem (apart from the large distances) is not the airport per se, but rather the limited number of scheduled flights (only three times a day to Helsinki) which are a bottleneck for economic development. Better flight services to a greater hub (like Stockholm or Copenhagen) should have a positive effect to economic development in the region.

- Western Greece: The bottleneck for economic development is not the lack of airport infrastructures, but rather the limited number of scheduled flights. Better flight services (more scheduled flights to relevant destinations such as Athens, Frankfurt or London) should have a positive effect to economic development in the region, especially in a time when decentralization is becoming a trend in Greece. In addition, improved other traffic infrastructure (better access to other regions by rail or road, e.g. to Athens) will have a positive influence on the attractiveness of the region for people and business

and therefore on economic performance.

- Savona: Here, airport infrastructures and the absence of scheduled flight services are not a bottleneck for economic development. The existing airport in Villanova d'Albenga is rather a bottle to be filled up with all sort of new activities. However, better train links to Genova, Milano and Nice should increase the attractiveness of the province of Savona.

Summing up, the improvement of scheduled flights should be positive for some regions. Other regions shall think of reusing their existing airport infrastructure in a more efficient way and improve, instead, their traffic links by rail or road.

The three different types of empirical analysis present **evidence** that accessibility is relevant for most European regions. From a political point of view, we can state as follows:

1. Airports do matter (in most regions in Europe, particularly in peripheral regions).

2. Supply side effects are indeed relevant (and sometimes the limiting factor for economic growth).

3. Demand side effects are relevant as well (but of lower importance).

4. Policy can make a difference (when effectively used).

The political implication of the results is quite clear: good accessibility enhances economic performance. As supply side effects are important particularly in remote regions, traffic and infrastructure policy does matter. However, policy actions may not be limited to airports, and may also include more frequent and/or faster connections. More systematically, **options** include:

- better airport infrastructure (like higher passenger capacity or longer runways)

- better flight services (more scheduled flights to relevant destinations)

- better transport infrastructure to airports (improvement of rail or road infrastructure)

- better public transport services to airports (improvement of rail or bus services)

- better other traffic infrastructure (better access to other regions by rail or road)

- better interregional transport services (more trains or bus services to relevant destinations)

Regarding remote or peripheral regions in Europe, airport infrastructure is seldom a bottleneck and thus the enlargement of passenger capacity or

runways seldom a feasible option. However, there are good reasons to defend regional airport companies and airlines since they are important for the development in remote regions.

The traditional challenge with many small regional airports is that they and/or the flight services are not financially sound which has led to the provision of financial support to airports and flight companies. Although subsidies often distort competition or are said to be wasted money, our results suggest that there indeed is a case for them if the result is increased regional growth and welfare.

Thus the message for policy makers of remote or peripheral regions is apparent: identify the bottleneck regarding transportation and then choose from the list above. Be aware that the mere physical existence of an airport (runway etc.) does not guarantee any flight operations. In such a case financial incentives for more scheduled flights to relevant destinations (particularly the next big hub) may be an effective mean for improving regional economic performance.

1.2 The recycle of secondary airports and new opportunity for the territory

Throughout the world, there are hundreds of second and third tier obsolete airports stuck in a pre-decline phase. It is urgent to think about their future, in order to transform airports' infrastructure into urban re-activators, before that the airport infrastructure arrives in its obsolete phase.

The ADES research case studies are: *Jyväskylä Airport*, City of Jyväskylä, Central Finland; *Araxos Airport*, *Aktion Airport*, *Andravida Airport*, Region of Western Greece; *Villanova d'Albenga Airport*, Province of Savona, Italy. These airports show different examples of the widespread situation of underused airports structures that have never managed to reach their potential or have lost their central role.

a. *On Hold* Airports
It is necessary to approach the everyday dimension of the airport's life. It is necessary to think in airports at the present time, with the current socio-economical condition. In that sense, the research suggests an operation of *recycling obsolete infrastructure.* Abandoned airports (*Andravida Airport)* and airports *on hold* (*Villanova d'Albenga Airport, Jyväskylä Airport*, *Araxos Airport, Aktion Airport*) are the material on which we are working on.
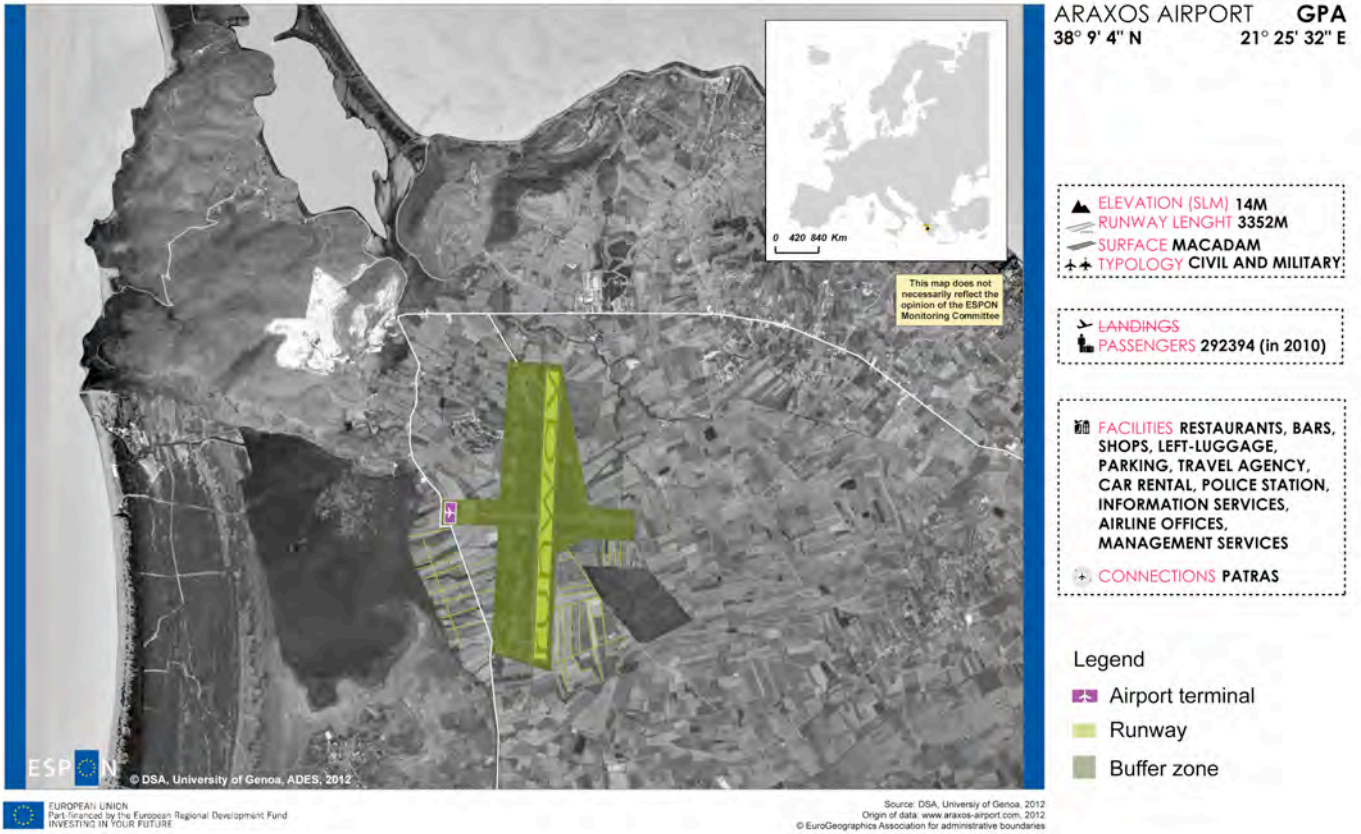
ID_Jyväskylä Airport

JYVÄSKYLÄ AIRPORT JYV
62° 23' 58'' N   25° 40' 42'' E

ELEVATION (SLM) 140M
RUNWAY LENGHT 2601M
SURFACE ASPHALT
TYPOLOGY CIVIL AND MILITARY

LANDINGS 14812 (in 2010)
PASSENGERS 88608 (in 2010)

FACILITIES RESTAURANTS, BARS, SHOPS, POST OFFICE, TELECOMUNICATION SERVICES, FIRST AID, FIRE SERVICES, PHARMACY, LEFT-LUGGAGE, CHILD FACILITIES, VIP LOUNGE, DISABLE FACILITIES, PARKING, TRAVEL AGENCY, CAR RENTAL, POLICE STATION, INFORMATION SERVICES, AIRLINE OFFICES, CONFERENCE ROOMS, MANAGEMENT SERVICES,
CONNECTIONS JYVÄSKYLÄ

Legend
Airport terminal
Runway
Buffer zone

This map does not necessarily reflect the opinion of the ESPON Monitoring Committee

Source: DSA, University of Genoa, 2012
Origin of data: www.finavia.fi/airports/airport_jyvaskyla, 2012
© EuroGeographics Association for administrative boundaries

Map 1. ID_ Jyväskylä Airport document

ID_Aktion Airport

AKTION AIRPORT PVK
38° 55' 32'' N   20° 45' 55'' E

ELEVATION (SLM) 3M
RUNWAY LENGHT 2871M
SURFACE ASPHALT
TYPOLOGY CIVIL AND MILITARY

LANDINGS
PASSENGERS 292394 (in 2010)

FACILITIES RESTAURANTS, BARS, SHOPS, BANKS, POST OFFICE, TELECOMUNICATION SERVICES, FIRST AID, FIRE SERVICES, PHARMACY, LEFT-LUGGAGE, CHILD FACILITIES, VIP LOUNGE, DISABLE FACILITIES, PARKING, METEOROLOGICAL CENTER, TRAVEL AGENCY, CAR RENTAL, POLICE STATION, INFORMATION SERVICES, AIRLINE OFFICES, MANAGEMENT SERVICES
CONNECTIONS PREVEZA

Legend
Airport terminal
Runway
Buffer zone

This map does not necessarily reflect the opinion of the ESPON Monitoring Committee

Regional level: NUTS 3
Source: DSA, University of Genoa, 2012
Origin of data: www.hcaa-eleng.gr/preveza.htm, 2012
© EuroGeographics Association for administrative boundaries

Map 2. ID_Aktion Airport document

ID_Araxos Airport

ARAXOS AIRPORT **GPA**
38° 9' 4" N   21° 25' 32" E

This map does not necessarily reflect the opinion of the ESPON Monitoring Committee

ELEVATION (SLM) 14M
RUNWAY LENGHT 3352M
SURFACE MACADAM
TYPOLOGY CIVIL AND MILITARY

LANDINGS
PASSENGERS 292394 (in 2010)

FACILITIES RESTAURANTS, BARS, SHOPS, LEFT-LUGGAGE, PARKING, TRAVEL AGENCY, CAR RENTAL, POLICE STATION, INFORMATION SERVICES, AIRLINE OFFICES, MANAGEMENT SERVICES

CONNECTIONS PATRAS

Legend
Airport terminal
Runway
Buffer zone

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Source: DSA, Universiy of Genoa, 2012
Origin of data: www.araxos-airport.com, 2012
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Map 3. ID_ Araxos Airport document

ID_Andravida Airport

ANDRAVIDA AIRPORT **PYR**
37° 41' 0" N   21° 28' 0" E

This map does not necessarily reflect the opinion of the ESPON Monitoring Committee

ELEVATION (SLM) 17M
RUNWAY LENGHT 3139M
SURFACE ASPHALT
TYPOLOGY MILITARY

LANDINGS -
PASSENGERS -

FACILITIES MILITAR FACILITIES, PRIVATE JET SERVICES, PARKING

CONNECTIONS IONION SEA PATRAS

Legend
Airport terminal
Runway
Buffer zone

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EUROPEAN UNION
Part-financed by the European Regional Development Fund
INVESTING IN YOUR FUTURE

Source: DSA, Universiy of Genoa, 2012
Origin of data: www.andravida.gr, 2012
© EuroGeographics Association for administrative boundaries

Map 4. ID_ Andravida Airport document

Map 5. ID_ Villanova d'Albenga Airport document

b. Recycle strategy

Building new infrastructure, ever more today, in this moment of crisis, does not reveal itself as the most sustainable strategy, considering sustainability as an aim in relation to social and territorial changes. The European Commission's White Paper (2001)[3] indicates that it is an absolutely necessary strategy to interrupt the connection between increased mobility and economic growth.

This is the context in which this research wants to offer an alternative to the excessive construction of new infrastructure: don't build new roads but strengthen the existing public system. At the same time, don't build new airports, but to reuse the existing airport infrastructure and use them as activators of the economies and local contexts. **The recycling of obsolete infrastructure**, and the re-use in order to optimize their potentialities becomes the most sustainable and desirable solution. To re-think not only the abandoned and unused infrastructure in search of a new identity, but to recycle all those infrastructures those are already active but poorly operating and unproductive.

Around the word, exist a lot of examples of Re-cycled airports (see *SciR _Chapter 1.3*). After their decommission, many former military airports were not re-used and they remain in an abandoned state for years. But due to the

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[3] *The European transport policy for 2010*, COM(2001) 370. Reviewed in 2006 by the Council Commission Communication and the European Parliament.

growing population and the high demand for new houses, many of these airports could be re-developed as a new part of the city. Starting with the transformation of the air connection infrastructure (runway, technical street) into urban main roads and street, and continue this new urban development with houses, public services, commercial and business areas.

In other cases, many problematic airports no longer present themselves in the potential range for urban expansion. These airports, which were once peripheral, have now been engulfed in the urban context, becoming physically central in the city. This simplifies their re-conversation into urban park space. These case studies propose the transformation into public urban parks as the suitable solution for the re-use of abandoned airports.

Therefore, the main question for the project seems to identify strategies of *recycle* existing obsoletes infrastructure rather than the construction of new infrastructure. The experimentation of different tactics, that are defined case by case, offers a network of paths in the landscape rather than it presents one-way routes that strongly limit the way of living in the territory[4].

c. *Osmotic* device

The preliminary results suggest the impossibility to propose one singular strategy for the airports' development. The diversity of the territories and the complexity of the problems drive the TPG to think on multiple proposals of future development strategies. These strategies will propose new operations. **The device** that drives these operations **is the *osmosis*[5].**

The *osmotic devices* will establish a stronger relation between the infrastructure and their surrounding territories. At the same time they will gain an economic improvement and new uses for the airports.

From an infrastructure 'tube' to an *osmotic infrastructure*, in osmosis with the surrounding area. Consider the infrastructure as a place of permanence and not just a transition, a biological material originating from the surrounding area and an integral part of the new housing situation. Through this *osmotic membrane* it could be possible to design infrastructure in a different way, as a place to stay and not only to cross. No longer like a tube that connects faraway places, but as a biological material which is part of the new housing situation. The *osmotic membrane* gives a new relevant value as multi-functional infrastructure. At the same time, a spine that holds up a fragmented and dispersed urban structure, and an *osmotic membrane* that promotes trade and exchange between infrastructure and landscapes along the way.

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[4] Cfr. Mirko Guaralda, *Le infrastrutture viarie dismesse o declassate ed il progetto di paesaggio.* Libreria CLUP Soc. Coop., Segrate (MI), 2006.

[5] Osmosis is the net movement of solvent molecules through a partially permeable membrane into a region of higher solute concentration, in order to equalize the solute concentrations on the two sides. It may also be used to describe a physical process in which any solvent moves, without input of energy, across a semipermeable membrane (permeable to the solvent, but not the solute) separating two solutions of different concentrations. Cfr. *Osmosi*, www.wikipedia.org.

Infrastructure that generates trade with landscapes but also allows us to see new landscapes. The airport becomes a place to live and not only a door to cross to go to another destination. From airports to reach to fly 'beyond', a far away destination, to airports in which to go and stay in, as attractors of flows related to activities associated with the local area and the structure of the airport.

In that sense, the **airport osmotic infrastructure** becomes *a place to live before a place to leave*[6]. It is organised to satisfy not only one specific sector (flight operation) but it could adapt itself and its efficiency in relation to the surrounding context and business, it could exchange fluxes (physical and immaterial) with the surrounding territory and it could accommodate multiple functions, as in the Postmodern examples (see *SciR_Chapter 1.3*).
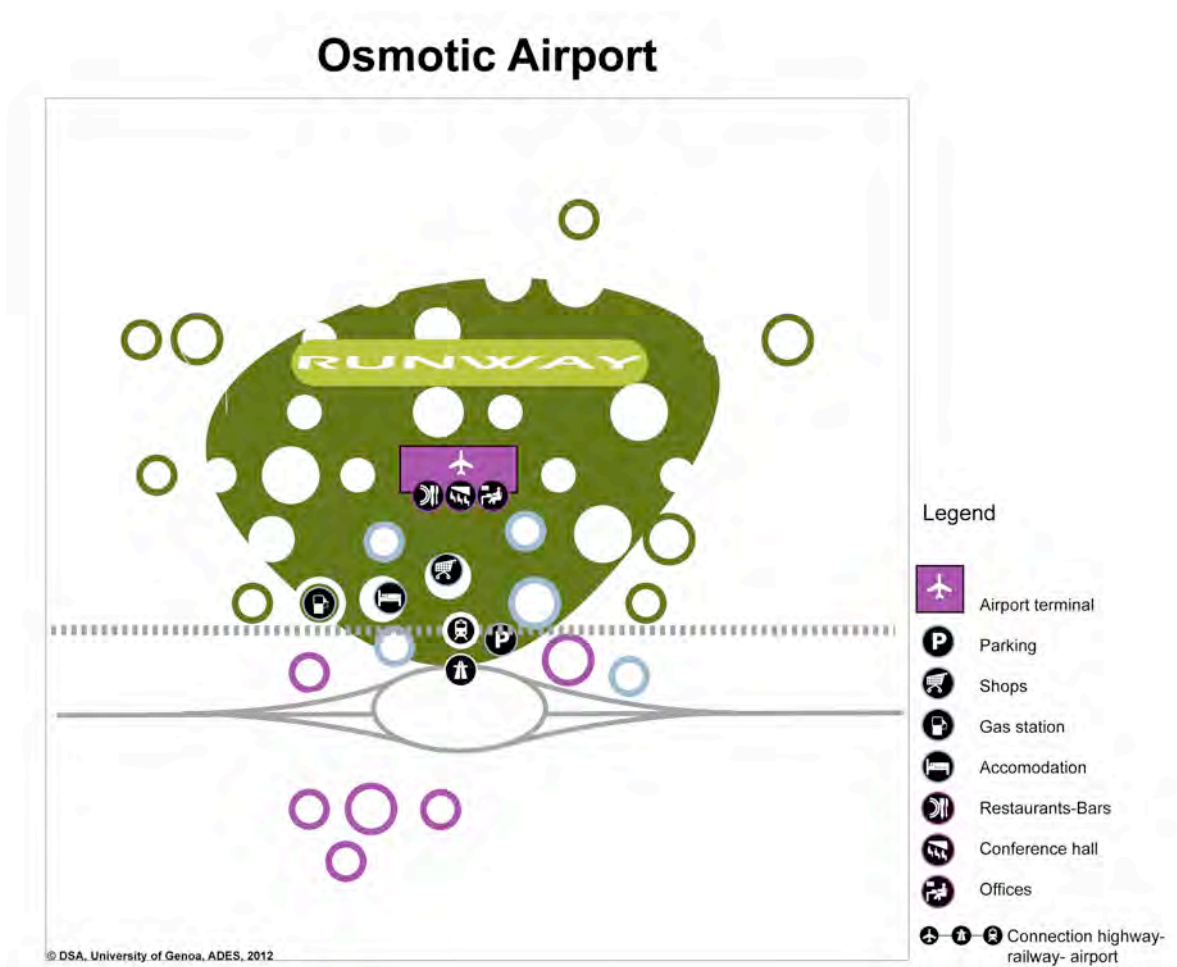
Osmotic Airport

Map 6. Osmotic Airport concept

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[6] Ricci M., Favargiotti S., (2012). *The Re-cycle of secondary airports and new opportunities for the territory - ADES Research (ESPON 2013 Project). AIRDEV 2012*. Airport Development Conference. Conference Proceedings. Edit by Rosário Macário. ISBN: 978-989-20-3071-5.

2 Options for policy development

The peripheral context of airports generates interest but also a limit. Urban growth, in this moment of crisis, is very slow therefore making airports' possible central role in urban development very difficult. Furthermore, in many cases, politicians don't find a real convenience to strengthen schedule flights or improve technical and physical characteristics of these infrastructures. When it happens, the airport dramatically graves on the regional economy. And this is what happens in the majority of ADES cases studies.

According to that, the recycling of airports could become an operative strategy for other urban transformations. The reconversion of airport infrastructure will increase quality and development of the surrounding urban and social condition: from airports on hold to airports catalytic of processes. The re-significance of this infrastructure could activate processes of growth of mobility, to develop transport and communication networks, to lost a physical precise cities' connotation, to increase the need of landscape and places in which to live in and recognize themselves. This could be the operative strategy for these airports to recalibrate their fundamental function in their physical contexts: the integration of air traffic transportation facilities with activities that regenerate their life and the surrounding business.

In that sense, the political conclusion is that the improvement of accessibility may help improving the economic situation of a region. However, each region must carry out a thorough analysis what is the most efficient way to improve accessibility. In some cases (like in a remote area in Finland) this might be the strengthening of an airport (expansion of the structures and good offer of scheduled flights). In other cases (like in Greek regions), it might be the subsidy of scheduled flights to the next large hub. In few cases, it is recommended to completely abandon airport activities in order to transform it in an urban facility that will have stronger effects on the economic performance of the region. In even other cases (like in Italian regions) it might be best to integrate urban functions in the airport areas and to improve the highway or rail network system to better reach a nearby airport with a good offer of scheduled flights. A preliminary description is captured in the following chapters.
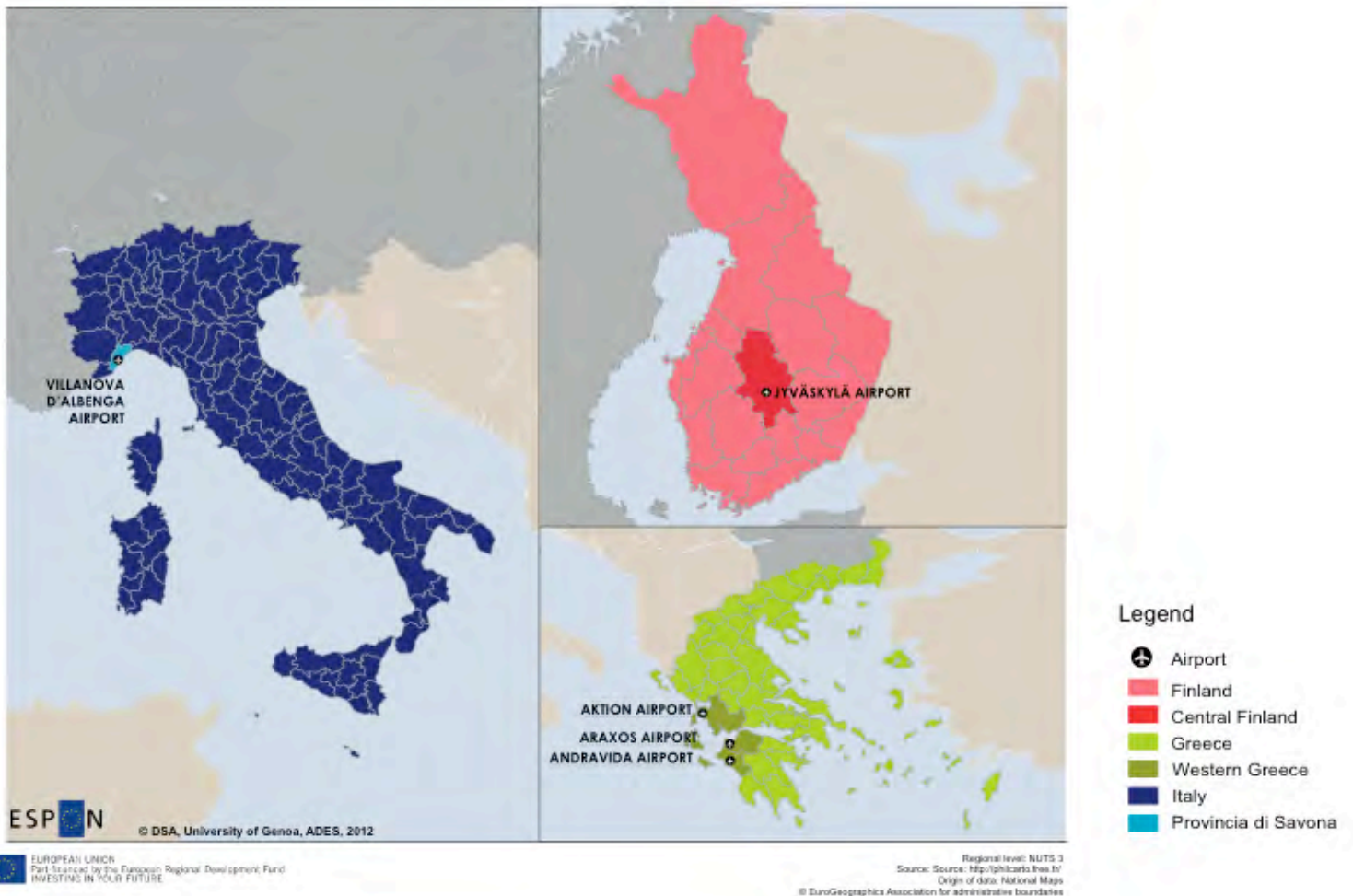
2.1 Strategies and tactics for ADES case studies

The research stresses the idea of **airport as a resource**. The airport is considered not only in its functional role but it is also consider as image of a territory, whose development has to be taken in account in the regional planning.

Studying the three contexts, we realized the difference and the similarities between ADES case studies. the contexts – geographical, economical, social – are extremely heterogeneous that didn't allowed to define an airport model to adopt indistinctly in all regions.
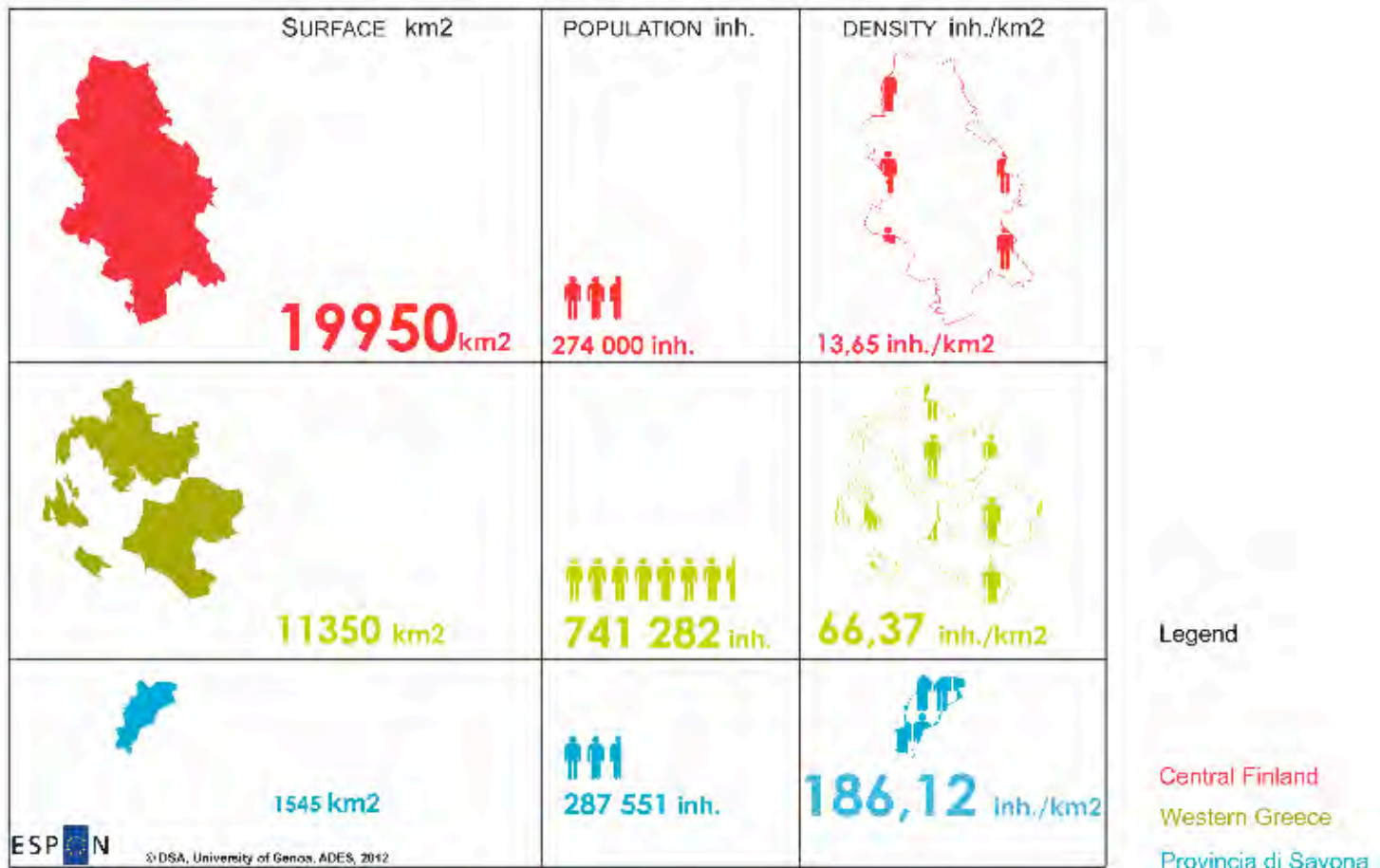
In fact, the geographical situation of the three stakeholder regions is very different (Maps 7-8). Jyväskylä in Central Finland is very central to Finland but very peripheral relative to Central Europe. As the economic centre of Finland is south of Jyväskylä, Central Finland is even more remote and Helsinki becomes a natural gateway to "Europe" for the whole of Finland. Patras in Western Greece is also rather central to Greece, but Greece as a whole is at the southern periphery of Europe. Despite the fact that Patras is even closer to Central Europe than the capital Athens, almost all air traffic goes through Athens. The situation of Savona differs considerably. It is rather central in Europe, but very peripheral in an Italian context. The airports of Genoa, Nice, Turin and Milan are relatively close. Thus, the air link situation of the three stakeholder regions also differs substantially.

Map 7. Context_Nations_Stakeholder regions

Context_Regions

	SURFACE km2	POPULATION inh.	DENSITY inh./km2
	19950 km2	274 000 inh.	13,65 inh./km2
	11350 km2	741 282 inh.	66,37 inh./km2
	1545 km2	287 551 inh.	186,12 inh./km2

ESPON

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Legend

Central Finland
Western Greece
Provincia di Savona

Map 8. Context_Stakeholder Regions_ Comparison of Surface, Population and Density

The main economic indicators, the industry structure and regional contexts characteristics have compared in the three stakeholders regions. This provided important topics for reflection on the cognitive framework for socio-economic and territorial aspects that define the potential economic impacts of airports. More detailed and fundamental information have been provided by in-depth interviews and structured questionnaires (see *SciR_Chapter 3* and *Annex 2*) carried out in local languages with key relevant stakeholders (at least five interviews per Region covering policy advisors, experts in different fields and policy makers).

According to that, it wasn't possible to draw one general model to adopt in all Stakeholders regions. We propose three **strategies for development and renewal of infrastructure** and the peripheral region in which each airport is located. According to the heterogeneity of the three contexts, the logic for intervention in various areas is obviously different, depending on contextual analyzes conducted and results obtained.

The guidelines for the vision are based on three different strategies:
- Expansion of the existing airport, increasing the number of flights, adding new functions to neighbouring industrial and commercial (**incREase**);

- Maintenance of airport operation, hybridization with insertion of the functions of existing activities and related to the local context surrounding integration of urban functions (**REuse**);
- Abandon the airport function in favour of a comprehensive recycling action, a reclaiming land from the old infrastructure, creation of a park and public facilities for the city's new urban development (**REcycle**).
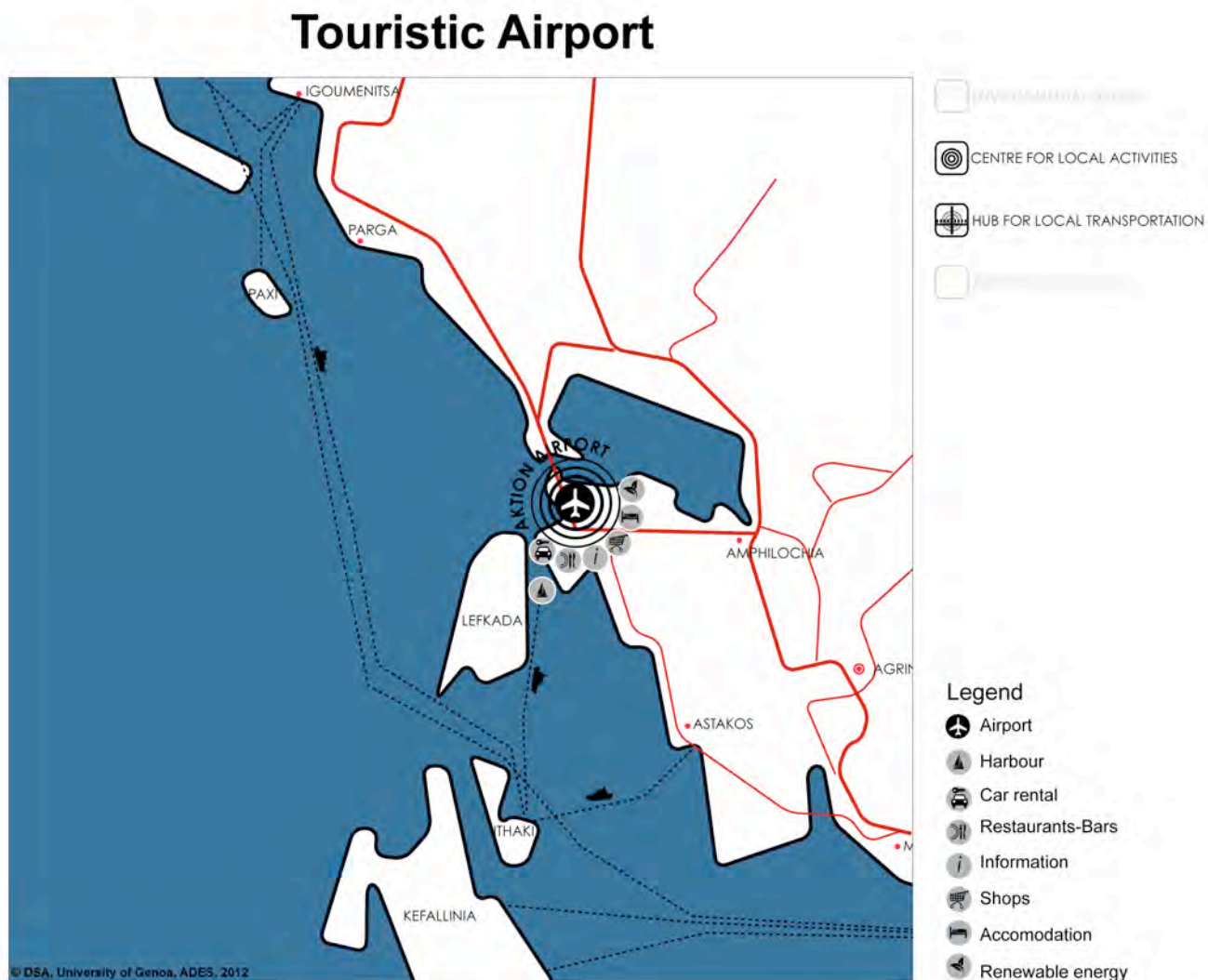
a. incREse

This design strategy provides for the maintenance of existing airport facilities and strengthen it with new facilities and equipment. In particular, it's proposed the development of the potentials found in the analysis, in an attempt to enlarge the airport and ensure economic growth in the local context.

In Central Finland, military traffic has a strong role and will secure the good conditions also for the commercial air traffic in the future. Moreover, the development of Jyväskylä air traffic will concentrate on the international connections (and transfer passengers). At the same time, the rail transportation will be developed (domestic travel). *Jyväskylä airport* aims to become to be an important junction for Central Finland.

Map 9. incREse strategy_Industrial Airport_ Jyväskylä
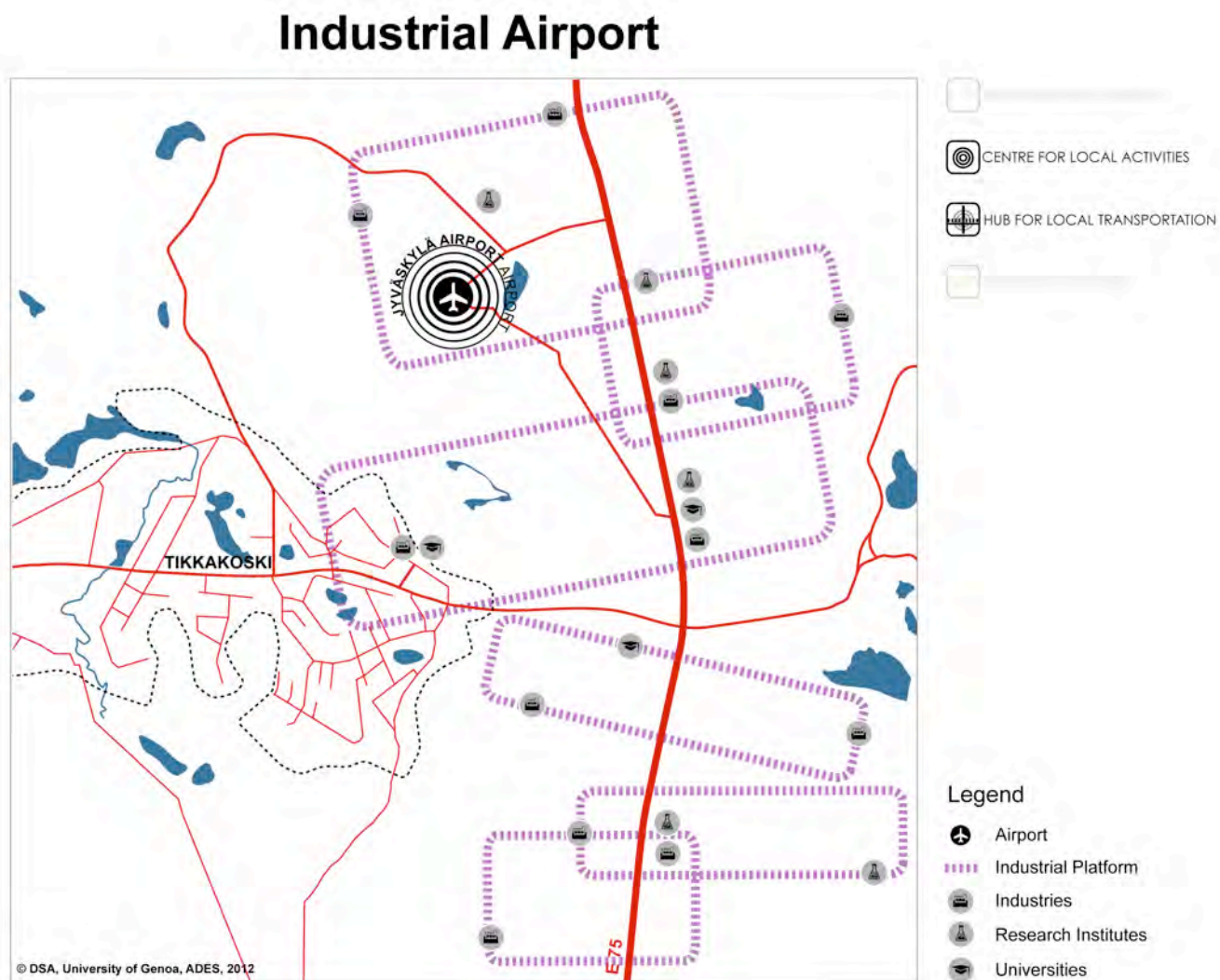
Aktion airport, instead, points to a strengthening of existing airport facilities to support the tourist traffic in summer and increasing the number of flights during the summer. This airport could become a strategic hub in the airport connection, especially connected to the tourism. Tourism, even if is not taken in account as a data in the algorithmic formulas, has a fundamental role in the development of the Greek region. According to that, Aktion could become an airport for Low-cost carriers. In that sense, it is realistic to think an enhancement of the attractiveness of the airport hub (terminal and surrounding territory), especially with the connection to the port of Lefkada and to the others port that bring to the Mediterranean islands

Map 10. incREse strategy_Touristic Airport_Axtion

For these reasons, the **incREase strategy** is approached to the cases of *Jyväskylä* and *Aktion* **airports**.

b. REuse

This design strategy provides for the maintenance of airport operation and hybridization with insertion of the functions of existing activities and related to the local context surrounding integration of urban functions. In particular, it's proposed the development of the potentials found in the analysis, in an attempt to merge the airport with the local context.

Araxos airport (next to Patras) is a typical airport that can work when and if is required. In the sense that it will a better solution to integrate with the city of Patras trough the de-localization of activities from the city (eg. The University, and research institutes) to the airport. Even more today, with the good connection between Athens and Patras, it seems not so relevant to transform Araxos airport in a big hub of airport connection. In this way, it provides that structure activity lasts all year and provides the local context new areas of economic growth and productive equipment. The air traffic, in this case, will be concentrated during the summer and connected to tourism in the region.
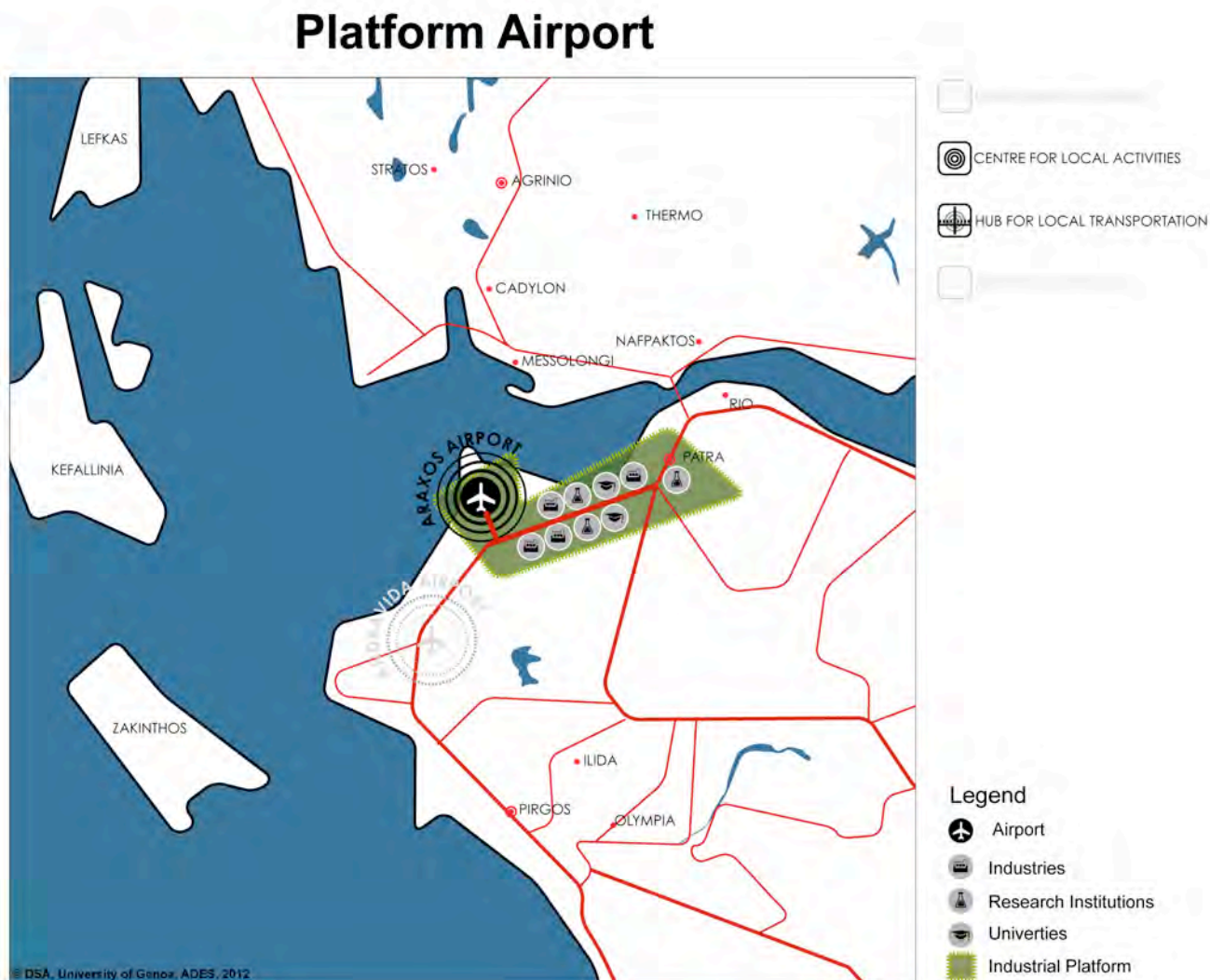

Map 11. REuse strategy_Platform Airport_Araxos

Villanova d'Albenga airport is "an essential qualitative piece to strengthen of the infrastructure system in the Province of Savona"[7]. The manufacturing and technological activity is qualified, the characteristics of the territory, the agriculture, the alimentary sector are growing sectors with a strong component of foreign trade (20% export), and the relevance of the tourism. In this airport the traffic peaks have always been linked to the most important events and activities of Cannes, Monaco and Côte d'Azur.

The transport is a consequence of the creation of a question. In the future it could be possible that new tourists will arrive with new flights carriers. However, tourists are not bringing by the creation of new flights. The creation of a touristic offer, the offer of hospitality, the promotion in Europe and in the world will attract tourists.

Industrial Airport
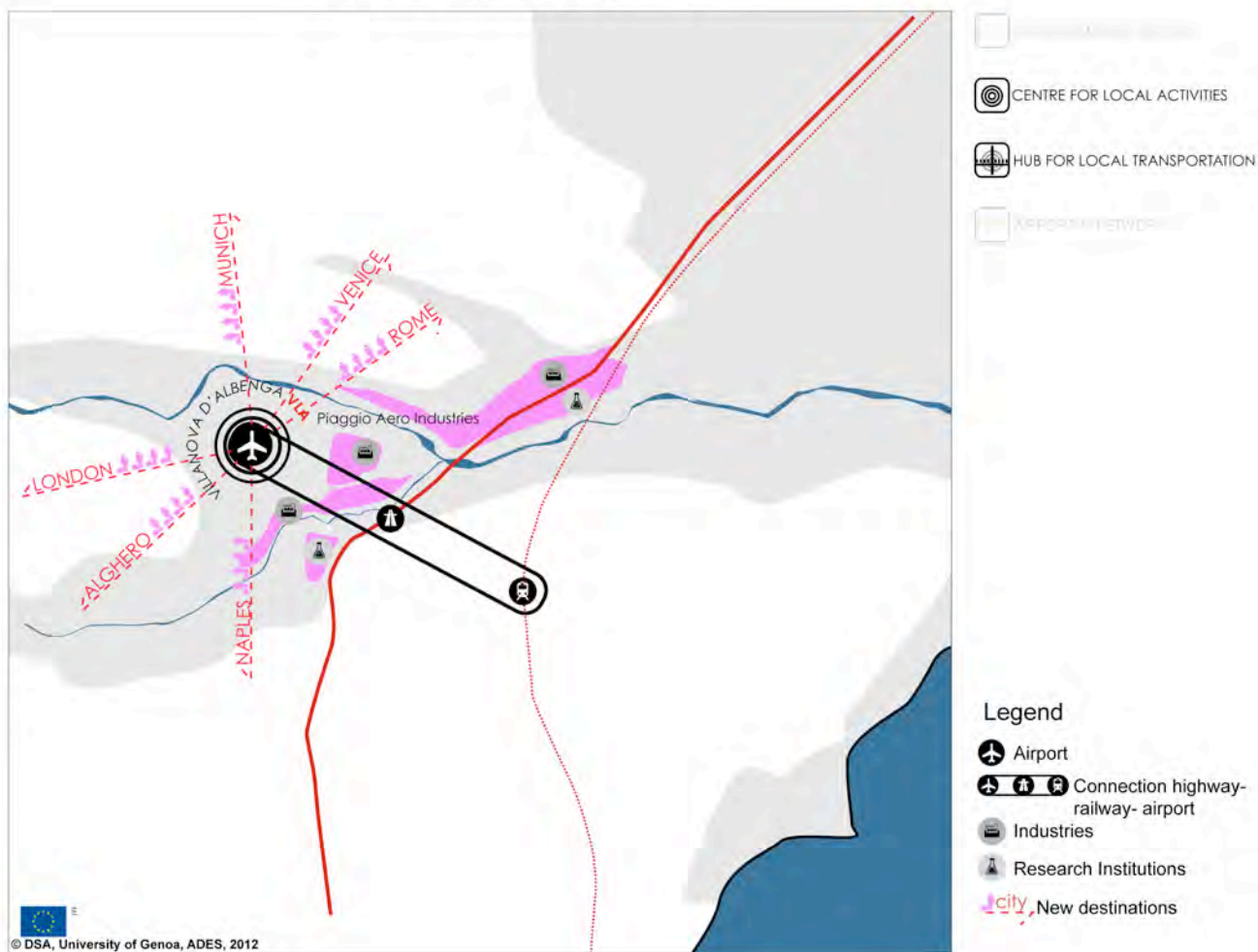
Map 12. REuse strategy_Industrial Airport_Villanova d'Albenga

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[7] L. Pasquale, President of Unioncamere, Liguria.

According to that, the development strategies of Villanova d'Albenga airport stress two directions. On one side, the possible further development of the airport is only in business aviation, or executive jet, because of the impossibility of accept all typologies of aeroplanes. On the other side, it's possible imagine that land is used to cultivate flowers and agricultural products by the society, in a further vision in which there is synergy between agricultural and touristic sectors (e.g. open air exhibition in the land; contemporary art events; etc.). Another interesting vision could be to work with the industrial sector that could find its localization in the flat land of Albenga. In this way, the growth of the airport could generate new possibilities to know the surrounding territories and enrich the poor local context. At last, the relationship with Nice and Canne airport is crucial because is a cross-border network and it will create a relationship that strengthens and generates growth in a *European region*.

According to that, the **REuse strategy** is approached to the cases of ***Araxos*** and ***Villanova d'Albenga*** **airport**.

c. REcycle
This design strategy provides for leaving the airport function in favour of a comprehensive recycling, reclaiming land from the old infrastructure of the landscape and the city's new urban development, with creation of parks and public facilities. In particular, it's proposed the development of the potentials found in the analysis, in an attempt to recycle the airport and give back to the city.

The primary aspect related to the recycle of small airports is the requalification and development of a good level of accessibility, allowing these to become dynamic centralities for the surrounding territory. In fact, more accessible larger scale national and international trade has often overshadowed these territories. Accessibility is therefore fundamental and central resource for territories, helping them to attract and re-activate diverse incoming flows, such as tourism, but also activities related to commerce, culture, education, health, agriculture, energy or high-tech technology. Value and anticipate the correct strategy of recycling airport is an increasingly urgent need to anticipate the inevitable decline of these structures and to activate recovery process in synergy with the different urban realities.

Andravida airport offers only military transport services. It is located in a strategical position in the Region of Western Greece. This area is ranked among the privileged areas of Greece in terms of existing natural, cultural and tourism advantages. In particular, it take advantage from the countless natural attractions of the inland and the mountainous areas, the large areas and the purity of the sea, the rich and rare ecosystems, the monasteries, the modern sports facilities, the convention centers, the growing and modernized tourist facilities compose a variety of comparative advantages. The growth potential of both industries (agriculture and tourism) is high if the airports development is combined with local development projects. Such projects, in

terms of tourism can be hotels and thematic tourism attractions, and combined transport services and usage of modern cultivating methods for agriculture. Moreover the strategic position of the region can foster international collaboration of local agricultural producers and touristic agents to neighboring EU countries. Furthermore, two airports already support the Region of Western Greece. It doesn't really need a new airport for transport operation.

In the possibility that the military activity will abandoned Andravida airport, the more realistic and desirable vision for the future of this airport is the complete recycle of it. Andravida airport could be the privileged place to be transformed a new natural attraction and urban facility. It has to be abandoned from the flights aviation in favour of a transformation of the land into a urban park, with the localization of recreation facilities, in order to improve the value of the surrounding territory.

Map 13. REcycle strategy_Andravida Eco Airpark_Masterplan

In that sense, the **REcycle strategy** could be approached to the cases of *Andravida* **airport** as a long-term future vision.

2.2 Recommendations for secondary airports in Europe

When it comes to recommendations, we have to distinguish between lessons for the regions on the one hand and lessons for the airports on the other hand (despite the fact, that in some regions the airport are owned or even managed by regional authorities).

a) Regional authorities

One of the strongest results of this study is that accessibility indeed matters. Thus, it is important for each and every region to be accessible. This is relevant for both people and companies, as well as from the region when travelling outbound as from other regions when travelling into this region. General **options** for peripheral regions to improve their accessibility and thereby their economic situation include:

- better airport infrastructure (like higher passenger capacity or longer runways)

- better flight services (more scheduled flights to relevant destinations)

- better transport infrastructure to airports (improvement of rail or road infrastructure)

- better public transport services to airports (improvement of rail or bus services)

- better other traffic infrastructure (better access to other regions by rail or road)

- better interregional transport services (more trains or bus services to relevant destinations)

Obviously, there is not one single recommendation for all regions. Our analysis shows that we have to distinguish several types of regions. We should distinguish two types of regions, of course being aware that the separating line between the two types is more a grey area than a clear solid line. The distinction depends on the localization of second and third tier airports with regard to major airport hub.

The first type defines regions far away from the next good airport (offering frequent flights to all relevant destinations) such as four or more hours by train or car. For these regions, the general findings include:

- Airport activities are relevant for economic performance

- Airport infrastructures are usually not the bottleneck

- Often a bottleneck are regular scheduled flights to relevant destinations

The second type includes regions rather close to the next good airport (offering frequent flights to all relevant destinations) such as three or less hours by train or car. For these regions, the situation is completely different and the general findings include:

- Airport activities are not relevant for economic performance

- Airport infrastructures and activities are usually not the bottleneck

- Often a bottleneck is a fast access to the "good" airport in the neighbour region

Thus, it is important for authorities of peripheral regions to know whether they belong to "type one" or "type two":

- Type one: regions far away from major airport hub: They need a functioning airport. Relevant is the time needed to relevant destinations, including the big European capital cities. To this end they need an airport with adequate infrastructures, fast access to the regional airport, frequent scheduled flights to relevant destinations (among them at least one big European hub)

- Type two: regions next to major airport hub. They do not need a functioning airport. Relevant is the time needed to relevant destinations, including the big European capital cities. To this end they need fast access to the next bigger airport with frequent scheduled flights to all relevant destinations (including all European hubs) by road and or rail.

Regarding the three stakeholder regions, we come to the following results:

- **Jyväskylä**: The fast train to Helsinki takes a bit more than 3 hours; thus, the plane is not much faster on a city to city basis than the train. The plane is only faster, when people want to travel further and need to change plane in Helsinki. Thus, Jyväskylä is in the grey zone between the two types.
  Nonetheless, better direct flight services to a greater hub (like Stockholm or Copenhagen) should have a positive effect to economic development in the region. As such flight operations may not be profitable, national or regional subsidies to the airport or airline companies may be an effective tool to enhance the flight schedule.

- **Western Greece**: The estimated time between Patras and Athens International airport is approximately 2 and a half hours by car. So it is definitely more convenient than airplane or fast train (which takes some 3 and a half hours). However since the region is lengthy this does not apply for all places within it. Some of them will need definitely more than 4 hours to the nearest airport. To this end the airport of Aktion should increase its scheduled flights, not only in the summer time. Better direct flight services (more scheduled flights to relevant destinations such as Athens, Frankfurt or London) should have a positive effect on economic development in the region. As such flight

operations may not be profitable, national or regional subsidies to the airport or airline companies may be an effective tool to enhance the flight schedule. In addition, better other traffic infrastructure (better access to other regions by rail or road, e.g. to Athens) will have a positive influence on the attractiveness of the region for people and business and therefore on economic performance. In that sense, regional efforts and investments should focus on just one regional airport with adequate flight density and public transport access: Aktion airport should be considered.

- **Savona**: The fast train from Savona to Genova just takes half an hour, to Milano and Nice it is two and half hours; thus, the train is faster on a city to city basis than the train.Savona belongs to type 2. The existing airport in Villanova d'Albenga is not really relevant for the accessibility of (the province of) Savona. However, better train links to Genova, Milano and Nice should increase the attractiveness of the region.
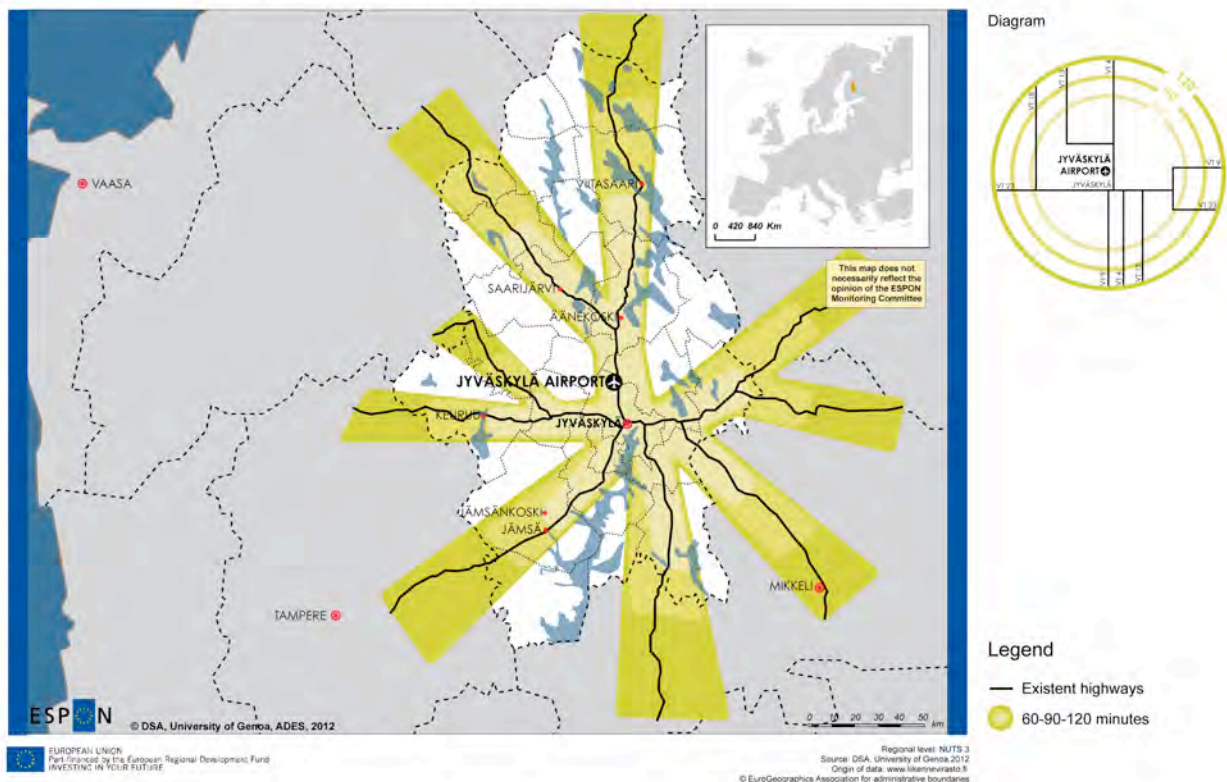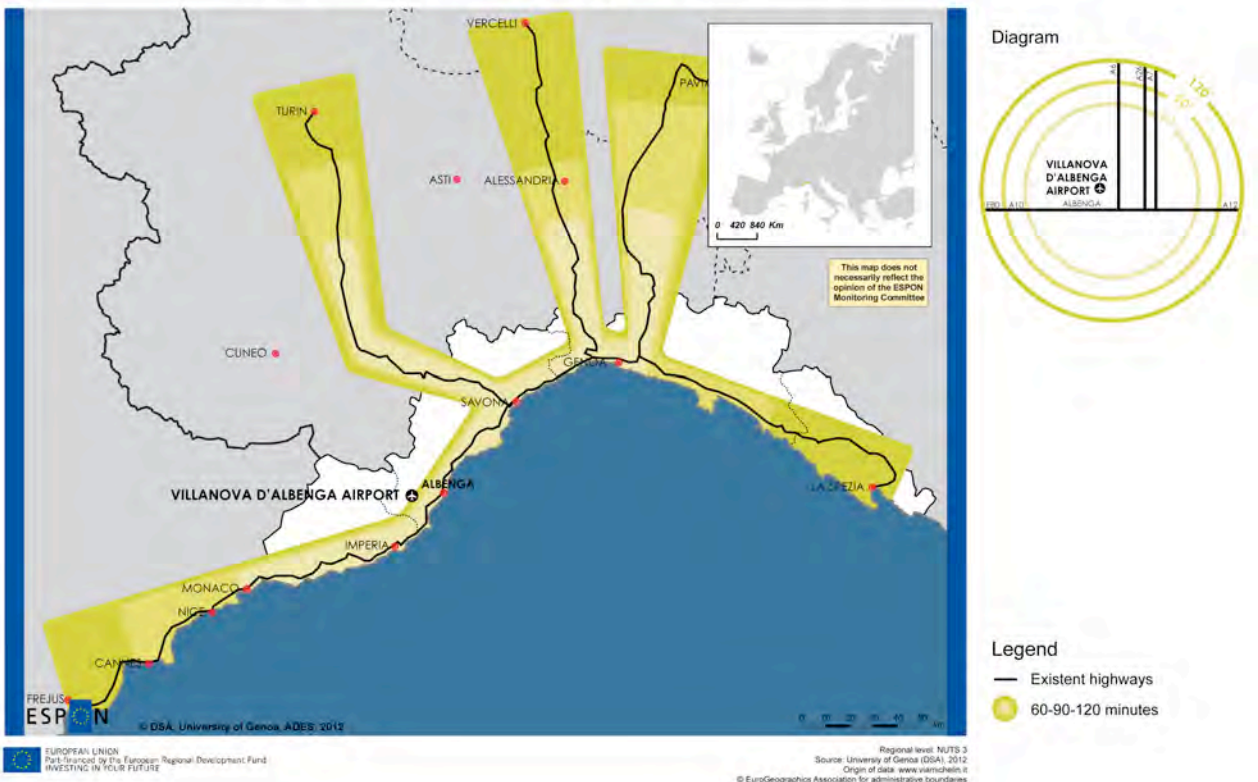

Map 14. Descriptive Maps_Infrastructure_Highways_Central Finland
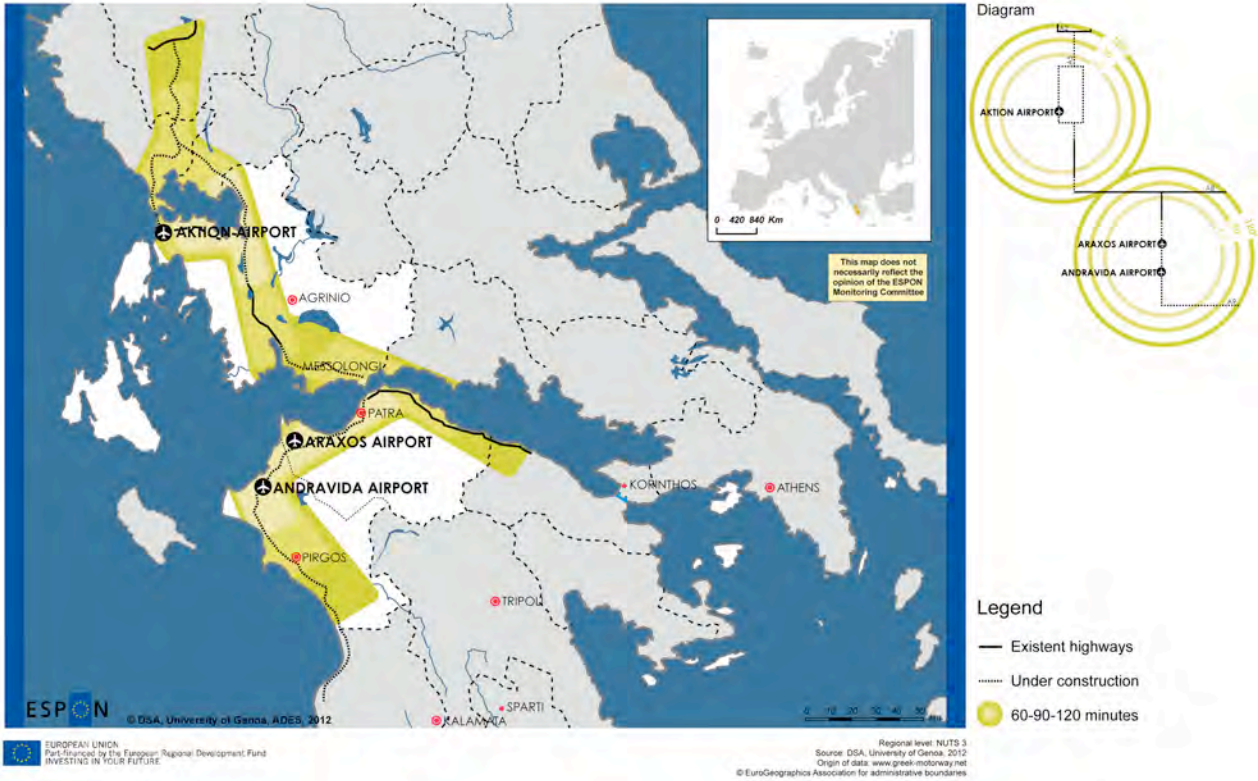
Map 15. Descriptive Maps_Infrastructure_Highways_Western Greece

Map 16. Descriptive Maps_Infrastructure_Highways_Province of Savona

b) Airport authorities

For airport representatives, the situation may differ from the situation of the regional authorities, particularly when their airport belongs rather to the second type (regions next to major airport hub).

- Airports in type one regions: improvement strategy: These airports are important for the accessibility and economic performance of the respective regions. Thus, number of scheduled flights to relevant destinations should be augmented to improve the accessibility of the whole region. Actions may include talks with airline companies as well as talks with regional and national authorities to get subsidies for destinations which are interesting for the region but tend generate losses for the airlines.

- Airports in type two regions: renewal strategy: These airports are not important for the accessibility and economic performance of the respective regions because the accessibility is granted by nearby airports in neighbouring regions. Thus, existing airports cannot expect to be subsidised and have to look for something else. They can stay an airport for private aviation or charter flights, or they can convert to something new (see the renewal strategies in the previous chapter).

Regarding the three stakeholder regions, we come to the following results:

- **Jyväskylä**: The problem is not the technical airport capacity, but rather the limited number of scheduled flights (only tree times a day to Helsinki) which are a bottleneck for economic development. Better direct flight services to Helsinki and to a greater hub (like Stockholm or Copenhagen) should have a positive effect to economic development in the region. As such flight operations may not be profitable in the short run, temporary subsidies from the national or regional authorities may be an effective tool to enhance the flight schedule.

- **Western Greece**: The bottleneck for economic development is not the lack of airport infrastructures, but rather the limited number of scheduled flights. Better flight services (more scheduled flights to relevant destinations such as Athens, Frankfurt or London) should have a positive effect to economic development in the region. As such flight operations may not be profitable, subsidies from the national or regional authorities may be an effective tool to enhance the flight schedule. In addition, an extension of charter activities may help to improve the profitability of the infrastructures.

- **Savona**: The existing airport in Villanova d'Albenga is not really relevant for the accessibility of (the province of) Savona. Thus, its future will hardly be an airport with scheduled flights. A renewal strategy is much more likely successful (and also effective for the region). All sort of new activities – both in aviation and in other fields – may help to overcome the current weaknesses. As displayed in *SciR_Chapter 3.6*, Villanova d'Albenga is already on its way to a new future.

3 Key analysis / diagnosis / findings and the most relevant indicators and maps

3.1 Maps

Maps are a powerful tools to visualise spatial data but they can be also a useful instrument to help decision makers to choose and define the best strategies for local development. They are essential implements of communication with the local context, and were developed to be instructions for use, in service of political actors and institutions in general.
Maps are divided in three groups:

- **Descriptive Maps**: to show the current situation
- **Concept Maps**: to represent the project essence and the *manifesto*
- **Vision Maps**: as a support for further development process

a. Descriptive Maps

The objective of *Descriptive Maps* is to visualize statistical information. For each region, *Descriptive Maps* outline the current situation. They show both the present situation and the changes over the last years in the three regions. The maps focus (among others) on the spatial profile and accessibility as well as regional transformations, new centralities, environmental mitigation and compensation. In the Draft Final Report were included the most representative maps to better explain and understand contexts or strategies. All the map are included in *Annex 3 _Book Map.*
The set of maps has been envisioned according to a precise structure, through which is possible understand the logical path of construction of each context and every consequential vision. In particular:

- **Europe**
  It is an overall image of Europe in which are juxtaposed ESPON maps of accessibility and GDP per capita. The comparison between these two maps is used to introduce two fundamental issues around the research work: economy and accessibility of each area. From these maps is possible to understand how seemingly inaccessible areas, can have, instead, a high level of production and economic. In contrast, regions well connected and equipped with infrastructure networks, reach rather low values of GDP. This situation leads to reflect on the importance of local contexts and the need to make insights at the regional scale.

- **Nation**
  In these three maps, one for each nation, are represented at national level the position of the main national airports. Airports are catalogued by the flow of passengers per annum (in reference to 2010 in particular). In this way there is an immediate image of the main airports hubs for each region. In particular, flows of passengers range from a maximum of 35 million in a year (e.g. Roma Fiumicino, Italy) and minimum of 100.000 in a year (e.g. Araxos, Western Greece).

- **Region**

  The first regional-scale map shows the three main statistical data on the peripheral regions in the studio: surface, population and density. The comparison of these data provides an interesting insight into the sheer diversity of the three territories: Central Finland has a surface of 19950 kmq and a population of only 274.000 inhabitants, Western Greece has a surface of 11350 kmq and a population of 741.282 inhabitants, Liguria, finally, has a surface of only 5420 kmq, but also a population of 1.616.788 inhabitants. The most significant is the density: 13,65 inhabitants/kmq for Central Finland, 66,37 inhabitants/kmq for Western Greece and even 298,3 inhabitants/kmq for Liguria.

  Below, was prepared a series of maps on a regional scale, for each region, represents the current environment through their specificity. In particular: infrastructures (highways, secondary roads, train, harbours, airports), industry and commerce (industrial districts and shopping malls), landscape heritage (parks and natural reserve, beaches, blue flags, orange flags, monuments), public services (sport complex, hospitals), education and research (universities, research institutions). Each system is rational and is interpreted through conceptual and synthetic diagrams.

- **Airports**

  In this structure the connection between Descriptive Maps and Vision Maps is realized through the introduction of three maps on the airports, themes of the research. They are like ID cards and contain all the basic information on the airports of Jyväskylä, Andravida, Araxos, Aktion and Villanova d'Albenga. In particular, surface, number of employees, flows of passengers, length and characteristics of the track, etc.
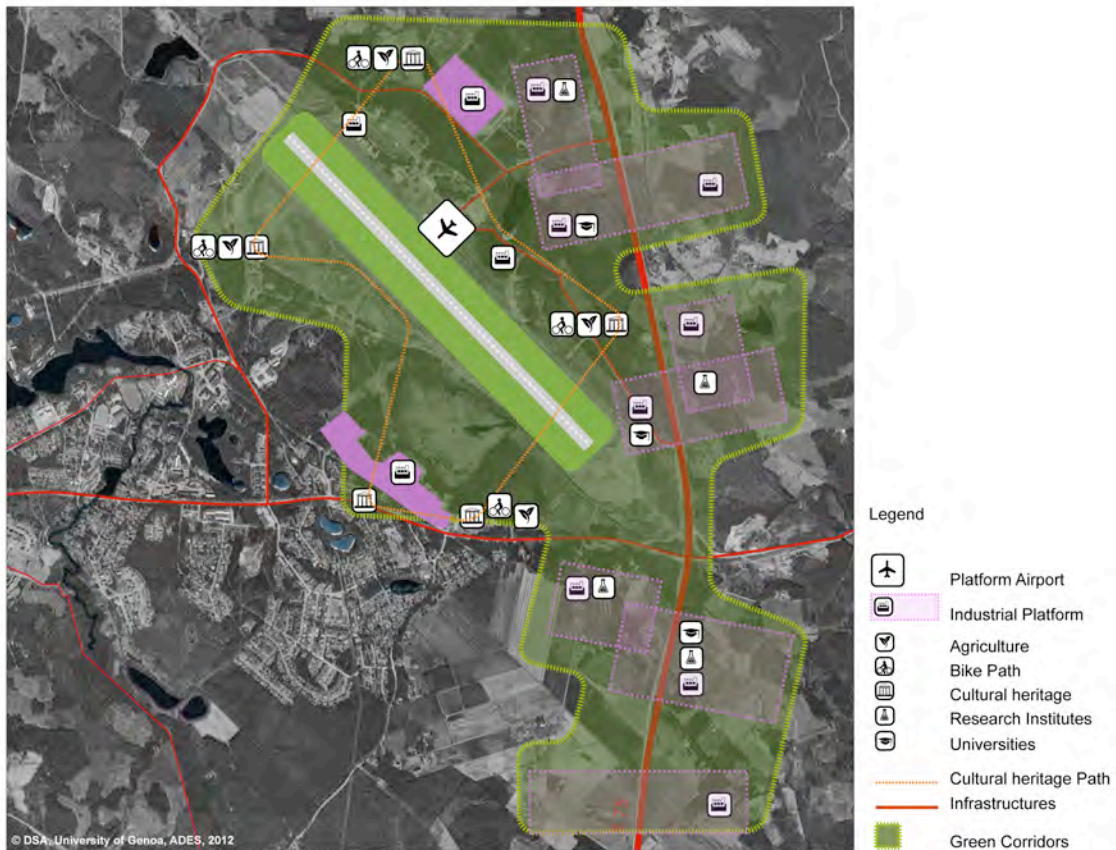
b. Concept Maps

The *Concept* of *osmotic airport* introduces this group of maps. The concept is an abstract image describing the inner nature of the project and at the same time represents its essence and manifesto. Through one icon-image, the *osmotic concept* clearly defines the ways to describe the transformation of physical space: it establishes a stronger relation between the infrastructure and their surrounding territories. At the same time the territories gain an economic improvement and new uses for the airports.

c. Vision Maps

The objective of *Vision Maps* is drawing a set of images that visualise potential futures and possible further development, specifically of the transportation system. Vision maps explore potential new assets; they use design as analysis and methodological support for strategic processes.

Airport infrastructure for its dimension and relations with the territory is a potential catalytic agent and an activator of contexts: airports as generators of development in peripheral regions but also as generators of a new image for the area and of themselves. As introduced above, the logic for intervention in various areas is obviously different, depending on contextual analyzes conducted and results obtained.

Platform Airport

Legend

- ✈ Platform Airport
- ⬭ Industrial Platform
- ⱴ Agriculture
- ⚴ Bike Path
- ⯐ Cultural heritage
- ⓐ Research Institutes
- ⓤ Universities
- ⋯ Cultural heritage Path
- — Infrastructures
- ▦ Green Corridors

Map 17. Platform Airport_ Jyväskylä _Masterplan

Touristic Airport

LEFKADA

KEFALLINIA   ITHAKI

Legend

- ✈ Touristic Airport
- ⱴ Renewable energy
- ⓘ Information
- ▦ Shops
- ⬭ Accomodation
- 🚗 Car rental
- 🍴 Restaurants-Bars
- ⚓ Harbour
- — Commercial axis
- ⋯ Maritime routes
- ▦ Buffer zone-Green corridors

Map 18. Touristic Airport_Axtion_Masterplan

Logistic Airport

Map 19. Logistic Airport_Villanova d'Albenga_Masterplan
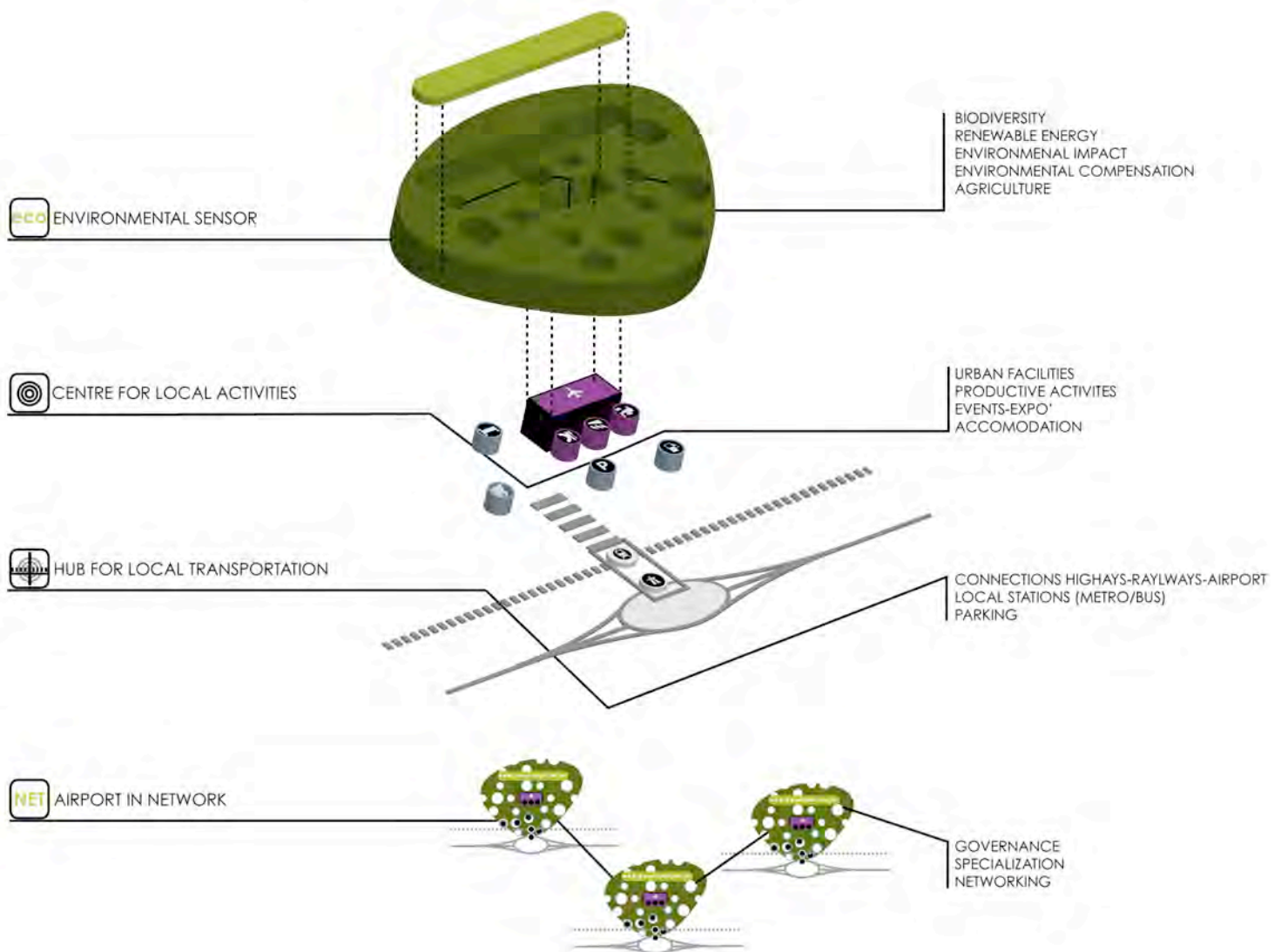
3.2 *Osmotic Airports*: 4 devices

The **osmotic airport** is *a place to live before a place to leave*. It establishs a stronger relation between the infrastructure and their surrounding territories. At the same time they will gain an economic improvement and new uses for the airports. The goal is to allow the economic growth of the territory without the construction of new big infrastructure and buildings.

In that sense, the *osmotic airport* is organised to satisfy not only one specific sector (flight operation) but it could adapt itself and its efficiency in relation to the surrounding context and business, it could exchange fluxes (physical and immaterial) with the surrounding territory and it could accommodate multiple functions, as in the Postmodern examples (see *SciR_Chapter 1.3*).

4 tools drive the osmosis process:

- (a.) Airport as environmental sensor
- (b.) Airport as services centre for local activities
- (c.) Airport as hub for local transportation
- (d.) Airport in network

Network devices

ENVIRONMENTAL SENSOR

BIODIVERSITY
RENEWABLE ENERGY
ENVIRONMENAL IMPACT
ENVIRONMENTAL COMPENSATION
AGRICULTURE

CENTRE FOR LOCAL ACTIVITIES

URBAN FACILITIES
PRODUCTIVE ACTIVITES
EVENTS-EXPO'
ACCOMODATION

HUB FOR LOCAL TRANSPORTATION

CONNECTIONS HIGHAYS-RAYLWAYS-AIRPORT
LOCAL STATIONS (METRO/BUS)
PARKING

AIRPORT IN NETWORK

GOVERNANCE
SPECIALIZATION
NETWORKING

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Map 20. *Osmotic Airport* devices

a. Airport as environmental sensor
The first tool deals with the environmental and landscape implication of airports, such us mitigation of impacts and risks. An airport is an environment detractor. Its impacts are produced by the ground structures - land use, light pollution, interference with wildlife and vegetation - and by the aviation activity of the airport - pollution emissions and interference with the birds.
Conformity to the regulations and standards imposed by current legislation, *osmotic airport*, for its dimension and its relation with the territory, is develop as a landscape operation.

This tool defines an environmental code in order to invest on policies of environmental protection. In that sense, the project becomes a project of landscape, where noise barriers, new green areas, re-permeable soils (e.g.

runways in grass), are no longer considered mere technical devices, but an integrated piece of a new landscape. This also allowed to reduce the consumption of recourses and the protection of biodiversity, especially trough the preservation and integration of green corridors. The buffer zone is a filter/barrier but it is also the place to reconnect parts of the territory through environmental linear infrastructure (ecological corridors) and heterogeneous and punctual elements (stepping stones). According to this device, the airport hosts the technologies for the production of renewable energy - wind, biomass, solar, photovoltaic.

b. Airport as services centre for local activities
This tool stresses the integration of the airport in the territory, by including services connected with the local production. In that sense, a priority is to improve the airport as a logistic hub. In fact, the development of economies, businesses and settlements, will enhance the attractiveness of local contexts. Regional offices of big companies and institutions, representative offices of categories, centres for conference and business meetings (consulting, advertising, legal and financial, informational, commercial, administrative, firms), technology and communication industries, high-tech research centres could settled in the airport territory: so, it becomes more valuable in the market, and therefore it is a resources and specificity for the region.

This tool defines an integrated process to increase the functions in the airport. This is refers not only to the flight operations (for example: storage for planes, production of planes, business aviation, school of aviation), but also to include productive functions in the airport that allow to use the airport as **a new territorial centrality of local production** (as explained through examples in *SciR_Chapter 1.3*). This will gain the opportunity to have benefits from the airport also when it is not use for flight operation.

Currently, Villanova d'Albenga Airport is already in progress the collaboration with the Piaggio Aero Industries. Piaggio has located one of its industries in the land owned by the airport. This industry is specialized in designing, producing and testing mechanical part for aircrafts. It has now 700 employees and it supposed to be the main plant of this industry in Liguria.

c. Airport as hub for local transportation
Around airports and along the infrastructure system of accessibility there is a growing concentration of activity that develops new forms of urban settlement. The airport and the immediate area are themselves trading centre and transport media that induce new territorial dynamics and influence new landscapes.

According to the guidelines of the European infrastructure development plan for 2014-2020, is to increase the airport connections with smaller networks of the surrounding territory, in order to bring the airport in better condition and to improve the organization in network. In that sense, this device proposes the **integration with local transport systems such as railways and local**

buses. This provides an integration with the planning of local infrastructure system. Better train links to the nearest main cities should increase the attractiveness and the accessibility of the airport and, indeed, of the region.

d. Airport in network

A territorial synergy (networking) between nearby airports drives a cooperation of airports. It will increase complementarities and, at the same time, specialisation of each airports. The airport in network strengthens and creates growth opportunities in a European point of view. A governance of systems will drive this cooperation. Representatives of each airports will be involved in the Management Committee of the others airports. All representatives of the airports approve a shared commercial policy: **an overspecialization of airports to overcome the competition.**

Villanova d'Albenga airport, with Nice and Cannes airports, is an operative example of an international cooperation. In that case, Nice Airport is the international big hub. Cannes Airport will be specialized in business aviation. Villanova d'Albenga will be the developed by hangar for the aircrafts' maintenance of all airports.
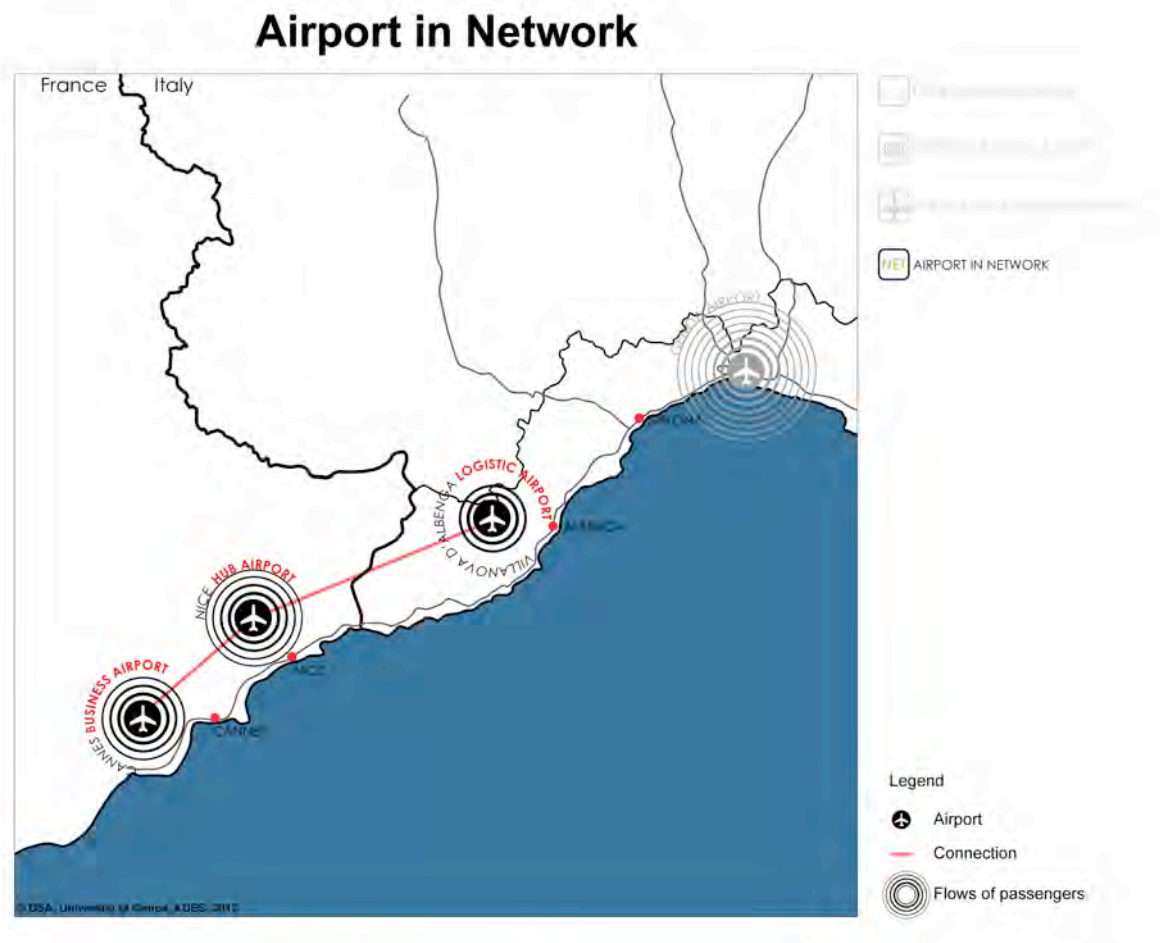
Map 21. Airport in Network_Villanova d'Albenga Airport

4 Issues for further analytical work and research, data gaps to overcome

There are a few issues for further work. A first extension is on the geographical scale. The present study was executed only for regions in Western Europe (in the borders of 1989). This is due to the fact, that regions in Eastern Europe have a completely different history and thus a completely different path of evolution. Technically speaking, regions in Western Europe and in Eastern Europe do not belong to the same population and should, therefore, not be analysed at the same time. However, it should be interesting to make a similar analysis for peripheral regions in Eastern Europe (including data, empirical analysis and case studies).

On the analytical side, this project focussed on accessibility in general and airports in particular. A further study field should be the cooperation between different transport modes in the various regions. The research question might ask for the optimal mix of transport infrastructure and services in a given region, including rail, road, and air.

In a dynamic view, future research should include also prices for both transport services and for the use of the traffic infrastructure and account for the impact of high capacity utilization not only on prices but also on the supply on the respective markets.

4.1 Concluding remarks

The results of this targeted analysis show that accessibility is an important factor for economic performance in Europe. Large regions with big cities and their airports usually profit from large demand for transportation services. These demand side effects dominate the development of infrastructures and traffic services and thus induces supply side effects. I addition, the resulting good accessibility will contribute to further economic performance. The result of this process is a positive self-accelerating process between economic performance and accessibility.

Smaller regions usually do not profit from such effects. On the contrary, there is even the risk of a downward accelerating process (some kind of a vicious circle), where poor economic performance only requires poor accessibility, which in turn has a negative impact on economic development. Therefore, it is necessary to break up this vicious circle a set a positive impulse. Depending on the concrete situation of a region, this can be a subsidy for additional scheduled flights to the next relevant hub.

However, airports often offer the opportunity for improvement not only in the field of air traffic, but rather in many other dimensions. In this study, we showed various renewal strategies for existing airports, be they used or rather unused and waiting for new tasks.

C   Scientific report

1. INTRODUCTION

The EU cohesion goal calls particularly for an improvement of the framework conditions of peripheral or remote regions. Better accessibility is one of the means to move towards this goal.

Economies of scale and agglomeration effects in favour of big conurbations (or even mega cities) are generally accepted. However, it is widely accepted that there are also diseconomies from rising costs to industry, due to increasing cost of land and labour, traffic congestion, crime etc, which make smaller cities and city nets more valuable than very large cities. Measured in pure terms of GDP per capita, the effect of a polycentric territorial development is likely to be underestimated. Even when looking at growth, GDP per capita growth figures will tend to be biased in favour of larger cities as they ignore negative external effects which will prevail in large conurbations.

Measures of level or changes in wellbeing would – were they widely available – clearly be in favour of smaller cities and peripheral regions, as such measures take all negative externalities into account. As a consequence, growth policy in the sense of maximizing human wellbeing in Europe should focus primarily on peripheral or remote cities and regions. This will also help establishing a more balanced territorial development.

Academic research has shown that accessibility is one of several relevant location factors. As it is quite obvious that it is hardly feasible for every region in Europe to have a large airport, the project will not only discuss the role of airports for economic and social development, but also in which cases (regions, cities) which type and quality of transport services (and infrastructure) best suit the needs of the population (airports, rail links, highways).

The main question to be answered is: What is the optimal amount and optimal mix of traffic infrastructure for different types of peripheral regions?

1.1 Significance of ADES Research
The project deals primarily with the relation between accessibility, airport development, territorial challenges and economic prosperity.

Since the late Nineties, the development of the infrastructures networks caused an unexpected acceleration in the changing process at the urban scale. In Europe, during the last centuries, the transformations of the urban settlements leaded the growth of the industrial city. This generated a complex change in the way of thinking and living the territory, the landscape and the city. The infrastructures characterized these processes. The grafts of Pan-European transport corridors had an impact on the attractiveness and competiveness of the urban areas. It is clear how new economies influence relations and exchanges between territories. New temporal regimes are

identified by new work life and social attitudes. These ways of life brought new uses for the territories that expressed different population with different social condition and different organization of time.

A direct relation between activities and places is not anymore an essential condition. The measurement of physical distances has less significance[1]. The cities have lost a delimited physical connotation and they become more fields of relations[2]. The *neverending city*, which today draws the ways of living in Italy and in Europe, is the result of a myriad of autonomous decisions - generated by the intensity of interconnections - that affect the structure and forms of all[3].

A continuous urbanized landscape has joined in new metropolitan conurbations - *constellations of identity*: these conurbations are able to compete in the global market. Cities once dominant, have seen resized their importance. Others cities have reach a central and a new territorial role in the junctions of infrastructure networks. The urban geography traced by the speed of the infrastructure networks has promoted several territories and has marginalized others. These processes directly involved the space, the lives and imaginations of the citizens. In other words, at the end of last century, these urban transformations have supported the post-modern idea that not the productions but rather the connections create the fundamental conditions for the economic growth of regions and territories.

It is a conviction that directly relates the future of the local population with the myth of infrastructure development. This has driven the European policies in order to fund the territorial cohesion and the investments on the physical forms of urban sprawl[4]. It activated processes of urban regeneration in the areas around the infrastructure hubs. It also generated a different culture of the city and the landscape and it created new landmarks in the *neverending city*. The AV corridors, the new big airport hubs, the Euro Tunnel, Euralille, the Öresund bridge, but also the high speed train station, the projects for the bridge over the Stretto di Messina and the stations High speed (and changes brought while it is waited the project realization), are among the most visible effects - and more extreme - of the *super*-infrastructures in the European territories.

This view of growth is mainly based on three principles axiomatic.
The first is deterministic: the infrastructures produce economic development

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[1] Cfr. Franco Farinelli, *L'invenzione della Terra,* Sellerio, Palermo, 2007.

[2] Cfr. Zygmund Bauman, *Liquid Modernity*, Polity Press, Cambridge, 2000.
[3] Cfr. Bonomi A., Abruzzese A., La città infinita, B. Mondadori, Milano, 2004.

[4] The European Union has assigned an important role to the transport sector in the actions of urban renewal. Maastricht introduced the concept of the Trans-European Network of Infrastructure for energy, transport and telecommunications (TEN). In this framework have been identified 10 guidelines multimodal Pan-European or Trans-European Corridors. This powerful skeleton attracts industrial districts, services, and commercial areas, and it causes the quaternary transformation of the city. The Trans-European rail corridors are an opportunity to rebalance the urban framework. In Italy a logistics network should have been made in order to connect the main rail terminals to the productive areas, to the main ports and to the markets of Central, Eastern and Western Europe.

in peripheral areas. The second, almost the reciprocal of the first, asserts that there is no economic development without new infrastructures. For the third axiom the development of infrastructure networks gives value to new landscape: a landscape which brings together speed and permanence, cathedrals and shopping malls, metropolis and *strapaese* (ruralism), the traces of the history and the unclear figures of the change[5].

At the present time, none of these axioms seems to be valid, neither the third. The economical and environmental crisis has radically changed the way we look to the future. The resources to build new infrastructures have been cut down. But it is not only a matter of this. The data of abandoned infrastructures, but also the conflicts over the construction of the AV and the directives of the 2014-2020 funding[6] give the measures of how much the new European Governance is questioning not only local development strategies, but also the principles that guided the regional policies about infrastructure in the last century. It is important to reflect on contemporary city and on its future. A new urbanity has been gradually defined by new environmental and landscape qualities with a higher respect and consideration on local territories and identities.

This is profoundly changing not only contexts and topics, but also the way to project infrastructures. It happens at architectonic, urban and landscape scale. It subverts the axioms of *super*-infrastructure.

The peripheral territory. The infrastructures. The crisis
The phenomena of urban sprawl, the 'loss of centre', the role of infrastructure, and the 'fusion' between city and country are widely studied territorial and urban transformation phenomena, starting from the '60s.

Where the city 'invades' everything, it still makes sense to talk about periphery?

Economists consider what is peripheral as a consequence of multiple factors: accessibility, intensity of flows transport and domestic product per capita (GDP). According to this interpretation, the areas less accessible are the more peripheral. At the same time, the territories with less regular flows (transport of persons or goods) are the areas where there is more poverty.

Peripheral territories exist: these are a recognized and widespread reality. The definition of *peripheral* commonly came out from an Eurocentric vision of the world. Defining what is peripheral in Europe is a very difficult and ambiguous issue. Its definition can be in a superficial way declined to indicators that determine a *peripherality* based on the data considered each single time. The first objective is therefore to change the point of view, from national to local scale, by combining information provided by the indexes to establish parameters by which define what is peripheral in relation with each

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[5] This new landscape is defined by the European Landscape Convention in 2000.

[6] Cfr. EU Cohesion Policy 2012-2020, European Commission
http://ec.europa.eu/regional_policy/sources/docgener/panorama/pdf/mag40/mag40_it.pdf

local territories.

In Italy, the history of modern and pre-modern infrastructures coincides with the need to connect different places and territories of a country affected by a complex geography in order to save them from isolation and marginalization. After the Second World War, roads and highways were carried out to assert the emancipation of national economic *boom* from poverty. Through the construction of new infrastructures, peripheral areas became less remote and more related to central geographic, economic, territorial, commonly recognized (in terms of geography, economy or territory). If from one side the construction always moved money, economy and construction market, on the other, once construction is completed, these facilities often remain isolated, proving that the best strategy would perhaps have been not to build them at all. Hence the paradox: the infrastructures, instead of integrating territories and implementing local deficiency, become the main problem.

The infrastructure, without real and widespread processes of economic support, and without coherent strategies and territorial projects, don't generate any development. A new infrastructure supports forms of development where these processes are already in place. The theme, in the last 50 years, has also been associated to the impact of the urban phenomenon, that is the end of the compact city which has come to be the sprawl city without limits, where the continuous consumption of land has seconded a model that forced expansion, and forces the connection of many points in a network that tends to the limits of the urban expansion, hence the spread of road networks with an exponentially increasing of the individual use of cars. A well known and widely investigated model, which produced extensive suburbs, marginality, precarious economic development, heavy pollution and that only recently stimulates deep thought.

But things are changing and the persistence of a crisis that changes the nature of the phenomena, their speed and priority of the solutions requires new forms of analysis and sustainable alternatives with the new context that will lead to a greater sensitivity with respect to change and persistencies of the present time. In this framework, the infrastructure becomes the main topic: one thing is to talk about the infrastructure issues in a context of development, and another thing is to talk about it in a state of constant slowdown and perhaps even a stable situation.

Through the accessibility infrastructure has a different reading: in those areas where accessibility is weak, this does not ignore the total lack of infrastructure, but rather to reflect on the fact that many areas have unused infrastructure. At the same time there are areas that are economically developed but are not equipped with a superstructure infrastructure, revealing how accessibility, economic development and peripheral issues are trans-scalar to each other but can also develop in parallel planes.

Going back to original question, does physical infrastructures (roads, railways, airports) to really develop peripheral territories? According to the data set out above, the answer maybe not: at least not always, for three

reasons.

I. The *peripherality* in the European territories today is an ambiguous condition, perhaps more a social issue than a geographical question. It depends from the development processes that are not necessarily related to the intensity of physical connections and material flows of people or things. There are peripheral areas in the heart of large metropolitan areas and it is possible to identify important centralities in remote areas. Furthermore some territories economically well developed limited their accessibility and connections: an *enclave* territory as an affirmation of local identity. For example the Alto Adige or the surrounding areas of Cuneo are the richest and most developed regions of the Italian territory but the accessibility is limited. Also some Greek islands, those suffering less the crisis, are classified as economically peripheral areas in the European Union only because they don't have a high development of infrastructures and they are far from the main flows of traffic.

II. In the European *neverending city*, the periphery as a physical space does not exist by definition. Each place can be at the same time the central or peripheral with respect to the various immaterial networks of relationships that structure the settlement around the world.

III. Somehow the physical space of the major material networks in Europe is saturated. The physical infrastructures are already built and there are no more funds for all new interventions that were planned. The European funds planned for the period 2014-2020 are geared towards the development of interconnections with the networks of corridors minute local, the creation of new hubs light to the government of the effects on cities.

The European funding planned for the period 2014-2020 is geared towards the development of the corridors whit local networks, to the creation of new slight hubs (it seems ended the era of big railway stations and fast competition with the airports), and to govern the effects on cities. Furthermore, many local population do not accept anymore that the environmental and landscape quality of their territories could be damage by new heavy construction. The increasing social conflicts for the construction of the high-speed train line are graver in peripheral contexts: this indicates the need to change the paradigm.

This actual condition also explains the irrelevance of the axiom for which there is no development without new infrastructure. The Europeans landscapes are full by the ruins of this statement. There is a widespread situation of underused infrastructures that have never managed to reach their potential or have lost their central role. They partially or totally lost their uses and brought negative economic consequences on their surrounding contexts.

In Italy, for example, there are more than 6000 km of abandoned railway lines: these lines are closed to traffic, unfinished lines and variations of the

main route[7]. There is a widespread number of stations and tollbooths abandoned or partially used, including some recently built. There are 114 airports open to traffic. 13 of these are used only for military operations. Furthermore there are hundreds airfields and heliports suitable for landing. Only 39 of these airports are classified as commercial airports and not all have a regular traffic of flights[8]. It is not possible to list all the abandoned or underused roads. In that sense, it is significant the research of Mirko Guaralda on abandoned infrastructures[9], or the icon-project of Elisabetta Terragni for the Historical Museum of Trentino[10] where an high-speed road becomes an extraordinary public space for culture and representation of local identity (see below *Chapter 1.3b*).

Therefore questioning the nature of the infrastructure, with particular attention to airport infrastructure, becomes a key consideration in the approach to this research topic. Airport infrastructure for its dimension and relations with the territory is a catalytic agent and an activator of contexts: airports as generators of development in peripheral regions but also as generators of a new image for the area and of themselves.

In particular, the re-use of secondary airports, projecting the territory in the European network of mobility, offers interesting potentialities of development. The key question becomes the land use management: an operative airport in an international context attracts other functions and activities not strictly related to air traffic, as input to the local economy of the territory. Therefore the need to understand the nature of these transformations, to govern them coherently and in line with the contextual situations in which these are developed, making the presence of a regional airport a positive energy for territorial development and also for the community, and not the cause of negative externalities. Attention must be given to the structuring of the airport complex, that is the study of the dynamics of the location of new businesses, service facilities and transport infrastructure, the consequences for pollution, the occupation of agricultural land, the compromising of natural areas, etc. Therefore the goal is to understand what is the sustainability of these interventions for the territories. This issue will be developed by ADES Research through operative strategies elaborated on the ADES case studies.

1.2 Methodology

At the heart of this highly participatory project were interdisciplinary discussions held in three learning network workshops in the three stakeholder countries (Genoa, Athens and one Skype meeting). In addition, a number of focus groups and meetings with local stakeholders were also held. These had a substantial impact on the development of the ADES project. Already in this first phase, many learning network members posed critical questions that had

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[7] Cfr. http://www.ferrovieabbandonate.it, dati Associazione Italiana Greenways, 2012

[8] Cfr. Mosè Ricci*, iSpace*, Meltemi editore, Roma, 2009.

[9] Cfr. Mirko Guaralda, *Le infrastrutture viarie dismesse o declassate ed il progetto di paesaggio.* Libreria CLUP Soc. Coop., Segrate (MI), 2006.
[10] Cfr. Pippo Ciorra, Sara Marini (a cura di) *Re-cycle*, Electa, Milano, 2011

to be reflected on and resolved. This means that the project didn't always follow the straight time and methodology line as originally anticipated in the project proposal but often modified its timetable following the input of different stakeholders and partners.

However, the methodology is structured on two main parallel levels: the empirical analysis and the case studies analysis. The empirical analyses focus more on the general case using data from many regions throughout Europe. The case studies analyses focus on the three stakeholder regions. They are crucial to highlight specific characteristics and to identify guidelines for the airports' future.

The methodology of the project can be summarised as follows:

(A) Empirical work:

- Data base and benchmarking

- Panel causality tests

- Structural regression analysis

- Frontier analysis (DEA)

(B) Case studies in the stakeholder regions

- City of Jyväskylä – Finland

- Region of Western Greece – Greece

- Province of Savona – Italy

(C) Consistent summary of all results and policy recommendations

Part A looks at many regions. Using a common database covering several hundred regions, we use three different empirical methods to catch different dimensions of the same issue: What is the relation between accessibility and economic performance? The three different methods highlight different aspects. The causality tests focus on the question whether the direction of influence goes from accessibility to economic performance emphasising supply side elements, or whether it rather goes from economic activities to accessibility emphasising demand side elements. While these results are qualitative, the structural regressions estimate numerically the size of such influences. Thus, it is possible to see how relevant the impact of accessibility is relative to other regional location factors. The frontier analysis finally will show the degree of production efficiency of each region and bring out the limiting factors. This will give answer to the question whether an insufficient traffic infrastructure is a limiting factor for the economic development of a region.

Part B focuses on the three stakeholder regions to discuss the general results obtained in *Part A* on the very concrete basis of just a few real regions. Here it is not a statistical average; it is rather the socio-political and economic reality of three European peripheral regions. What is their situation, how do their economic leaders and policymakers analyse and judge their very situation? What is the need of the regions for accessibility and transport services, how do they see the situation of their own region? To answer these questions, we use several methods (1) a benchmarking analysis with a systematic comparison of the three regions with other European regions; (2)

a topological and socio-geographical analysis in the context of the transportation facilities including neighbouring regions; (3) an analysis of the airports of the respective regions and their role for the regional economies (a detailed description will be captured in the *Draft Final Report*). This part is supported by the presentation of other projects (see *Annex 5*) that transformed abandoned or obsolete airports in new urban centralities.

Part C is a synthesis of all the results obtained above. We shall bear in mind that using such an abundance of different types of analysis, not all results may be consistent. It will be the task of this *Part C* to interpret all results and form a consistent view of the transportation reality of peripheral regions in Europe which is strong enough to be base for solid policy recommendations. In addition, a set of maps will be deliverd by the TPG (see *Chapter 5*). Maps are essential implements of communication with the local context, and were developed to be instructions for use, in service of political actors and institutions in general. ADES Maps are divided into two groups: *Descriptive Maps* (to show the current situation) and *Vision Maps* (as a support for further development process).

To ensure optimal effectiveness and efficiency of the ADES project, effective and timely communication is crucial during the whole project. **(D) A dissemination strategy** coordinates the presentations of results and the calendar of events for the communication of the project. The TPG will contribute actively to all the dissemination events organised by the Stakeholders, providing relevant information, presentations and support at local level through the local experts, as well as attending transnational events and dedicated meetings of umbrella organisations where required.

During these months, the TPG was already involved in different national and international events in which the partners presented and discussed the results of the first research phase. We plan to participate in even more ESPON events, international seminars and local events to presents the project and further research results. We indicate a detailed list of events (see *Annex 4*) in which different TPG partners participated. The research activities have already progressed considerably. The main challenge now is to bring all results together, compose consistent results and formulate adequate policy recommendations.

The Final Report will be submitted by the 31st January 2013.

1.3 Literature review

a) Economic studies on accessibility
There are numerous studies addressing the economic effects of (regional) airports or transport infrastructure in general. Montalvo (2007) analyzes different methodologies to measure the economic impact of airports. The main classification of impacts makes a division into direct, indirect and induced effects. The latter effects are usually determined by the input-output methodology. The basic questions concerning the choice of the methodology

are additionality and transferability. Moreover, he spots a trade-off between scientific standards and practical considerations when doing an impact study.

A similar study was done by the Transporation Research Board (2008). It focuses on the methods and models used in economic impact studies. According to the authors there are three principal methods: the input-output method, a collection of benefit methods (quantitative and qualitative measures of benefits and costs such as saved time and avoided costs by using air transportation) and the catalytic method. Even though the method most often used is the input-output method, the relatively new catalytic method is best suited for the analysis. Nevertheless several limitations in the state-of-the-art approaches were identified.

There are also several studies measuring the regional impact of an airport in a case study framework. Hakfoort, Poot and Rietveld (2001) for example measure the impact of the Amsterdam Schiphol Airport on the Greater Amsterdam Region using an input-output model. Of course the airport of Amsterdam is a hub and not at all a regional airport. They claim that one job on the airport leads to about one job in indirect and induced employment. Between 1987 and 1998 an additional employment of 48'000 jobs was created in the region by the growth of the airport. The authors mention two limitations of their analysis: First, they did not do a full cost-benefit analysis. For instance, they did not take into account the negative externalities. Second, the economic impact of this particular airport can be much wider than assumed since Schiphol Airport is the only major airport in the Netherlands and there are good connections to other parts of the country by train and car.

Britton, Cooper and Tinsley (2005) develop a robust methodology to measure the economic catalytic effects of air transport in Europe. Catalytic effects include the economic effects from the contribution of air transport to tourism and trade as well as the contribution to productivity and GDP. The economic catalytic effects were already substantial and were expected to increase in the future, according to the research project.

In another study, Kupfer and Lagneaux (2009) examine the importance of air transport and airport activities in Belgium. They conclude that the direct and indirect activities in 2006 accounted for roughly 6.2 billion Euro, i.e. two percent of Belgium's GDP and domestic employment. In addition the authors point out that most Belgian airports are specialised (air cargo, low-cost passenger transport or business travel).

Button and Taylor (2000) examine the connection between international air transportation and economic development. They develop a modeling framework to examine the effects of further liberalisation of air transportation business on the economies of US regions that have limited international services. They conclude, that "there are links between the economic structures of surrounding areas and the availability of international air services to the EU market". More new economy employees were attracted, retained or internally generated in areas which offer such service than in regions without service. According to their analysis international air service is subject to diminishing marginal returns.

Heuer and Klophaus (2007) highlight the importance of Frankfurt-Hahn airport for the regional economic development. By measuring direct, indirect, induced and catalytic effects they conclude that the analysed regional airport is an important job generator. They claim that the direct, indirect and induced effect led in 2005 to employment increase of slightly over 6'000 people, compared to 5'500 people in 2003. The gross value added in 2005 was about 300 Mio. Euro and over 270 Mio. Euro in 2003. For 2012 they expect that the effect on employment will increase to over 16'000 and the gross value added will increase to about 800 Mio. Euro.

Heymann and Vollenkemper (2005) analyse in their study the expansion of the regional airports in Germany. They identify several problems: Firstly, the 39 regional airports are quite small. 33 out of them have even less than 100'000 passengers. That is not enough to work cost-covering. Secondly, there is overcapacity in air traffic in Germany. Thirdly, there is not a nation-wide airport policy in Germany. Airport expansion is therefore often made single-handedly. In fourth place, the expansion of regional airports is highly subsidized by the local municipalities. Finally, private financing of expansion plans is necessary to increase the efficiency of investments.

Green (2002) uses a statistical approach to describe the relation between airports and economic development in US cities. He finds that – after correcting for simultaneity issues and using control variables – passenger boardings per capita is a strong predictor for population growth and also seems to be a good predictor for employment growth. However the magnitude of the coefficients is too large to be plausible. Additionally, he suggests making airport policy regionally, rather than locally. The costs of airports to members of a community are highly concentrated geographically while the benefits are more diffused throughout the people. Since airports are sometimes under the control of local governmental units, decisions about the airport are based on municipal interests not taking into account all benefits.

In Yao and Yang (2008) the statistical relationship between airport development and economic growth in China is examined. They find that airport development is positively related with economic growth, industrial structure, population density and openness, but negatively related with ground transportation. The authors conclude – inter alia – that airport development must be linked to the level of economic development and that the development of air transport is in western and northeastern regions an important and effective substitute for ground transport. According to the authors, "the development of air transport should be considered as an important stimulus to promote economic growth in the remote and backward provinces in the west and northeast regions to reduce the country's overall spatial income and economic inequality".

Canning and Pedroni (2004) investigate the long run impact of infrastructure on income per capita for numerous countries from 1950 to 1992. They try to answer the question whether stocks of infrastructure are at, above or below their growth maximising level. If the level of infrastructure is too high investment is diverted from other capital investments to the point where income growth is reduced. The main conclusion is that in most cases infrastructure stimulates long-run growth. For telephone and paved roads all

countries are on average near the growth maximising level. However there is a wide dispersion between the countries. For electricity generating capacity all countries are near the optimal level, albeit a under provision can be observed in some.

Munnell (1990) examines the claim that public capital investment makes a significant contribution to national output, productivity, growth and international competitiveness. The author concludes that those US states that have invested more in infrastructure have tendentiously a greater output, more private investments and more employment growth.

b) Examples of renewal strategies
Building new infrastructure, ever more today, in this moment of crisis, does not reveal itself as the most sustainable strategy, considering sustainability as an aim in relation to social and territorial changes. The European Commission's White Paper (2001)[11] indicates that it is an absolutely necessary strategy to interrupt the connection between increased mobility and economic growth.

This is the context in which this research wants to offer an alternative to the excessive construction of new infrastructure: don't build new roads but strengthen the existing public system. At the same time, don't build new airports, but to reuse the existing airport infrastructure and use them as activators of the economies and local contexts. **The recycling of obsolete infrastructure**, and the re-use in order to optimize their potentialities becomes the most sustainable and desirable solution. To re-think not only the abandoned and unused infrastructure in search of a new identity, but to recycle all those infrastructures those are already active but poorly operating and unproductive.

Around the word, exist a lot of examples of Re-cycled airports. After their decommission, many former military airports were not re-used and they remain in an abandoned state for years. But due to the growing population and the high demand for new houses, many of these airports could be re-developed as a new part of the city. Starting with the transformation of the air connection infrastructure (runway, technical street) into urban main roads and street, and continue this new urban development with houses, public services, commercial and business areas.

In other cases, many problematic airports no longer present themselves in the potential range for urban expansion. These airports, which were once peripheral, have now been engulfed in the urban context, becoming physically central in the city. This simplifies their re-conversation into urban park space. These case studies propose the transformation into public urban parks as the suitable solution for the re-use of abandoned airports.

Therefore, the main question for the project seems to identify strategies of

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[11] *The European transport policy for 2010*, COM(2001) 370. Reviewed in 2006 by the Council Commission Communication and the European Parliament.

recycle existing obsoletes infrastructure rather than the construction of new infrastructure. The experimentation of different tactics, that are defined case by case, offers a network of paths in the landscape rather than it presents one-way routes that strongly limit the way of living in the territory[12].

Re-use IT!
The context changes the economic frame but it also brings into the foreground specific conditions in the construction of cities and territories, put aside for a long time, but that may return to be expendable and important values.
Existing peripheral areas that have been infrastructured but do not work. Therefore it is more correct to talk about *peripheral infrastructures* and make questions about the strategies to re-use them. Through the construction of new infrastructure, up until the recent past, marginal areas became less remote and more related to centralities (geographic, economic, territorial, etc). Once construction was completed, these infrastructures were often isolated, proving that the best strategy would perhaps have been not to build them at all. Today, even more in this moment of crisis, building new infrastructure does not reveal itself as the most sustainable strategy.
This moment in time does not seem to be that of great innovation. It's rather a time of reflection and re-use of what has already been produced. The concept of reuse has always been present in the city and in architecture, however, the conditions in which it proposes the reuse change.

Recycling means the reuse of waste materials, which have lost value and/or meaning. It's a practice that helps to reduce waste, to limit its presence, to reduce disposal costs and to limit production of new waste. Recycle means, in other words, to create new value and new meaning. Another cycle is another life. Recycling is the ecological action that pushes into the future by transforming the existing waste in the prominent figures and producing the city's culture, the beauty and the urban quality.
Recycle infrastructure is an attitude quite diffuse in the reactivation of obsolete urban infrastructures. These recycled infrastructure projects reinterprets a fragment of transportation infrastructure, converting it to pedestrian and public use. The projects are experiments in the reuse of an industrial site, a reinvention of the infrastructure's significance and identity, the mending of a tear in the urban fabric. They want teach that gardens born in an asphalt crib.

The High Line[13] is a new 1.5-mile long public park built on an abandoned elevated railroad stretching from the Meatpacking District to the Hudson Rail Yards in Manhattan (Figure 1a). Inspired by this post-industrial ruin, the new park interprets its inheritance, translating the biodiversity in a string of site-

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[12] Cfr. Mirko Guaralda, *Le infrastrutture viarie dismesse o declassate ed il progetto di paesaggio.* Libreria CLUP Soc. Coop., Segrate (MI), 2006.

[13] Ciorra P., Marini S. (a cura di), (2011). Recycle. Strategie per l'architettura, la città e il pianeta, Electa, Milano.

specific urban microclimates along the stretch of railway that includes sunny, shady, wet, dry, windy and sheltered spaces. Through a strategy of agri-tecture – part agriculture, part architecture – the High Line's surface is digitized into discrete units of paving and planting which are assembled into a variety of gradients from solid paving to richly vegetated biotopes. The long pre-cast concrete paving units have tapered ends that comb into planting beds creating a textured, "pathless" landscape where the public can meander in unscripted ways.

The park accommodates the wild, the cultivated, the intimate and the social (Figure 1b). Access points are durational experiences designed to prolong the transition from the frenetic pace of the city streets to the slow, otherworldly landscape above.

Figure 1a,1b. The High Line, James Corner Field Operation, New York (2007-2011)

The Trento Tunnel[14] is a minimal intervention which re-converts two high-speed tunnels (Figure 2a) into museum galleries where it is possible to re-feel the sense of place and palaces of memory. To enter them is to travel in time through the 20th century. To see the light at their end is to spy the seam where a territory's past meets its future. The project merges recycling, restoration and renewal (Figure 2b).

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[14] Ciorra P., Marini S. (a cura di), (2011). Recycle. Strategie per l'architettura, la città e il pianeta, Electa, Milano.

Figure 2a-2b. The Trento Tunnel, Elisabetta Terragni, Trento, Italy (2007-2008)

c) Airport afterlife

In particular airports, today, have never been more central to the life in cities, yet they remain peripheral to many discussion in urban design and planning. Airports are an architectural structure and an urban function: in most cases they lack a physical and spatial integration with their urban context. This situation generates the emblematic role for transport architecture, particularly airports and railway stations. The conflict between these, their fundamental role in the urban structure, the oppressive impacts that they generate on the surrounding territory, their potential role as attractors and/or generators of local economies through their strategical connection with their surroundings, gives them an ambivalent, but fundamental, role in contemporary urban development strategies.

> «The world's architects and planners are increasingly treating the airport not as a separate entity but as just another part of the urban condition. (…) The task now is to design effectively for the whole physical, environmental and emotional experience of the airport over a wide area.»
> Pearman (2008), 236.

Operative airport hubs, both small and large scale, generate iconic images marking their presence in the territory and acting and being used as a centrality to their new urban condition.

However there is a widespread condition of underused and potentially obsolete airport structures that have never managed to gain of have lost their central role, causing them to totally or partially lose their use.

The question is therefore: how can these be re-used, re-generating themselves, their central role and the surrounding territory?

The central issue is to investigate the possibility of recycling existing airport infrastructure and to re-use and maximize their potentiality through development strategies. It is referred not only to abandoned and obsolete infrastructure, searching for a new identity, but also to infrastructure that is still active, but poorly operative and productive.

The primary aspect related to the recycle of small airport is the requalification

and development of good level of accessibility, allowing these to become dynamic centralities for the surrounding territory. In fact, more accessible larger scale national and international trade has often overshadowed these territories. Accessibility is therefore fundamental and central resource for territories, helping them to attract and activate (or re-activate) diverse incoming flows, such as tourism but also activities related to commerce, culture, education, health, agriculture, high tech or energy.

Airports Afterlife Case Studies:
1. **Abandoned Airports > Urban development + Parks**: *Stapleton, Denver, CO; München Riem, Germany.*
2. **Abandoned Airport > Urban Parks**: *Crissy Field, San Francisco; Tempelhof, Berlin, Germany.*
3. **Postmodern Airports**: *Skavsta Airport, Sweden; Liege Airport, Wallonie, Hispaniola Airport, Dominican Republic.*

1. Abandoned Airports > Urban development + Parks
After their dismissing, many former military airports were not used and they remain in an abandoned state for years. Due to the growing of population and the high request of new dwellings, many former airports could be re-developed as a new part of the city. Starting from the transformation of the infrastructure air connection (runway, technical street) into urban mail road and street, there was planning a new urban development with houses, public services, commercial and business areas and extremely well connected to the nearby main cities. Public urban parks add value to the gradual renovation of existing structures and the new urban development area.

Stapleton, Denver, CO
Stapleton was opened on October 17th, 1929 as Denver Municipal Airport. Its name was changed to Stapleton Airfield after a 1944 expansion and the major force behind the project when it began in1928. By the 1980s, plans were under way to replace Stapleton with a new airport. Stapleton was plagued with a number of problems concerning inadequate physical and technical structures for flights (runways, little or no room for other airlines) and noise and pollution problems. Meanwhile, the new Denver International Airport (DIA) officially opened in north-eastern Denver. The runways at Stapleton were marked with large yellow "Xs", which indicate it was no longer legal or safe for any aircraft to land there.
While Denver International was being constructed, planners began to consider how the Stapleton site could be redeveloped.

A private group of Denver civic leaders, the Stapleton Development Foundation, convened in 1990 and produced a master plan for the site in 1995, emphasizing a pedestrian-oriented design rather than the automobile-oriented design found in many other planned developments. Nearly a third of the airport site was slated for redevelopment as public park space (Figure 3).

Figure 3. Forest City Enterprises, Denver (2001-2008)

The former airport site (4,700 acres / 19 km^2), 10 minutes from Downtown Denver, is now being redeveloped by *Forest City Enterprises* project. Construction began in 2001 on single-family houses, row houses and condominiums. The new community is zoned for residential and commercial development, including offices, parks, and a "big box" shopping centre.

München Riem, Germany
Construction on the airport started in1936. The first plane landed on October 25th, 1939, signalling the beginning of air traffic. At that time, it was one of the most modern airports in the world. In 1992 it was completely dismissed.
For an interim time after the move, the remaining facilities were used as a venue for large events such as concerts and raves. Riem was well known internationally in the techno, alternative and rock scenes.

Figure 4. Munich Riem Airport Re-transform in Messestadt Riem, Germany
(from late 1990s to the beginning of the 21st century)

The transformation of the former airport to the *Messestadt Riem* (Convention City Riem) with a name-giving convention centre, apartments houses and parks was one of the largest projects in urban planning of the City of Munich in the late 1990s and the beginning of the 21st century (Figure 4). The only structures that remain of the airport today are the tower and the original terminal building, the *Wappenhalle* (hall of the coats of arms). Both structures are protected monuments. Moreover, a small stretch of the former runway still exists at the eastern end. In 2005, the former airport was the site of the *Bundesgartenschau* (Federal Horticultural Show).

2. Abandoned Airports > Urban Parks

Many problematic airports no longer present themselves in the potential range of urban expansion. These airports, which were once peripheral but have now been engulfed in the urban context, become physical centralities of the city and simplify their re-conversation into urban facilities. The case studies propose as the suitable urban solution for the re-use and re-conversion of abandoned airports the transformation of them into public urban parks.

Crissy Field, San Francisco
Crissy Field is a park in San Francisco. It was originally an airfield, part of the United States' Presidio Army base.   The Presidio ceased all military operations and the base became part of the federal Golden Gate National Recreation Area under the Base Closure Act, in the 1990s. Redesigned by Hargreaves Associates in 1994, Crissy Field re-transformed itself, from a military airport into a public open space.
Now it is parte of the *Golden Gate National Recreation Area* (Figure 5).

Figure 5. Crissy Field Park, San Francisco (1994)

It is divided into 6 major naturalistic zones: the rehabilitation of a 1920s grass airfield; a mile-long promenade; wetlands; beach & dunes; a pic-nic area; and East Beach. Those are the parts that re-create the Crissy Field Airport into a park, a new green heart of San Francisco.

Tempelhofer Park, Berlin, Germany
Berlin Tempelhof Airport, often called the "City Airport", ceased operating in 2008 in the process of establishing Schönefeld as the sole commercial airport in Berlin.
During its post-airport usage it hosts numerous fairs and events. Officially re-opened in May 2010 as a city park, today more than 200,000 Berliners have visited the park to enjoy its wide open spaces for recreation ranging from biking and skating to baseball and kiting (Figure 6).

Figure 6. Tempelhofer Park, Berlin, Germany (2010)

3. Postmodern Airports

Most of these small and medium airports were minor war airfields from the beginning of the XX century. After their post war dismissal, they remained unused for years until when local municipalities put their attention on these to find alternative solutions for their use. Meanwhile, the proliferation of low-cost companies started to promote the revitalization of secondary airports. In this context, the fundamental role of these airports as strategic hubs in the new low-cost fluxes and their moderate, but well connected, dimensions make them become crucial airport infrastructure on the local and European scale. They generate a rapid transformation of land use and of the infrastructure network relative to land transportation. The integration of new economical, cultural and leisure activities to these airports, permitted to make the surrounding territory more dynamic and to improve local business. In that sense the secondary low-cost airports became a landmark in the territory and an important element for the local economy.

Skavsta Airport, Sweden

An airbase during the Second World War, the airport was used as a military airport until 1980, when it was taken out of service. Today, Stockholm-Skavsta Airport is an international airport near Nyköping in Sweden, approximately 100 kilometres southwest of Stockholm. Low-cost airlines and cargo operators serve it. Approximately 40 established companies already with 1300 people employed on site[15] (Figure 7).

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[15] Source: Stockholm-Skavsta Airport web site (www.skavsta.se)

Figure 7. Business Park Airport. Skavsta Airport, Sweeden (from 1997)

The Skavsta Airport and its *Buisness Park* represent the potentiality of the airport as a *productive ecosystem* in which different industrial activities could take advantage of using the logistic infrastructure of the airport itself. The possibility, therefore, to combine passenger transport with the transport of goods is the central point of this airport which entails a rigorous evaluation of both the strengths and weaknesses of the industrial production of the surrounding municipalities that actually could benefit from better opportunities for innovation in the logistics market.

Liege Airport, Wallonie
The Liege Airport (Figure 8), connected to the Euro Space Centre (Figure 9), is a centre of technology and aerospace innovation. The network in the region generated by *Liegi Airport*, *Charleroi Airport* and the different *Euro Space Centre* bases in Wallonie, shows: the implementation of activities related to design prototypes for the aviation industry; the impulse for knowledge of the universe for educational purposes, teaching and divulging of issues related to space research; and, finally, the advantages of exploiting cultural, social and

business tourism in the area of innovative projects, education and entertainment.

Figure 8. High Tech Aerospace in Airport. Liege Airport, Wallonie

Figure 9. High Tech Aerospace in Airport. Euro Space Center, Transinne, Wallonie

Hispaniola Airport, Dominican Republic
The Island of Hispaniola is a natural beauty that attracts people from all over the world. In the island there are abundant raw materials to produce biofuels and available work force to grow biomass and process it into fuels. The growth of biomass and the processing of that biomass into the refines fuels

produces economic incentives to attract inner cit population back to the rural area with the promise of a higher quality of life for the workers and their families. A network of airports and aviation community managed and supported this policy. The Green Airport (Figure 10) serves as a catalyst to the ongoing development of an energy policy promoting the use of domestically renewable energy sources in the island. To adopt sustainable energy systems thereby alleviating pollution.

Tge green Airport activities are: flight training; educational and demonstration programs to show the feasibility of new renewable energy technologies; academic courses in conjunction with local and international universities; research certification programs on alternative fuels for both piston and turbine engines; Agricultural Spray Aircraft; eco-tourism activities using biofuels powered aircraft; recreational flying; small efficient aircraft powered by renewable fuels used for environmental monitoring and security patrolling.

Figure 10. The Green Airport. Hispaniola Airport, Dominica Republic

1.4 EU documents, researches and ESPON Projects

The ADES project is related to the goals of European Union in terms of competitiveness, territorial cohesion and environmental sustainability. The role of accessibility to economic development is raised by different ESPON project, in particular by TRACC Project. The modern idea that infrastructures produce economic development in peripheral areas and the belief that there is no economic development without new infrastructures are not anymore valid univocally, as explain above in *Chapter 1.1*. Although the role of accessibility to economic development is important, it can't guarantee economic development by itself and moreover its role has been over-appreciated as outcomes also from ESPON Seminar in Paphos, Cyprus.

To this end, ADES research have been taken into account different ESPON project that deals with the accessibility issues but it distances itself from the main results and it proposes a innovative strategy to the overall accessibility ecosystem. In fact, the REnewal strategy identifies Re-use and RE-cycle tactics for existing obsoletes infrastructure rather than the construction of new infrastructure (see *DFR_Chapter 2*).

The following documents and projects contributed to focused the aims of ADES research. The contents of the *Fifth Report of Social, Economic and Territorial Cohesion*, other studies on transport services and *the AsPIRE project* was discussed and taken into account by the TPG.

The contents of the **Fifth Report of Social, Economic and Territorial Cohesion** give important references. The Fifth Report precise that regional competitiveness and development prospects are also affected by infrastructure endowment, such as transport or telecommunication networks. This document is relevant for ADES research to define the basis of our reflections regard the main research issues of: accessibility, infrastructure (in particular air travel), transport system and regional development.

As indicated by many studies, the provision of public infrastructure has a positive and large effect on productivity and growth. Physical infrastructure can adversely affect the environment, especially heavy and long-lasting infrastructure such as roads, motorways, railway lines and modifications to watercourses. In such cases, the trade-off between economic and environmental costs and benefits needs to be explicitly and properly taken into account. The report assumes also that a good transport system is important for regional economic development. It reduces journey times and, accordingly, production costs, so increasing competitiveness. It improves access to markets for consumers, workers and business and is an important aspect of the attractiveness of a region for investors. However, a good transport system in itself is not sufficient to ensure regional development. The effect of investment in transport and other infrastructure on economic performance also depends on the region's capacity to use it efficiently, as well as on investment in other factors important for development, such as in human capital and innovation. This partly explains why the return on investment in infrastructure can vary significantly between regions.

Furthermore, air travel has continued to grow over the past few years up until the onset of the crisis in 2008. The highest growth in traffic has been in secondary airports, which are mostly used by low-cost airlines as well as in the airports in the capital cities in the EU-12. This proliferation of low-cost companies started to promote the revitalization of secondary airports. They generate a rapid transformation of land use and of the infrastructure network relative to land transportation. The integration of new economical, cultural and leisure activities to these airports, permitted to make the surrounding territory more dynamic and to improve local business. In that sense the secondary low-cost airports became a landmark in the territory and an important element for the local economy. For that reason they are a relevant examples taken in account by ADES research.

In a study about **«Transport services and networks»** the authors (2004) examine how the transport network may constitute a key factor of a more balanced, polycentric and sustainable development. A further question is how the accessibility to basic services and to knowledge should be developed in order to increase the territorial development. The authors conclude that the reality is more complicated than the generally accepted idea «more network for better accessibility for more GDP». This idea is shared by ADES project. The economical and environmental crisis has radically changed the guideline for infrastructures' development. At the present time, the axiom that infrastructures produce economic development in peripheral regions seems to be no more valid. The concept of periphery is ambiguous, as we explained above. The «Transport services and networks» study underlines this statement. In fact, even in central regions there are enclosed zones, the space is heterogeneous from the national to the local scale. Nevertheless there is a kind of structure: a center-periphery structure, consisting of a pentagon called blue banana and peripheral spaces less inhabited and less served by networks. However, regions in both parts are very heterogeneous as the authors identify «central» zones in the peripheries and zones with peripheral characteristics in the pentagon.

Another important reference for the peripheral issue is the European comparative research project entitled **Aspatial Peripherality, Innovation and the Rural Economy (AsPIRE)**, which was funded by the European Union Fifth Framework Programme. The AsPIRE project was concerned with the changing nature of peripheral disadvantage. A starting point for the project was the fact that technological advances in transport and communication have created the potential for gradual but fundamental changes in relationships between accessible "core areas" and the less accessible "periphery". Some peripheral regions seem to take advantage of these new opportunities, whilst others, perhaps more accessible in conventional spatial terms, seem to lag behind. The AsPIRE project defines the concept of *aspatial peripherality*. This term indicates regional deficits which are often associated with peripheral location but can also appear in centrally located regions. In a time when physical distance or travel cost are less and less restrictions to economic activity, such deficits as insufficient utilizations of new information and communication technologies or poor networks between local firms, development agencies and markets are becoming more and more important for central as for peripheral regions. ADES research agree with this analysis, as mentioned above: in the European *neverending city*, each place can be at the same time the central or peripheral with respect to the various immaterial networks of relationships that structure the settlement around the world.

In addition, the following ESPON studies, that address the issues of transportation or accessibility in Europe, are significant for ADES project. This strand of applied literature is in line with the EU 2020 priorities, which include among others "Inclusive growth – fostering a high-employment economy delivering economic, social and territorial cohesion" and the priorities from the

Territorial Agenda 2020 include among others the following goals: to promote polycentric and balanced territorial development and to improve territorial connectivity for individuals and enterprises.

The **ESPON 1.2.1** deals with "transport services and networks: territorial trends and supply", where they examine how the transport network may constitute a key factor of a more balanced, polycentric and sustainable development.

The **ESPON INTERCO** deals with territorial cohesion and polycentrism and how to measure it. Focusing on the accessibility by air, road and rail, it is rather clear that large disparities still exist. In many cases, regional disparities even increased due to the construction of high-level transport infrastructures such as high-speed rail lines or motorways, connecting urban centers with each other and bypassing rural or remote areas. As for accessibility by road, the disparities are still important among territories especially in remote areas, despite some effort to increase accessibility in some region that helps the trend towards more convergence in return. However, we know that access to services is a challenge for European countries within territories as well as between territories as it is underlined in the *Fifth Cohesion Report.*

ESPON Applied Research:
- ESPON TRACC: TRansport ACCessibility at regional/local scale and patterns in Europe
- ESPON SIESTA: Spatial Indicators for a Europe 2020 Strategy Territorial Analysis
- ESPON GEOSPEC: Geographic Specificities and Development Potentials in Europe

A study that has started in July 2010 named **Transport accessibility at regional/local scale and patterns in Europe (TRACC)** addresses issues of accessibility on a European and a regional level. One of the main motivating question of this project (What is the relation between accessibility (at the different levels and for different modes) of European regions and their economic development?) is a common goal with ADES research. The TRACC project aims at taking up and updating the results of existing studies on accessibility at the European scale, to extend the range of accessibility indicators by further indicators responding to new policy questions, to extend the spatial resolution of accessibility indicators and to explore the likely impacts of policies at the European and national scale to improve global, European and regional accessibility in the light of new challenges, such as globalisation, energy scarcity and climate change. Furthermore shall be examined how bottlenecks for the four transport modes can be identified on the regional and European scale. This Applied Research Project is of high relevance for the ADES study as it comprises much information about the accessibility of European regions.

The aim of the project **Spatial Indicators for a Europe 2020 Strategy Territorial Analysis (SIESTA)** is to provide evidence on the territorial dimension of the EU2020 Strategy by identifying opportunities for different

types of regions in relation to the targets and flagship initiatives set out in the strategy. In particular the following research areas are identified: (1) which types of regions have what opportunities with regard to exploiting their territorial potentials in support of smart, sustainable and inclusive territories in Europe, and (2) which types of regions can be perceived as key drivers for European development and growth at various scales. In this field, ADES research will explore potential new assets for air transportation system. In fact, airport infrastructure for its dimension and relations with the territory is a potential catalytic agent and an activator of contexts: airports as generators of development in peripheral regions but also as generators of a new image for the area and of themselves.

The main objective of the project **Geographic Specificities and Development Potentials in Europe (GEOSPEC)** is to provide a coherent transversal framework to characterise the past trends, state and potential future developments of geographical specificities for territorial policy and regional development. A secondary objective of this study is to facilitate the integration of this sense of commonality and of the discourses constructed to justify specific treatments, on the basis of geographic specificities, in European territorial cohesion strategies.European maps revealing the specific types of territories and regions and their strengths and weaknesses as well as new typologies aiming at the clustering of regions.
Also ADES research will propose the maps as fundamental tool to help decision makers to choose and define the best strategies for local development (see *Chapter 4*). The additional value of ADES maps will develope to be instructions for use, in service of political actors and institutions in general. The TPG will produce the graphical analysis of the case studies regions through the realization of two different typologies of maps: **Descriptive Maps (**to show and confront the current situation) and **Vision Maps (**as a support fot further development process).

2. EMPIRICAL RESULTS

This chapter presents all empirical results. The whole empirical body deals with the question of the relationship between accessibility and economic performance in peripheral regions in Europe. The methods, however, vary across the chapter. Using different methods augments the chance to capture the relevant issues in a holistic way. We explain the methodology of the empirical research and show the three different methods applied and the results obtained:

      1. Panel causality tests

      2. Structural regression analysis

      3. Frontier analysis

We first describe the methodology and the data used and conclude the chapter with a summary of the findings.

2.1 Introduction and methodology

While the case studies analyses in the next chapter focus on the three stakeholder regions, the empirical analyses in this chapter focus more on the general case using data from many regions throughout Western Europe. Using a common database covering several hundred regions, we use three different empirical methods to catch different dimensions of the same issue: What is the relationship between accessibility and economic performance? The three different methods highlight different aspects. The causality tests focus on the question whether the direction of influence goes from accessibility to economic performance emphasising supply side elements, or whether it rather goes from economic activities to accessibility emphasising demand side elements. While these results are qualitative (though based on a quantitative model), the structural regressions estimate numerically the size of such influences. Thus, it is possible to see how relevant the impact of accessibility is relative to other regional location factors. The frontier analysis finally will show the degree of production efficiency of each region and bring out the limiting factors. This will give answer to the question whether insufficient traffic infrastructure is a limiting factor for economic development of a region.

We first describe the data set used and the data developed under this project. Using a common database covering several hundred regions, we use three different empirical methods to catch different dimensions of the same issue: What is the relationship between accessibility and economic performance? Thereby we can distinguish two main channels of influence:

- Supply side effects: Good general framework conditions (including accessibility) improve the attractiveness of a region and thus attract both people and companies. Production and supply of goods will grow. Therefore, accessibility will enhance economic performance.
- Demand side effects: When a region grows – be it more people or

higher wages – the demand for travelling will usually grow. Thus, it will be interesting for suppliers of travel services to enlarge their supply. If there are bottlenecks in the infrastructure, such additional demand may lead to an improvement of the respective infrastructure. Therefore, economic performance improves accessibility.

The three different methods focus on different aspects of the relation between accessibility and economic performance and will shed light on the question whether supply side or demand side effects effectively dominate.

2.2 Database

As the following three sections on causality, structural regressions, and frontier analysis use the same data base, a short description of it is provided in this section (a detailed description is captured in *Annex 1*). The data base covers different types of data: economic performance, population and area, location factors (including accessibility), and airport performance per region. The following tables provide an overview of the four types:

Table 1 Data on economic performance

Shortcut	Indicator	Unit
XXN	nominal GDP	in Mio. Euro
XXR	real GDP	in Mio. Euro PPP[16]
NN	Employment	in thousand persons
XAN	nominal hourly productivity of labour	in Euro
XAR	Real hourly productivity of labour	in Euro PPP

Data source: BAKBASEL

Performance data are indicators of economic activity and success. Often, they are also used as indicators to measure success of economic policy. They are purchasing-power corrected.

Table 2 Data on population and area

Shortcut	Indicator	Unit
PO	Population	in thousand persons
FL	Area	in square miles

Data source: BAKBASEL

Data on population and area are primarily used to descale data like GDP or employment which heavily depend on the geographical delimitation of a region.

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[16] PPP = purchasing power parity corrected

Table 3 Data on location factors

Shortcut	Indicator	Unit
AC	Total accessibility	Index
AG	Geographical accessibility	Index
AT	Transport accessibility	Index
RGEP	national regulation of labour markets	Scale
RGPM	national regulation of product markets	Scale
TXCO	tax burden for companies	in %
TXMP	tax burden for manpower	in %
FEGP	research & development	in % of GDP
IVSE	secondary education	in % of labour force
IVTE	tertiary education	in % of labour force
Pat	Patents	Scale

Data source: BAKBASEL

Location factors describe the attractiveness of a region. Their quality can determine economic performance in the long run. Many location factors can be influenced by policy decisions; hence countries and regions have some scope in determining their long term growth path. Although some location factors are elusive, others can be measured with the help of quantitative indicators. Data on accessibility have been produced in the context of this project. All other data are part of the pre-existing database of BAKBASEL.

Table 4 Data on airport performance

Shortcut	Indicator	Unit
AXP	number of commercial passengers	Passengers
AXC	cargo (freight & mail)	in metric tons

Data source: ACI[17]

Data on airport performance, measured as the number of passengers on commercial flights and as tons of freight and mail of an airport, are used to investigate the interrelation with economic activity. When there are several airports in a region, the performance data will be aggregated.
The data base includes time series as from 1990 to 2010 for 336 regions (NUTS2 or NUTS3). Airport data are very often not available for such a long period. *Annex 1* provides a detailed description of all data and sources.

As already mentioned above, data on accessibility has been produced in the context of this project. All other data are part of the pre-existing database of BAKBASEL and is not part of this project.

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[17] ACI = Airport Council International

Special attention is paid to **accessibility** as a location factor. In general, people are not interested in transport infrastructures per se. The nicest new airport is hardly of any value if there are no scheduled flights. On the other hand, it is very relevant, when a train can run at a higher speed and reach its goal faster, even when there is no new infrastructure, but only new coaches and engines or probably only a new computer programme.

Accessibility is a complex term. Thus, it is important to clarify what should be measured before indicators are determined. The accessibility concept used here is based on the idea of realizing an economic benefit out of easily reaching other regions and at the same time of being easily reached from other regions. This benefit is characterised by the answers to the questions formulated in the following table.

Table 5 Accessibility concept

5 questions …	… and 5 answers
Accessibility for whom?	People, especially for businessmen and employees
Accessibility of what (potential/activity parameter)?	Markets for goods and services (nominal GDP)
Which metric for spatial resistance?	Travel time (fastest connection) and geographic distance (linear distance)
Within which area?	Europe: 336 West-European starting points (core cities of the 202 considered NUTS2-regions) 291 European (east and west) destinations (important European cities)
Which mode of transport?	Europe: Multimodal (ideal combination of air, rail and road traffic)

Source: BAKBASEL

The accessibility model focuses on the benefits for businessmen and employees, which come along with easy accessible markets for goods and services. This corresponds to the transmission channel of increased productivity through more efficient management of existing markets or the opening up of new markets, respectively. However, travelling costs reduce the benefits mentioned before.

At a first glance, travel fees in Euros appear to be the relevant cost item. While this should be true for most tourists, for the business traveller mentioned above, time is usually money and time cost substantially higher than travel fees. Thus we employ a model with time as a measure of spatial resistance (whereby the fastest daily connection is chosen).

In addition we also adopt a model where air distance is used as an indicator for spatial resistance.

The following graph illustrates this procedure. Accessibility (A) can be calculated using weighted travel time to 202 NUTS2 regions in Western Europe with an inverse exponential function.

$$A_i = \sum_{j=1}^{m} w_j \cdot e^{-\beta_c \cdot c_{ij}}$$

A_i = Accessibility value of starting point i

w_j = potential/activity of the destination j

c_{ij} = spatial resistance between starting point i and destination j

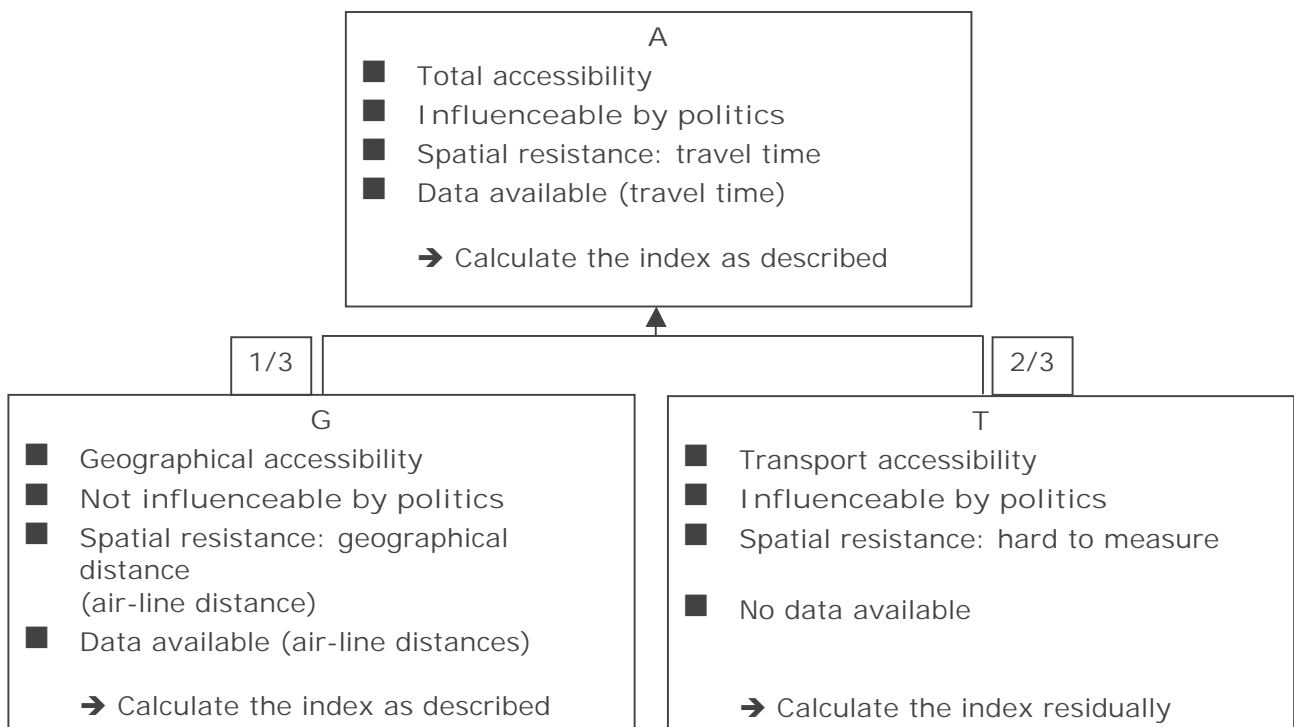β_c = spatial resistance sensibility (related to the spatial resistance c).

$e^{-\beta_c \cdot c_{ij}}$ = Discount factor

As this accessibility value is a rather abstract item, the final step includes its indexation. The measure is multimodal, taking into account the best combination of air, rail and road travel. The weight used is the relative GDP or "market share" of each region.

In the same way, accessibility can be calculated using air distances resulting in the so called geographical accessibility (G).

In general, these two concepts do not yield the same result: The difference is due to transportation services. Thus, the transport accessibility (T), which reflects both all kind of transport infrastructure and the quality of transport services, can be calculated residually. Assuming a weighted additive relation (of the form A = 1/3*G + 2/3*T), T can be easily computed residually (as T = (3A – G)/2).

Figure 1   Measurement concept of accessibility

Total accessibility
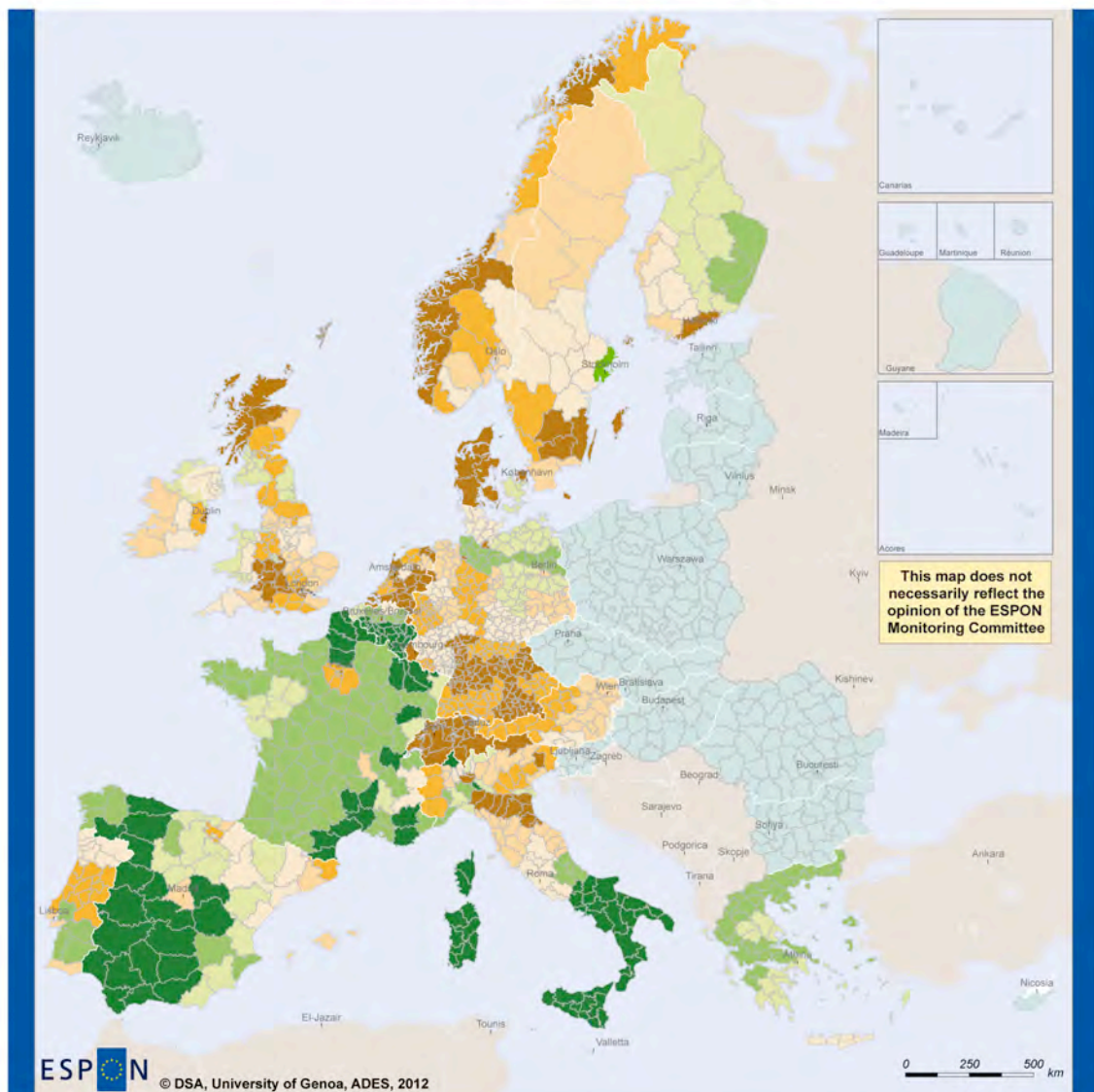
Legend

- <= 0.37179
- <= 0.40028
- <= 0.42916
- <= 0.45151
- <= 0.46765
- <= 0.49170
- <= 0.77353
- NO DATA

Map 1. Total accessibility (A): Multimodal, Europe, 2000-2008

Geographical accessibility
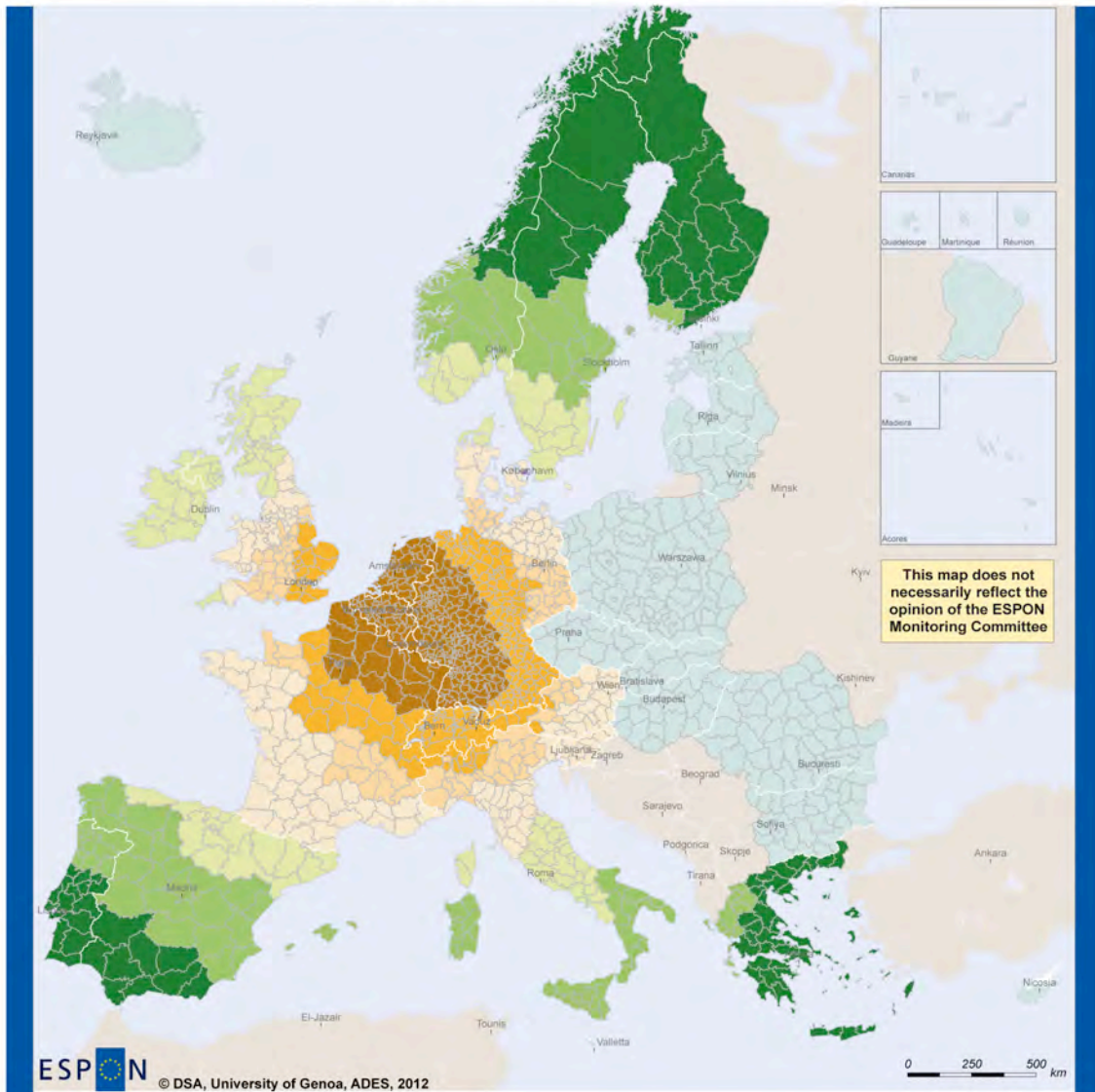
Legend

- ![dark green] <= 79.01614
- ![green] <= 87.88763
- ![light green] <= 99.68024
- ![cream] <= 107.31094
- ![light orange] <= 111.88486
- ![orange] <= 117.38406
- ![dark orange] <= 121.48755
- ![grey] NO DATA

Map 2. Geographical accessibility (G): Europe, 2000-2008

Transport accessibility
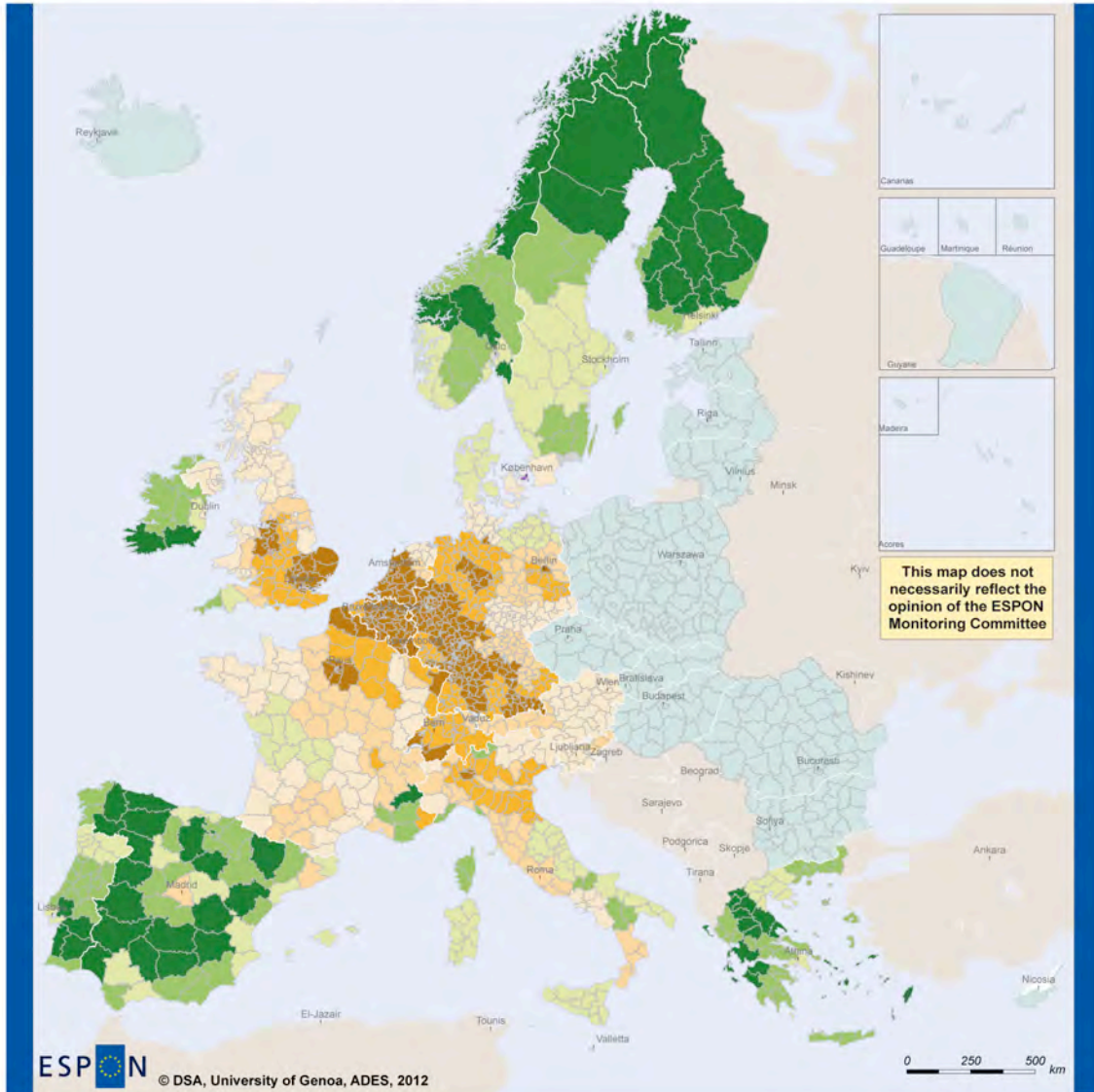
Legend

- <= 82.99801
- <= 89.72303
- <= 96.46073
- <= 101.64207
- <= 105.99314
- <= 110.76827
- <= 122.41824
- NO DATA
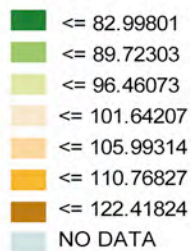
Map 3. Transport accessibility (T): Multimodal, Europe, 2000-2008

While air-line distances (G) are not influenceable by politicians, transport infrastructure and services (T) are man-made and regularly object of national and regional policy. Through this channel, also overall accessibility (A) can be influenced by policy.

Maps 1, 2 and 3 show the mean values of the accessibility indices over the period 2000-2008 for total accessibility (A), geographical accessibility (G) and transport accessibility (T). Geographical accessibility (G, Map 2) clearly shows that the centre of economic gravity of Western Europe is located in the triangle «London– Paris – Ruhr area». Around this core area, geographic accessibility declines in the form of concentric circles. Regions that are close to the centre of gravity tend to perform well in terms of total accessibility (A, Map 1) due to the simple fact of their geographical proximity to this centre. Regions located rather on the periphery are clearly harder to reach. However, regions with an important intercontinental airport (e.g. Stockholm or Madrid) stand out especially in terms of transport activity (T, Map 3). Stockholm clearly illustrates that despite of geographical disadvantages total accessibility is not necessarily bad. While Madrid or Stockholm are good examples for regions with a low geographical but excellent transport accessibility, the opposite holds true for some regions in central France or Eastern Germany.

As the three stakeholder regions (Savona, Western Greece, Jyväskylä) are all located in (so called) Western Europe, the statistical analysis focuses and is limited to this area. Regions in (so called) Eastern Europe have a completely different history and economic evolution path, which even could distort the results of the analyses below. For this reason, also the extensive data work has only been done for the regions, which will be included in the data set for the empirical analyses.

2.3 Panel causality tests

The first method used is causality tests. To address the existence of causality, we consider the nature of the relationship between regional development and transportation infrastructure, as evidenced by air traffic. We ask whether accessibility is a key factor to economic success in Europe or whether it is rather its consequence. As this question is of utmost importance to regional policy makers, we will analyze this causality in detail. We thus focus on the question whether the direction of influence goes from accessibility to economic performance emphasizing supply side elements, or whether it rather goes from economic activities to accessibility emphasizing demand side elements. Thus, we will get a qualitative answer to the question whether air traffic has an effect on regional growth in Europe.

The results present evidence of causal relationships and suggest that air transportation is more than a facilitator in remote regions. In these regions, in addition to regional growth causing airport activity, air activity appears to boost regional development. Supply-side effects are, thus, important for distant regions. In core regions, only the reverse is true: that is, airport activity does not cause regional growth, but regional growth causes airport activity.

2.3.1 The causality between regional airports and regional growth in Europe

The role of airports has become increasingly important with growing globalization. Air transportation as well as transportation in general can be seen as a facilitator that allows the economic potential of a region to be realized (Alkaabi and Debbage 2007; Debbage and Delk 2001; Goetz 1992). The provision of transportation does not, however, automatically lead to economic development. It may also be the other way round: economic development leads to the provision of transportation. Thus, while there is typically a strong correlation between air traffic and economic growth, the direction of causation is not entirely clear (Green 2007; Button et al. 2010). The causality may run primarily from transport infrastructure and accessibility to economic development, stressing supply side elements. In this case, airports act as a catalyst for local investment. On the other hand, it may primarily be economic development which determines transportation needs and services, stressing demand side elements. A largely unsettled question is which is stronger effect, the demand effect or the supply effect.

Evaluating the character of the causal relationship between two variables is not without problems. Attempting to get to the core of causal processes is an issue that is central to what econometricians do, and some progress has been made. Earlier airport studies by Brueckner (2003) and Green (2007) took advantage of the method of instrumental variables (IV) in panel data to control for the potential endogeneity of airline traffic. The problem, as almost always with the IV method, is to find appropriate instruments which, in this case, would explain only airport activity but not regional growth.

Button et al. (1999) used Granger causality tests to elicit that airport traffic leads development. Granger causality tests are designed to show causation by examining whether lagged values of (say) one variable, *x,* carry explanatory power in the presence of lagged values of the dependent variable, *y* and possibly other covariates, *z*. This exploits the fact that in time series there is temporal ordering, and the belief that effects cannot occur before causes. Conventional Granger causality test utilize time series data only from one observation, as was the case in the study of Button et al. (1999). Granger tests are, however, increasingly being used to evaluate causal relationships in panel data. Panel Granger tests are significantly more efficient than conventional Granger tests (Baltagi 2005; Hurlin and Venet 2001 and 2005; Hood III et al. 2008). But a potential flaw shared by many analyses is an inappropriate assumption of causal homogeneity. The literature based on early work by Hsiao (1986) and Holtz-Eakin et al. (1988) largely ignores the possibility of heterogeneity. A causal relationship may be present only in a subset of cross-sections and not in others. In our case, some airports may have a causal effect on development, while others do not have it, and vice versa.

To be able to deal with the possible problem of heterogeneity, we employ the Hurlin and Venet (2001 and 2005) procedure, in which three distinct scenarios are identified to describe the possible causal processes:

homogeneous non-causality, homogeneous causality and heterogeneous non-causality.

The chapter aims to shed further light on the relationship between regional airports and economic performance in different type of regions, including also remote and small airport regions. Prior studies of the economic impact of air transportation on regional development are small in number and concentrated mainly on large airports of the core regions (see, however, Button et al. 2010). In this chapter, we are especially interested in whether there are differences in causal processes between core and peripheral regions. Causality between regional performance and air traffic may vary according to peripherality, since especially remote regions need to be accessible via air connections in order to grow. The development of core regions are led by many agglomerative forces - their success is not inevitably dependent on the impact of airports, although they also naturally need efficient airlines.

2.3.2 Method and data

To address the existence of causality, the nature of the relationship between transport infrastructure and economic development is evaluated. Evaluating the character of the causal relationship between two variables is, of course, problematic. A standard tool used in econometrics is the Granger technique, which can, at any rate, be used as a first step in this evaluation. In the case of two variables, say x and y, the first variable, x, is said to cause the second variable, y, in the Granger sense if the forecast for y improves when lagged values for x are taken into account (Granger 1969). By estimating an equation in which y is regressed on lagged values of y and lagged values of x, we can evaluate the null hypothesis that x does not Granger-cause y. If one or more of the lagged values of x is significant, we can reject the null hypothesis that x does not Granger-cause y.

The introduction of a panel data dimension permits the use of both cross-sectional and time series information to test causality relationships, which apparently improves the efficiency of Granger causality tests (Baltagi 2005; Erdil and Yetkiner 2009). Granger tests can generate significant results with shorter time periods as the number of observations increases. Following Hurlin and Venet (2001; see also Hood III et al. 2008; Erdil and Yetkiner 2009), we consider the variables to be covariance stationary, observed for T periods and N cross-section units (which consist of regions in our case). For each region $i \in [1, N]$, the variable $x_{i,t}$ causes $y_{i,t}$ if we are better able to predict $y_{i,t}$ when using all the available information than when using only some of it.

Let us consider a time-stationary VAR representation, adapted to a panel context. For each region i ($i = 1,…, N$) and time period t ($t = 1,…,T$) we have

(1) $\qquad y_{i,t} = \sum_{k=1}^{p} \gamma^{(k)} y_{i,t-k} + \sum_{k=1}^{p} \beta_i^{(k)} x_{i,t-k} + v_{i,t} ,$

where $v_{i,t} = \alpha_i + \varepsilon_{i,t}$ are *i.i.d.* $(0, \sigma_\varepsilon^2)$ and p is the number of lags. The autoregressive coefficients $\gamma^{(k)}$ and the regression coefficients slopes $\beta_i^{(k)}$ are assumed constant for all lag orders $k \in [1, p]$. It is also assumed that $\gamma^{(k)}$ are identical for all regions, whereas $\beta_i^{(k)}$ are allowed to vary across individual regions. This is a panel data model with fixed coefficients.

Employing conventional Granger tests with panel data is not unproblematic. These problems may be caused by heterogeneity between the cross-section units. The first potential type of cross-section variation is due to distinctive intercepts. This variation is addressed with a fixed effects model in which heterogeneity is controlled by the introduction of individual effects α_i. Another basis for heterogeneity is caused by heterogeneous regression coefficients $\beta_i^{(k)}$. This is a more problematic situation than the first one, and requires a more complex analytical response. If we consider model (1), the general definitions of causality imply testing for linear restrictions on these coefficients. The procedure has three main steps which are related to the homogeneous non-causality, homogeneous causality and heterogeneous non-causality hypotheses (Figure 1).
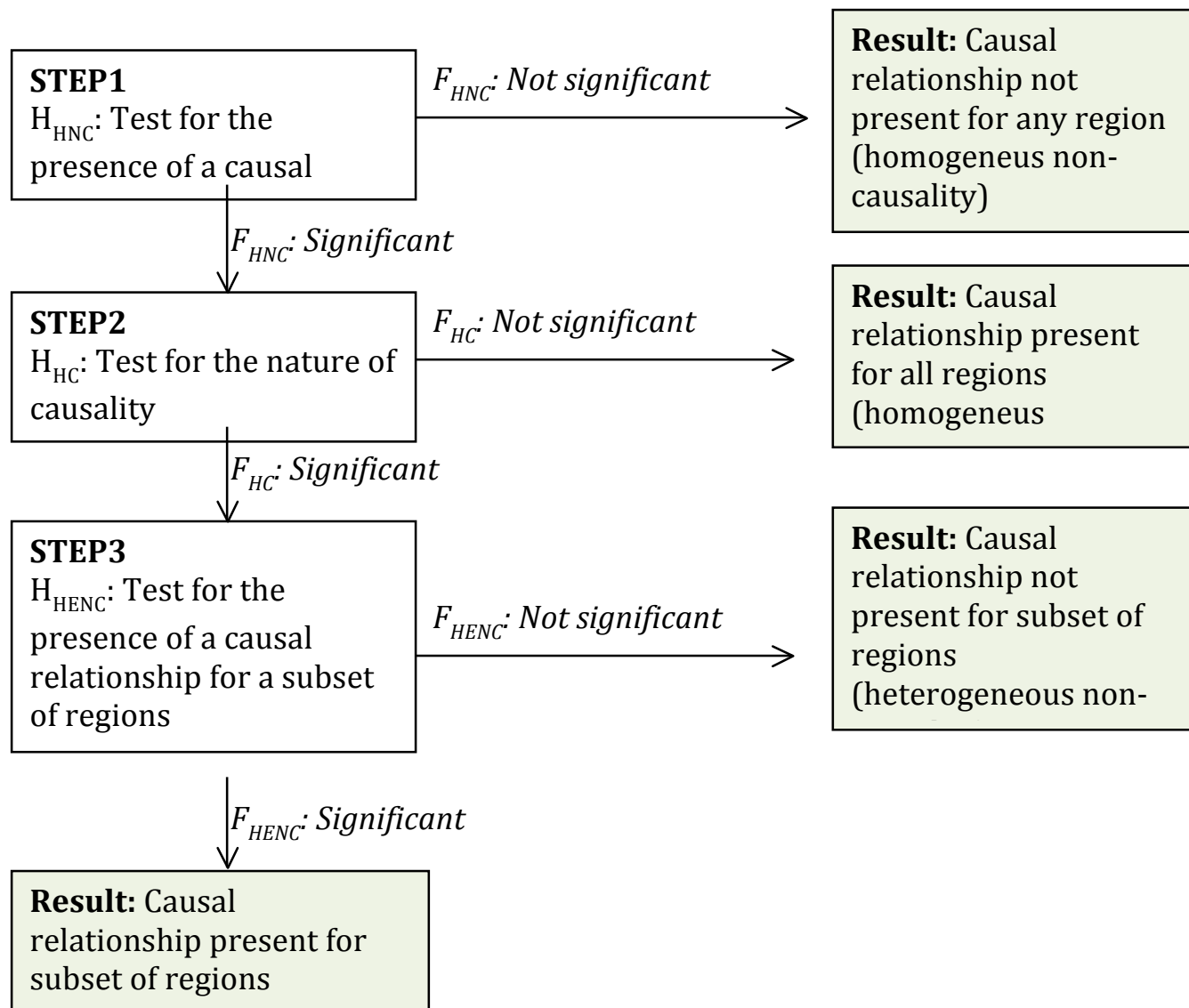
| STEP1
H_{HNC}: Test for the
presence of a causal | F_{HNC}: Not significant $\longrightarrow$ | **Result:** Causal relationship not present for any region (homogeneus non-causality) |

F_{HNC}: Significant

| STEP2
H_{HC}: Test for the nature of
causality | F_{HC}: Not significant $\longrightarrow$ | **Result:** Causal relationship present for all regions (homogeneus |

F_{HC}: Significant

| STEP3
H_{HENC}: Test for the
presence of a causal
relationship for a subset
of regions | F_{HENC}: Not significant $\longrightarrow$ | **Result:** Causal relationship not present for subset of regions (heterogeneous non- |

F_{HENC}: Significant

Result: Causal relationship present for subset of regions

Figure 1. Testing procedure

The empirical analysis is based on regional level data from Europe in the period 1991-2010.[18] To carry out causal analysis between regional development and airport activity, we need two variables for their measurement for which we have different options. For the measurement of regional development, we use two variables, the first one measuring growth in employment and the second one growth in purchasing power corrected real GDP. For the measurement of airport activity, we use a variable depicting development in the number of commercial air passengers. An alternative variable depicts development in freight and mail cargo, but as e.g. Green (2007) and Freestone (2009) stated, this variable is imperfect. In addition, we use a geographical accessibility variable which measures weighted average travel time to 202 NUTS Level 2 regions in Western Europe. The measure is multimodal which takes into account the best combination of air, rail and road. The weight used is the relative GDP ("market share") of each region.

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[18] Bak Basel Economics has produced the data set.

Airport Council International produces data on the use of airports in Europe but this data is limited by the number of reporting airports. The availability of airport data diminishes further as we go back in time. As the availability of airport data is incomplete it reduces remarkably the number of observations (regions) in the analysis. A complete airport data is available in the period 1991-2010 for 86 NUTS Level 2 or 3 regions from 13 countries in Europe (see Appendix). This data set includes 3 regions from Austria, 3 from Switzerland, 13 from Germany, 1 from Denmark, 22 from Spain, 12 from France, 2 from Ireland, 7 from Italy, 1 from Luxembourg, 2 from Holland, 2 from Norway, 3 from Portugal and 15 from the UK. To accomplish the panel causal tests, we have an adequate number of cross-sectional and time-series observations – in fact, the number of cross-sectional observations (regions) in relation to the length of time-series cannot be too large from the point of view of the method. However, there remains a question about the representativeness of the data. As the regions included in the data are distributed quite evenly across Europe, we may consider the data to represent Europe rather well.

To test the heterogeneous non-causality hypothesis in the third step of our testing procedure, we categorize the regions into three groups of equal size by means of the accessibility variable. This allows us to find out whether peripherality explains differences in causal processes. Accessibility is lowest in peripheral regions, highest in core regions and in between in intermediate regions. Table 1 shows that employment as well as real GDP is the higher the more accessible the region is. The number of air passengers is also lowest in peripheral regions and highest in core regions.

Table 1. Means of the variables by region type (yearly averages in 1991-2010)

Region type	Accessibility	Air passengers (1000)	Employment (1000)	Real GDP (Mio euro ppp)
Peripheral	88.7	1 981.8	376.4	19.992.3
Middle	102.4	4 794.8	703.2	44 819.7
Core	113.3	16 539.6	1 154.0	77 196.3
All regions	101.5	7 806.7	745.0	47 365.3

The Granger causality tests between regional growth and air transport in 86 European regions are performed for the period 1991-2010, with lags one and two. For both side variables in the analysis, we first take natural logarithms and then difference them in order to eliminate possible unit roots and to reach time stationarity. Consequently, we are in fact analysing growth rates. We

follow the nested procedure described above to test different causality relationships. The tests are based on Wald statistics.

2.3.3 Results

As a first step in exploring bi-directional Granger causality between airport activity and regional development, the homogeneous non-causality (HNC) hypothesis is assessed. The HNC hypothesis implies the non-existence of any individual causality relationships. In model (1), the corresponding test is defined by

$$i \in [1, N], \ \forall k \in [1, p]$$
$$H_1: \exists (i, k) \ / \ \beta_i^{(k)} \neq 0 \ .$$

For testing Np linear restrictions in (2), the following Wald statistic is computed:

$$(3) \qquad F_{HNC} = \frac{(RSS_2 - RSS_1)/Np}{RSS_1/(NT - N(1+p) - p)} \ ,$$

where RSS_2 denotes the restricted sum of squares residuals obtained under H_o and RSS_1 corresponds to the residual sum of squares of model (1). If the individual effects α_i are assumed to be fixed, the sum of squared residuals are obtained from the maximum likelihood estimation (MLE), which in this case corresponds to the fixed effects (FE) estimator. It has been shown that the FE estimator is biased in the case where T is small (Nickell 1981), but the bias decreases with T. We favour the FE estimator, since the bias may not be large and its use enables us to follow the testing procedure. Accordingly, the testing procedure can be implemented using the constrained regression technique (Hurlin and Venet 2001; Hood III et al. 2008). Interpretation of the statistic relies on the Fischer distribution with Np and $(NT - N(1+p) - p)$ degrees of freedom.

For the measurement of regional performance (y), we use two variables, GDP growth and employment growth, while for the measurement of air traffic (x) we also have two variables, the number of air passengers and accessibility. Table 2 includes the results from four possible combinations of the variables: air passengers and GDP; air passengers and employment; accessibility and GDP; and accessibility and employment.[19]

Table 2. Test results for homogeneous non-causality (HNC hypothesis)

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[19] In addition, despite its shortcomings, we also estimated the model with the air cargo-variable. The homogenous non-causality hypothesis was not rejected in either case, for which reason the testing procedure stopped in the first step, implying that there would not be causal relations in either direction between air traffic and regional development. This result, however, probably tells more about the limitations of the cargo variable than about the actual state of affairs.

| Direction of causality and lags | F-statistic and its significance | | | |
	Air passengers - GDP	Air passengers - employment	Accessibility - employment	Accessibility - GDP
Causality from air traffic to regional growth				
Lag 1	1.602***	1.591** *	1.947***	1.947***
Lag 2	0.576	0.716	0.991	1.391***
Causality from regional growth to air traffic				
Lag 1	0.956	1.206*	0.694	1.016
Lag 2	0.420	0.604	0.470	0.586

All the test statistics related to the homogenous non-causality hypothesis are statistically significant with one lag, when the direction of causality is from air traffic to regional development. With two lags, they are not significant, with the exception of the pair of variables "accessibility – employment". These results allow us to reject the homogeneous non-causality hypothesis: for at least some regions (and possible all), there is statistical evidence of Granger causality from air traffic (accessibility) to regional growth.

The evidence of the opposite direction of causality - from regional development to air traffic - is only partial. The test statistic cannot be rejected even at lag one when using the combination of variables "air passengers – GDP", "accessibility – GDP" or "accessibility – employment". It is, however, rejected at the 10% significance level when airport activity is measured with the number of air passengers and employment is used instead of GDP. This result calls for the next step in the testing procedure.

If the HNC hypothesis is rejected, the next step is to test the hypothesis of homogeneous causality (HC). The F_{HC} test statistic is calculated using the sum of squared residuals from the unrestricted model described above (RSS_1) and the sum of squared residuals (RSS_3) from a restricted model in which the slope terms are constrained to equality for all the panel members in the sample. Thus, the hypotheses are

$$\forall k \in [1, p] / \beta_i^{(k)} = \beta^{(k)} \ \forall i \in [1, N]$$
$$H_1: \exists k \in [1, p], \exists (i, j) \in [1, N] / \beta_i^{(k)} \neq \beta_j^{(k)} \ ,$$

and the test statistic is

$$(5) \qquad F_{HC} = \frac{(RSS_3 - RSS_1)/p(N-1)}{RSS_1/(NT - N(1+p) - p)} \ .$$

As in the case of HNC, if the individual effects α_i are assumed to be fixed, the ML estimator is consistent with the FE estimator. As the results related to the use of two lags showed insignificance above in most cases, we used here only lag 1.

The results shown in Table 3 indicate significant test statistics for all pairs of variables when the direction of causality is from air traffic to regional growth. Accordingly, at this point we can say that there are causal processes from air traffic (accessibility) to regional growth, but these processes are not uniform. The opposite direction of causality according to which regional growth as measured in employment causes air traffic in all regions is not rejected which implies a homogenous causal process. An alternative interpretation is that there are no causal processes at all. This the result we obtain with all other pair of variables.

Table 3. Test results for homogenous causality (HC hypothesis)

Direction of causality	F-statistic and its significance			
	Air passengers - GDP -employment	Air passengers - employment	Accessibility	Accessibility - GDP
Causality from air traffic to regional growth				
Lag 1	1.646***	1.521***	2.018***	1.950***
Causality from regional growth to air traffic				
Lag 1	-	0.925	-	-

The results so far indicate that air traffic, or accessibility in general, Granger – causes regional growth in some regions but not in all regions. The data generating process is non-homogeneous and homogeneous causality relationships cannot be obtained. It may, however, still be possible that for one or more cross regions, causality relationships still exist. There is need for further analysis, i.e. for testing the heterogeneous non-causality hypotheses. As the number of regions is high, 86, we do not test individually the contribution of each region to the existence of causality, but use the categorization of the regions into three groups according to their peripherality. The categorization is important, since we especially want to analyze the significance of remote airports for their regions.

The third step is to test the heterogeneous non-causality hypothesis (HENC). The F_{HENC} statistic is calculated using RSS_1, obtained above, in addition to the sum of squared residuals (RSS_4) from a model in which the slope coefficients for the panel members in the sub-group in question is constrained to zero.

The test examines the joint hypothesis that there are no causality relationships for a subgroup of regions. In this case, the Wald statistic is

$$(6) \quad F_{HENC} = \frac{(RSS_4 - RSS_1)/(nncp)}{RSS_1/(NT - N(1 + p) - ncp)} \; ,$$

where RSS_4 corresponds to the realisation of the residual sum of squares obtained in model (1) when one imposes the nullity of the k coefficients

associated with the variable $x_{i,t-k}$ on the n_{nc} regions of the subgroup. n_c is the number of regions not belonging to the subgroup (for which $β$ is not constrained to 0).

Interestingly, the results shown in Table 4 suggest that peripherality indeed matters: the more peripheral the region is the more important for its development is to have efficient air connections. This result is most evident with the pair of variables "air passengers – GDP". For peripheral regions, the test statistics is significant with all combinations of variables, but for the other types of regions the result somewhat varies depending on the variables.

Table 4. Test results for heterogeneous causality (HENC hypothesis, lag 1)

| Direction of causality and region type | F-statistic and its significance | | | |
	Air passengers - GDP	Air passengers -employment	Accessibility - employment	Accessibility - GDP
Causality from air traffic to regional growth				
Peripheral regions	2.527***	3.533***	2.952***	4.685***
Middle regions	1.374*	0.760	1.152	0.618
Core regions	0.873	0.393	1.607*	0.385

2.3.4 Conclusions

This study focuses on the importance of air transportation in different European regions. We are interested, particularly, in the relationship between air transportation and regional growth in peripheral regions. This starting point is different as compared to many prior studies which have concentrated hub airports and the development of metropolitan areas. In peripheral regions, air traffic may decrease the negative effects of long distances. Easy accessibility attracts firms, investments and other economic activity to the region and stimulates employment and production at established firms. Earlier studies and surveys clearly indicate that access to air transportation has a very important effect on location decisions of many businesses. A well-developed transport infrastructure is a facilitator that allows the economic potential of a region to be realized.

The Granger non-causality method in a panel framework which allows possible heterogeneity between regions provides a new approach to the analysis of the relationship between air traffic and economic development. Our results give evidence in favor of causal processes in these relationships. The results suggest that air transportation is even more than a facilitator in remote regions - in addition that regional growth causes airport activity, air activity also gives a boost to regional development. Supply side effects are important for distant regions. In core regions, the reverse is only true: airport activity does not cause growth, but regional growth causes airport activity.

In the light of these results, the message for regional policy makers is apparent: there are good reasons to defend local airlines since they are important for the development in remote regions. The traditional challenge with many small local airports is that they are not financially viable which has led to the provision of financial support to airports and airport companies. Though subsidies often distort competition or are wasted money, our results suggest that there indeed might be a case for them if the result is increased regional growth and welfare.

It should be, however, remembered that although Granger causality represents an advance towards uncovering true causal processes, it is indicative rather than confirmatory. While airport activity may seem to cause economic development because lagged airport activity values carry explanatory power, the apparent causation may be due to some omitted variables that move in tandem with airport activity, and which are not being picked up by lagged economic development values, suggesting airport activity is the cause. Moreover, lagged airport values may in fact be in response to anticipated future economic development values. It may happen, e.g., that airports have originally been built to regions that have most potential for economic success.

2.4 Structural regression analysis

The second method used is structural regression analysis. It estimates numerically the size of the influences. The regression analysis yields quantitative results about the relation of economic performance and transport infrastructure. Thus, it is possible to see how relevant the impact of accessibility is relative to other regional location factors.

The structural regression analysis clearly shows that accessibility does matter and has a significant positive impact on the level of regional GDP and productivity. The effect is much lower on the growth rates of economic performance. Also, the impact of geographical location is less relevant than the impact of transport services. This is very relevant to regional policy: Improving accessibility by either better infrastructures (such as new rail links) or better transportation services (such as additional scheduled direct flights to existing destinations or new direct flights to additional destinations) tends to increase economic activity in the region.

2.4.1 Research plan

This chapter presents the research plan for the regression analysis, which is pursued in the present study. First, a brief overview of the general procedure is given. This is followed by the detailed description of the applied econometric methods.

2.4.2 Overview

Based on the economic growth theory discussed previously, a theoretical relationship between accessibility and economic prosperity or development, has been postulated. Subsequently the question arises, whether this relationship can also be confirmed empirically. The according null hypothesis states that the influence of accessibility on economic prosperity is zero. Additionally, in our analysis we will distinguish between peripheral and non-peripheral regions.

We also investigate, whether economic prosperity has an impact on airport attributes (passengers, cargo). The implied null hypothesis says that the influence of economic prosperity on airport attributes is zero. Again, the distinction between peripheral and non-peripheral regions is tested. All the econometric estimations are performed using the software Eviews 7.2.

Theoretical equations to be tested

The following table displays the theoretical equations, derived from economic considerations that will be tested below.

Tab. 0-1   Theoretical equations to be tested

Name	Theoretical equations
Level	$\ln Y(t) = \beta_0 + \beta_1 \cdot \ln R_1(t) + \beta_2 \cdot \ln R_2(t)$
Difference1	$gY(t) = \beta_0 + \beta_1 \cdot gR_1(t) + \beta_2 \cdot gR_2(t)$

Source: BAKBASEL

Methods

In order to test the postulated relationships, we apply methods of inductive statistics, specifically linear regression analysis. Tab. 0-1 lists the equations that will be tested. After defining the structural models, they are estimated as pure cross-section specifications and as panel specifications.

The applied methods are prioritized as follows: The main specification is the level equation of the cross-sectional structure model. The aim of the other equations is to verify the obtained results regarding the robustness and the sensitivity and to eventually disclose other aspects. These other equations are designed in order to emphasize the differences in comparison to the main specification, and not to identify the best coefficients. The difference equations of the cross-sectional structure model extend the main specification by the dynamic aspect. The equations of the panel model use the panel structure of the data in order to generate more efficient estimates, as well as to further reduce the probability of a distortion due to disregarded variables (by including so-called Fixed Effects into the model).

Samples

The sample includes 336 NUTS 2 or NUTS 3 regions of Western Europe (including Greece) for the period from 2000 to 2008. When the impact on airport attributes is estimated, the sample is smaller and consists of data for the period 2006-2010.

2.4.3 Economic performance

To explain the regional differences in economic performance, the dependent variable in the level equation is not defined as the overall economic output, typically measured by the gross domestic product (GDP). The measure of GDP contains pure size effects (large and populous regions, as well as regions with many employees, coincide with higher output) and would therefore need corrections by including further right hand variables. Instead, the economic output is standardized by means of the population data.

The resulting GDP per capita (GDP divided by population) represents the welfare of the region. Accordingly, the participation rate (employment divided by population) is used as another left hand variable. The third possible dependent variable is the real hourly productivity of labour. It is expressed in euros and adjusted for purchasing power parity (PPP), which allows cross-country comparisons. For the specification in differences, the dependent variable is set as the growth rate of GDP per capita, the growth rate of the participation rate or the growth rate of the hourly productivity of labour, respectively.

The different specifications are presented in the following table.

Tab. 0-2   Dependent variable: Economic performance

Level/ Difference	Measures	Indicator	Shortcut
Level	Economic prosperity	Real GDP per capita (GDP / Population) Participation rate (Employment / Population) Real hourly productivity of labour	XP, PPR, XAr
Difference	Economic development	Growth rate of GDP per capita Growth rate of the participation rate Growth rate of real hourly productivity of labour	gXP, gPPR, gXAr

Source: BAKBASEL

The table below lists the independent variables (the components of the residual variable R), divided into three groups:

- Location factor accessibility: Variables that measure the accessibility of a region. Highlighted in dark grey.
- Other location factors: Variables that capture other location characteristics. Highlighted in light grey.
- Other residual variables: Variables that cover other growth effects. Highlighted in white.

In the framework of this study we are mainly interested in the variables of accessibility. The other two groups serve as control variables and are included into the regression in order to isolate the impact of accessibility and to avoid at the best distortions due to omitted variables.

The detailed definition of the variables, their measurement and evaluation, as well as the corresponding sign hypothesis, are described in chapter 0. The overview of the independent variables is given by Tab. 0-3.

Tab. 0-3   Independent variables

Level/ Difference	Residual factors	Indicators	Mnem.	Sign hypothesis
Level	Accessibility (Level)	Accessibility Indices Higher index means more accessibility	AC[…]	+
	Regulation (Level)	Regulation Index Higher index means more regulation	RG	-
	Taxation (Level)	Effective average tax rate	TX	-
	Innovation (Level)	Share of employees with tertiary education	IV	+
Difference	Accessibility (Growth)	Accessibility Indices Higher index means more accessibility	gAC[…]	+
	Regulation (Growth)	Regulation Index Higher index means more regulation	gRG	-
	Taxation (Growth)	Effective average tax rate	gTX	-
	Innovation (Growth)	Share of employees with tertiary education	gIV	+
	Convergence Term (Level)	Dependent variable of previous period	CT	-
	Error Correction Term (Level) Only for panel model	Residual of the corresponding level equation, delayed by one period	ECT	-

Source: BAKBASEL

Structural models

Structural models focus on the cross-sectional dimension of the data, as they explain an endogenous variable at a point in time by exogenous variables. Delayed values of the endogenous variable are not included as explanatory

variables. A partially dynamic component can only be introduced by using growth rates or panel methods.

The estimation of the structural models is carried out or by considering the data as pure cross-sections, or by exploiting the panel properties of the data. Although the data set is a panel, i.e. includes observations over a transverse and a longitudinal dimension, the main attention is paid to the cross-sectional model. It includes the average values over the period of 2000 to 2008 (economic prosperity) for each cross-sectional entity. The level values represent the arithmetic mean of the period and the difference values are expressed by the (constant) average growth rate over the time. The purpose of the subsequent panel regressions is the testing for robustness of the previously obtained cross-sectional results.

The focus on the cross-section model is due to the following reasons:

The transmission mechanism from accessibility to economic prosperity, which has been described previously, is very complex in terms of timing. We cannot expect the impact, triggered by an improved accessibility in one period, to take effect in the same or the ensuing period. On the one hand, rational agents might already take into account the announced improvements in accessibility for their decisions, before the quality of the transport infrastructure is actually enhanced. As a result, the economic activity increases prior to the actual improvement. On the other hand, the adjustment process of economic subjects to changes in the location factors usually takes some time. Accessibility and economic prosperity are therefore linked by a complex "lead-lag relationship".
The described transmission mechanism from accessibility to economic prosperity takes place primarily on the geographic level, and less over time. The increased attractiveness of a location will cause more companies to locate at this site. This compares to other locations at the same time. Obviously, the number of companies at the same location also increases over time. However, the impact of accessibility can be better captured by the spatial comparison.
The accessibility variable has been calculated for certain years only, based on specific timetables and other information. The years lying in between the "available" observations have been linearly interpolated. Critical observers could call the attempt of interpreting the exact dynamic structure of this variable as "bold" (because the dynamic structure might partially be caused by the computation of the data itself).

Calculating the average values for the level equations means to lose the dynamic information, while at the same time statistical noise is removed. For this reason, the results of the cross-sectional regressions are expected to be clearer and more explicit than those resulting from the panel estimations.
The detailed schedule of all the structural model estimations is shown in Fig. 0-1. The different equations are estimated as cross-section or as panel models. For each model, the estimated equations, presented in Tab. 0-4, are followed by the corresponding tests. In a first step, we undertake the cross-sectional regressions. The difference equation is extended by the

convergence term as an additional right hand variable in order to capture convergence dynamics.

Due to the additional time structure in the subsequent panel regressions, the aspects of time series econometrics must be considered. First, it has to be verified whether the variables (in levels) are stationary, which means, whether the stochastic processes are integrated of order zero (I(0)). This is necessary in order to achieve meaningful statistical results. In the case of stationarity, the panel regressions can be specified according to the cross-sectional equations. If the variables in levels are non-stationary, we test for the stationarity of the variables' differences. If the differences are still non-stationary, the research agenda has to be cancelled and redefined. However, if the differences are found to be stationary, which means the stochastic processes are integrated of order one (I(1)), we continue according to the schedule. In a next step we examine, if there exists a cointegration relationship between the dependent and at least one of the independent variables. In the case of cointegration, the panel regressions can be specified similarly to the cross-sectional regressions: In this specification, the level equation has to be interpreted as the cointegration relationship, that only applies asymptotically and in the long term. In addition, the convergence term is replaced by the error correction term. This correction term captures the dynamic effect of the fact that both, the dependent and the cointegrated independent variable, tend towards their equilibrium condition in every period. Therefore, the error correction term is represented by the delayed (by one period) residual of the corresponding level equation. If the cointegration relationship cannot be established, there exists no interpretation of the level equation. However, having obtained stationarity for the variables' differences, the difference equations, extended by the convergence term, can be estimated and interpreted without problems.

Fig. 0-1   Schedule of the structure models
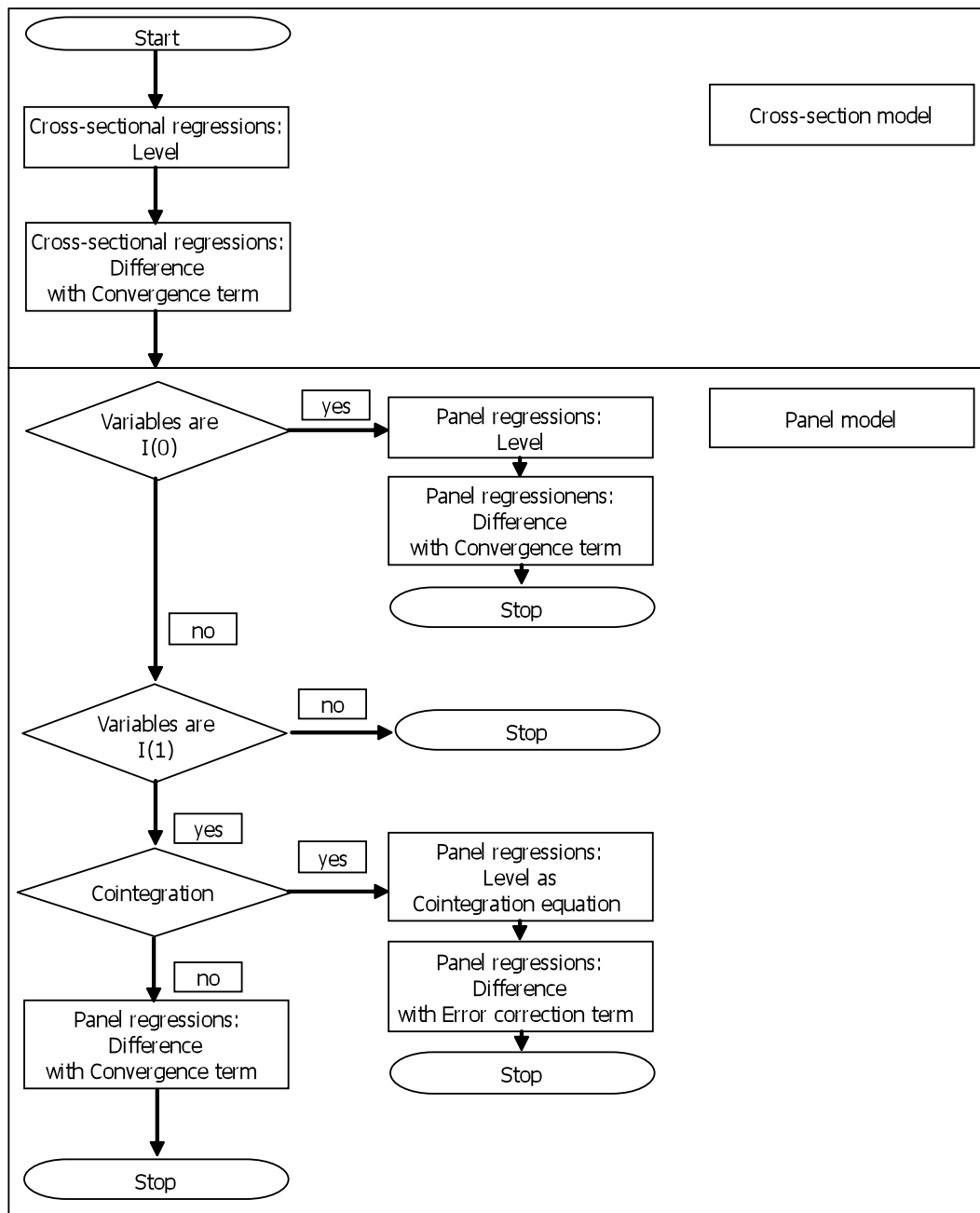
Source: BAKBASEL, based on Müller et al. (2011)

Testing for the characteristics of the stochastic processes is essential in order to ensure the validity of the panel regression results. If the regressand and the relevant regressors are non-stationary, they may seem significantly correlated, although they are completely unrelated. The correlation results from the fact that they both follow a trend over time. This spurious correlation should not be interpreted as a causal relationship (see Granger and Newbold (1974)) and the resulting high statistical significance of the regression outcomes may be misleading. In contrast to this, cointegration means that the

non-stationary processes follow a common trend over time. In this case, the equation in levels is interpreted as the long-term cointegration relationship.

Cross-section model

The theoretical equations of Tab. 0-1 lead to the following estimation equations for the cross-section model (Tab. 0-4).

Tab. 0-4   Estimation equations of the theoretical equations to be tested: Cross-section model

Name	Theory / Estimation	Equation
Level	Theory	$\ln Y(t) = \beta_0 + \beta_1 \ln R_1(t) + \beta_2 \ln R_2(t)$
	Estimation	$\ln XP_i = \beta_0 + \beta_1 \ln AC_i + \beta_2 \ln RG_i + \beta_3 \ln TX_i + \beta_4 \ln IV_i + \varepsilon_i$
Difference	Theory	$gY(t) = \beta_0 + \beta_1 gR_1(t) + \beta_2 gR_2(t)$
	Estimation	$gXP_i = \beta_0 + \beta_1 gAC_i + \beta_2 gRG_i + \beta_3 gTX_i + \beta_4 gIV_i + \beta_5 \ln CT_i + {}$ $+\, \varepsilon_i$

Source: BAKBASEL

The time index is omitted in the estimation equations, because the theoretical equation is only considered for one specific moment in time (the "arithmetic mean moment"). Further, we replace the residual variable R of the theoretical equation by the concrete location factors like accessibility (AC), regulation (RG), taxation (TX) and innovation (IV). The difference equation also includes the convergence term (CT), which is designed to capture growth dynamics resulting from the potential convergence amongst the regions. The convergence term is measured by the corresponding dependent variable in 1990. Here this would be GDP per capita in 1990. The subscript i indicates that the equations apply to all the cross-section entities of the sample. In econometrics this level equation is also called "log-log-model". It means that the estimated β-coefficients are interpreted as partial output-elasticities of the reduced-form production function. A one-percentage change in the independent variable AC therefore leads to a β_1-percentage change in the dependent variable XP.

The coefficients of the cross-section structural models are estimated by the means of linear regression and by the method of least squares (OLS). Further we used the heteroscedasticity-consistent estimation of the covariance matrix (White (1980)).

Panel model

Tab. 0-5 directly follows from Tab. 0-4.

Tab. 0-5   Estimation equations of the theoretical equations to be tested: Panel model

Name	Theory / Estimation	Equation
Level	Theory	$\ln Y(t) = \beta_0 + \beta_1 \ln R_1(t) + \beta_2 \ln R_2(t)$
	Estimation	$\ln XP_{it} = \alpha_i + \beta_1 \ln AC_{it} + \beta_2 \ln RG_{it} + \beta_3 \ln TX_{it} + \beta_4 \ln IV_{it} + \varepsilon_{it}$
Difference	Theory	$gY(t) = \beta_0 + \beta_1 gR_1(t) + \beta_2 gR_2(t)$
	Estimation	$gXP_{it} = \alpha_i + \beta_1 gAC_{it} + \beta_2 gRG_{it} + \beta_3 gTX_{it} + \beta_4 gIV_{it} + \{\ln CT_{it-1} \; oder \; ECT_{it-1}\} + \varepsilon_{it}$

Source: BAKBASEL

The equations of the panel model differ from the ones of the cross-section model in the following points:

- The subscript i is replaced by it. The equations apply to all cross-section entities, as well as to every point in time.

- The constant of the regression, β_0, is replaced by α_i. Estimating panel models means to estimate a regression constant for every single cross-section entity. These equations are called Fixed-Effect models. The introduction of the entity-specific constants allows to capture individually specific influences, that remain constant over time.

- In difference equations, that are based on a cointegrated level equation, the error correction term (ECT) replaces the convergence term CT. The error correction term is measured by the residual of the corresponding level equation, delayed by one period. If the convergence term CT is used instead (in non-cointegrated difference equations), it is expressed by the dependent variable delayed by one period.

Apart from that, the equations of the panel model can be interpreted in the same way as the ones of the cross-sectional model.

As mentioned before, the panel model is designed to test the robustness and the sensitivity of the cross-section model. The exploitation of the panel structure offers several advantages:

- The availability of observations for several points in time for each cross-section entity allows to capture influences that differ among the cross-section entities, but stay constant over time (they affect the entity specific constant α_i). This lowers the probability that the model estimation is distorted by disregarded variables.

- The existence of data over two dimensions increases the number of observations compared to the normal cross- or longitudinal-section datasets. This improves the efficiency of the estimators.

The panel structural models are specified as Fixed-Effect models. This decision is based on the Hausmann specification test, which is described in more detail in chapter 0. The coefficients of the equations, transformed by the Within-Transformation[20], are estimated by the means of linear regression and the method of the least squares (OLS). In order to avoid potential heteroscedasticity over the regions and autocorrelations within each region (cross-section clustering), we correct the covariance matrix by the procedure of Arellano (1987).

Airport attributes

In this section, the airport attributes are linked to the explanatory variables of economic performance. As measures describing the airport performance, we consider the number of commercial passengers, as well as the cargo (freight and mail) in metric tones. It follows that there are two dependent variables and therefore two groups of equations to be tested. The number of passengers and the cargo contain pure size effects, which are corrected according to the proceeding of the last section. The size effects are taken into account by standardizing the data. The number of commercial passengers is standardized by means of the population data, while the cargo in metric tones is divided by the real GDP.

The resulting ratio of commercial passengers to the total population measures the importance of the airport. Accordingly, the ratio of cargo to the real output is also designed to represent the relevance of the airport. The equations in differences include the growth rates of these ratios.

The different specifications are presented in the following table.

Tab. 0-6   Dependent variable: Airport attributes

Level/ Difference	measures	Indicator	Shortcut
Level	Airport attributes	Ratio of commercial passengers to population (Passengers / Population) Ratio of cargo to real GDP (Cargo / GDP)	APT, ACX
Difference	Airport development	Growth rate of the ratio of commercial passengers to population Growth rate of the ratio of cargo to real GDP	gAPT, gACX

Source: BAKBASEL

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[20] The Within-transformation is the subtraction of the entity-specific mean values of every variable included in the equation. This allows the elimination of the so-called individual effects, which are constant over time.

The table below shows the independent variables (the components of the residual variable R), which are different measures of economic performance. In this analysis the focus lies on the influence of economic performance on the importance of the local airport. The different measures included in the estimations capture distinct transmission mechanisms and are designed to avoid at best distortions due to omitted variables.

The detailed definition of the variables, their measurement and evaluation, as well as the corresponding sign hypothesis, are described in chapter 0. The overview of the independent variables is given by Tab. 0-3.

Tab. 0-7 Independent variables

Level/ Difference	Residual factors	Indicators	Mnem.	Sign hypothesis
Level	Economic performance (Level)	Productivity (real GDP / employment)	XN	+
	Economic performance (Level)	Participation rate (employment / population)	PR	+
	Economic performance (Level)	Share of related economic sector (sector product / nominal GDP)	A[…]	+
Difference	Economic performance (Growth)	Productivity (real GDP / employment)	gXN	+
	Economic performance (Growth)	Participation rate (employment / population)	gPR	+
	Economic performance (Growth)	Share of related economic sector (sector product / nominal GDP)	A[…]	+
	Convergence (Level)	Dependent variable of previous period	CT	-
	Error Correction Term (Level) Only for panel model	Residual of the corresponding level equation, delayed by one period	ECT	-

Source: BAKBASEL

Structural models

As explicated in chapter 0 the focus lies on structural models, which means on cross-sectional equations, including growth rates or panel structure in order to allow for dynamic effects. As before in the economic performance section, the level values are measured by the arithmetic mean, while the difference values are expressed by the (constant) average growth rate. The main purpose of the subsequent panel regressions is the testing for the robustness of the cross-sectional results.

The focus on the cross-section model is due to the following reasons:

As before, economic performance and airport attributes are linked by a complex "lead-lag **relationship**". T**he transmission mechanism from economic performance to the characteristics of the local airport is complex in terms of timing. The exact timing of triggered impacts is often unclear and rational agents tend to anticipate announced changes before the actual event, while other adjustment processes take more time.**
The airport data on passengers and cargo is limited. For many regions data is only available starting in 2006. As a consequence these time series are too short for obtaining reliable panel regression results.

Calculating the mean values allows to remove some statistical noise, although the dynamic information is lost. For this reason, the results of the cross-sectional regressions are expected to be clearer and more explicit. We follow the detailed schedule as already shown in Fig. 0-1.

First, the cross-sectional regressions are estimated. The difference equation is extended by the additional convergence term in order to capture convergence dynamics.

For the panel regressions, several tests concerning the characteristics of the time series data are necessary. The same reasoning as explained in chapter 0 applies here, too.

Cross-section model

The theoretical equations of Tab. 0-1 lead to the following estimation equations for the cross-sectional model (Tab. 0-8).

Tab. 0-8   Estimation equations of the theoretical equations to be tested: Cross-section model

Name	Theory / Estimation	Equation
Level	Theory	$\ln Y(t) = \beta_0 + \beta_1 \ln R_1(t)$
	Estimation	$\ln APT_i = \beta_0 + \beta_1 \ln XN_i + \beta_2 \ln PR_i + \beta_3 \ln A_i + \varepsilon_i$
Difference	Theory	$gY(t) = \beta_0 + \beta_1 gR_1(t)$
	Estimation	$gAPT_i = \beta_0 + \beta_1 gXN_i + \beta_2 gPR_i + \beta_3 gA_i + \beta_5 \ln CT_i + \varepsilon_i$

Source: BAKBASEL

The time index is omitted in the equations above, because the cross-sectional equations are only considered for one specific moment in time (the "arithmetic mean moment"). Further, the residual variable R of the theoretical equations is replaced by the concrete economic performance factors like productivity (XN), participation rate (PR), and share of the relevant economic sector measured in GDP (A). In the specification including the ratio of passenger to population as dependent variable this relevant economic sector is represented by the tourism sector in order to control for its influence on the number of passengers transferred by the local airport. Accordingly, the ratio of the industry sector to nominal GDP is included into the specification with the cargo per real GDP as regressand in order to capture the export-promoting influence of the industry sector on the transportation dimension of the local airport. The difference equation also includes the convergence term (CT), which is designed to capture growth dynamics resulting from the potential convergence amongst the regions. The convergence term is measured by the corresponding airport attribute in 2006. The subscript i indicates that the equations apply to all the cross-section entities of the sample. In econometrics this level equation is also called "log-log-model". It

means that the estimated β-coefficients are interpreted as partial output-elasticities of the reduced-form production function. A one-percentage change in the independent variable XN therefore leads to a β_1-percentage change in the dependent variable APT.

The coefficients of the cross-section structural models are estimated by the means of linear regression and by the method of least squares (OLS). Further we used the heteroscedasticity-consistent estimation of the covariance matrix (White (1980)).

Panel model

Tab. 0-9 directly follows from Tab. 0-8.

Tab. 0-9   Estimation equations of the theoretical equations to be tested: Panel model

Name	Theory / Estimation	Equation
Level	Theory	$\ln Y(t) = \beta_0 + \beta_1 \ln R_1(t)$
	Estimation	$\ln APT_{it} = \alpha_i + \beta_1 \ln XN_{it} + \beta_2 \ln PR_{it} + \beta_3 \ln A_{it} + \varepsilon_{it}$
Difference	Theory	$gY(t) = \beta_0 + \beta_1 gR_1(t)$
	Estimation	$gAPT_{it} = \alpha_i + \beta_1 gXN_{it} + \beta_2 gPR_{it} + \beta_3 gA_{it} +$ $+ \left\{ \ln CT_{it-1} \ oder \ ECT_{it-1} \right\} + \varepsilon_{it}$

Source: BAKBASEL

The characteristics of the panel model equations correspond to the ones described in the previous section. The time component t is introduced, the constant of the regression α_i now represents the entity-specific influence (Fixed-Effect model) and the cointegrated difference equations contain an error correction term ECT (delayed by one period) instead of the convergence term (starting year 2006).

As mentioned previously, the panel model is designed to test for the robustness and the sensitivity of the cross-section model. The exploitation of the panel structure offers the advantage of lowering the probability of distortion by including more information and the advantage of improving efficiency by increasing the number of observations.

According to the decisions when testing for economic performance, the panel structural models are specified as Fixed-Effect models (Hausmann specification test). The coefficients of the equations, transformed by the Within-Transformation[21], are estimated by the means of linear regression and the method of the least squares (OLS). In order to avoid potential heteroscedasticity over the regions and autocorrelations within each region (cross-section) clustering), we correct the covariance matrix by the procedure of Arellano (1987).

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[21] The Within-transformation is the subtraction of the individually specific mean values of every variable included in the equation. This allows the elimination of the so-called individual effects, which are constant over time.

2.4.4 Data for the economic performance models

In the previous chapters, the linear regression models were presented. The variables, which flow into the regression analysis, were only briefly mentioned. This chapter discusses the transmission mechanism and the sign hypothesis of the coefficients for the economic performance models.

The regression models are based on a panel data set. The sections represent 336 regions[22], while the longitudinal axis covers the periods from 2000 to 2008. The data derives from the European sample of the database of the "International Benchmarking Programme" by BAKBASEL (IBP database). A detailed description of these data is listed in the appendix.

2.4.5 Dependent variables

The GDP per capita, the participation rate and the real hourly productivity of labour are used as dependent variable. GDP per capita is the ratio of GDP and population and the participation rate is the ratio of employment and population.

2.4.6 Independent variables

- Accessibility

Accessibility as a residual factor

Referring to the reduced form of the classical production function in which production is based on the use of labor (L), capital (K) and residual factors (R), economic prosperity can be modelled as being dependent only on the residual factors. Its pivotal feature is the efficiency enhancement of the production process. For years, BAKBASEL has been approximating these residual factors by location factors such as the level of regulation, taxation or innovation potential. May accessibility be considered as a residual factor, too? In order to answer this question it is necessary to analyse whether accessibility leads to an increasing efficiency of the production process. From an economic point of view the following considerations can be made.

Easy accessibility, based on an efficient transport system, clearly leads to the reduction in transportation costs by saving time. In the framework of the transaction cost theory, the transport costs of goods or services, but also the costs of a person acting as a negotiation partner, can be interpreted as transaction costs. Thus accessibility leads to a reduction of transaction costs and therefore enhances the efficiency of these transactions. This is illustrated in Fig. 0-1. The investments in transport systems as the origin of the impact chain are also depicted.

The reduced transport/transaction costs have a positive influence on the economic process over several channels:

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[22] Further information about the regions is given in the data description.

- Increase in productivity

  - Goods – both inputs and outputs of the production process – can be transported from and to the existing (procurement/sales) markets more cost-effectively. Further, new and more remote (procurement/sales) markets can be made accessible. As a result there is a reduction in the intermediate costs (more efficient management of existing markets) or an increased added value (opening up of new markets). Thereby the added value, which can be assigned to the production factors labour and capital, is augmented. Assuming constant use of labour and capital, the productivity of these production factors therefore increases.

  - The lower transportation costs allow for a division of labour between regions and thus enable regions to specialize. Thereby economies of scale and other advantages of this specialisation can be used. This results in a further increase in the added value and the productivity (under the assumption of constant use of labour and capital).

  - An interregional/-national transfer of knowledge is strongly facilitated by lower transport costs. It is generally accepted in the economic literature that higher innovational strength leads to increases in added value and productivity.

Higher productivity has a positive influence on the economic well-being of the already residentiary workforce and lenders of capital, who can expect higher wages and dividends, or alternatively, under the assumption of constant interest rate payments, higher credit rating of the companies. Further, increased productivity attracts labour and capital from other regions. This can lead to clustering in certain industries, which again reacts positively upon the attractiveness of a region (feedback).

- Increase in mobility

  - People can travel for lower costs. This means not only increased well-being for the residents, who have better access to other regions (Vacation, business travel, etc), but also higher attractiveness for labour and capital coming from other regions, as it is closer from its origin in terms of travel time. Therefore, it also becomes easier to take part in the innovation processes of other regions.

The economic activity may benefit more from the increased attractiveness than from the increased well-being. First, the inflow of extra-regional capital is probably higher than the increase in the inner-regional capital. Second, there is not only an inflow of capital but also an inflow of labour due to the location's higher attractiveness. However, increased well-being also leads to higher attractiveness. For example, there are more means for cultural offers available, which is often a crucial location factor for extra-regional employees (especially in the case of high-skilled workers).

Summarising, it can be said that a region won't be able to benefit from the globalisation (opening up of new markets, division of labour, transfer of knowledge, interregional/-national mobility) until it has become easily accessible in terms of transport. Furthermore, a consistently high global

accessibility has the consequence of a more productive world economy, because production factors can be easier allocated to the place of their most productive use.

Fig. 0-1   Economic functional chain of investments in transport systems

(transport infrastructure or transport services)	Costs

⇩

Accessibilit
(shorter transport- and travel time)

⇩

Costs
(lower transport- and travel time)

⇩

Productivit (increased added value with constant use of labour and capital)	**Mobi**lit (increased efficiency	near-term benefit

⇩

Wellbein Caused by 1. Labour: higher wages 2. Equity: higher dividends 3. Debt: higher credit rating Caused by Residents can reach other regions at lower costs.	**Attractiveness** Caused by productivity Extra-regional companies want to benefit from productivity advantages. Caused by Extra-regional employees can travel to their homes at lower cost.	long-term benefit

Clustering

⇩

Economic activity

Source: BAKBASEL, based on Müller et al. (2011)

Tab. 0-1 allows to look at the relationship between accessibility (only multimodal) and economic prosperity. It displays the correlation coefficient for the total, geographical and transport accessibility. Thereby three kinds of influences of accessibility in accordance with the theoretical equations that will be tested are considered:

■ Accessibility level on GDP per capita level (level)

■ Accessibility growth on GDP per capita growth (difference)

It is evident that in level as well as in terms of growth rates a positive relationship seems to exist.

Tab. 0-1   Correlation: Accessibility and GDP per capita or participation rate, 1991-2008

		GDP per capita		Participation rate
		Level	Growth	Level
Total accessibility	**Level**	0.54	0.09	0.38
	Growth		0.29	
Geographical accessibility	**Level**	0.47	0.04	0.31
	Growth			
Transport accessibility	**Level**	0.52	0.10	0.37
	Growth		0.29	

Comment:

• Pearson correlation coefficient
• Accessibility level: natural logarithm of the average of 1991-2008
• GDP per capita level: natural logarithm of the average of 1991-2008, real GDP
• Accessibility growth: average annual growth rate 1991-2008
• GDP per capita growth: average annual growth rate 1991-2008

Source: BAKBASEL

It is interesting that the total accessibility level is slightly stronger correlated with the GDP per capita level compared to the transport accessibility level, while the opposite is true for the relationship between the level and growth values. However, when interpreting these results one needs to keep in mind BAKBASEL's computation method of the transport accessibility (division into 1/3 and 2/3). The correlation in growth rates could not be computed for the geographical accessibility, because this variable naturally has a growth rate of zero. Furthermore, concerning the relationship between accessibility and GDP per capita the question of causality remains unresolved: Does better accessibility level lead to a higher level of prosperity or vice versa? This uncertainty will be resumed in another chapter by means of the concept of the Granger causality.

- Regulation

Transmission mechanism
Regulation corrects market failures and compensates for externalities, but it is also costly. There are direct costs, like administration and controlling, as well

as indirect costs, as incompatible incentives or government failure. The optimal level of regulation cannot be determined theoretically; however, empirical studies are used in order to answer this question, at least partly. Regulations work through many channels of an economic system, and the relationship between regulation and growth is very complex.

Sign hypothesis
This study started from the premise that the optimal level of regulation is rather low. Low values of the regulation index should therefore be associated with a higher level of GDP per capita and growth; high index values would correspond to lower levels of GDP per capita and growth. The estimated coefficient in the regression should therefore have a negative sign.

- Taxation

Transmission mechanism
There are several ways in which tax levels influence the regional economic development. Taxation is a key topic for businesses evaluating the attractiveness of a location. A lower tax burden attracts new companies to a location and provides an incentive for existing companies to stay. Even if no location decision is involved, a lower tax burden increases competitiveness in the market by decreasing the costs for a company, which in turn supports company survival or growth.

This connection between taxes and economic growth is obvious for direct company taxation. In the case of personal income taxation however, this is less straightforward. But a similar connection is expected for several reasons.

First, company owners and top management in general earn more and therefore have to pay higher income taxes in most countries or regions. Their individual preferences might influence the decisions for the company location.

Second, employees' decisions are affected as well. Employees focus on their net available income, which is different from a firm's costs. If employees have some bargaining power and are mobile between regions, the companies will be forced to bear at least parts of the difference in the tax burden between competing regions. Otherwise, flexible employees will move to regions with lower tax levels, since their available in-come is higher there (everything else kept equal). Therefore, higher income tax levels can result in higher costs for companies. Highly qualified individuals are especially and increasingly internationally mobile. At the same time, these individuals are becoming more important for the knowledge based economy. Income taxation, especially the burden on highly qualified employees, can work as a cost factor, just as much as company taxation does.

Sign hypothesis
Based on the above reasoning, a negative sign for the regression coefficient of the taxation variable is expected.

- Innovation

Transmission mechanism

Innovation leads to more efficient production processes and to higher productivity of capital and labour. If the same amount of input can produce a larger quantity of output, economic prosperity has increased. In addition, innovative regions attract firms, as they expect a competitive advantage resulting from these new technologies. As a result, these regions show a stronger economical development.

Sign hypothesis

Based on the above reasoning a positive sign for the regression coefficient of the innovation variable is expected.

2.4.6 Other variables

Convergence term

The convergence term is introduced into all the difference equations, as well as into some of the panel specifications. It captures the effect of growth, resulting from the convergence of economic prosperity among regions in the long term. More prosperous regions are expected to grow less than poorer regions. The above-average growth rate of weaker regions may represent the impact of catching-up or the result of a well-directed promotion policy. We expect a negative sign for this variable's coefficient.

In the cross-sectional model, the convergence term is expressed by the level of the dependent variable of the region in the year 1990. In the panel model, as observations for several periods are available, the convergence term is defined as the level of the dependent variable of the region, delayed by one period. This dependent variable, as defined in the beginning, is or the GDP per capita, the participation rate or the real hourly productivity of labour, depending on the estimated equation.

Error correction term

If the panel model can be represented as a cointegrated level equation, the difference equation is extended by the error correction term as a right hand variable. It reflects the growth effects, which result from the cointegration of the variables that makes them moving towards their long-term equilibrium condition. If the value of the dependent variable exceeds its equilibrium value, the error correction term corrects for this difference by lowering the growth rate of the subsequent period and vice versa. For this reason, the sign of the error correction term is expected to be negative. The coefficient can be interpreted as the share of the deviation of the actual value from the equilibrium value, by which this difference is decreased every period back towards the equilibrium condition.

In order to measure the error correction term, first, the level equation is estimated and defined as the cointegration equation. Then, the residual of the same regression, but delayed by one period, is introduced to the difference equation as an additional right hand variable, the error correction term.

2.4.7 Data for the airport attributes models

In this chapter the transmission mechanisms and the sign hypothesis of the coefficients for the airport attributes models are discussed.

The regression models are based on the panel data set. The sections represent 336 regions[23], while the longitudinal axis covers the periods from 2000 to 2008. The data derives from the European sample of the database of the "International Benchmarking Programme" by BAKBASEL (IBP database). A detailed description of these data is listed in the appendix.

2.4.8 Dependent variables

Data on airport performance (assigned to the regions) such as the commercial passengers and the cargo (freight & mail) are used as the dependent variable.

2.4.9 Independent variables

Transmission mechanism

All three indicators affect the demand for air travel. This is shown most clearly in the share of tourism on the GDP. If the proportion is large, it can be assumed that the region attracts more tourists and hence the demand for flights is relatively high. Further, higher participation rate indicates relatively high demand for flights, as there are often business travelers who take the plane. In addition, high participation rate signals more economic prosperity, which gives people the opportunity to travel. The same applies to a high labour productivity.

Sign hypothesis

Based on the above reasoning, the sign for the regression coefficients of all independent variables is expected to be positive.

2.4.10 Other variable

Convergence term

The convergence term, as mentioned above, is introduced into all the difference equations, as well as into some of the panel specifications. It is designed to capture the effect of growth, resulting from the potential convergence of the airport attributes among regions in the long term. Convergence would mean that already large airports grow less than smaller airports. The above-average growth rate of small airports would represent the impact of catching-up or the result of well-directed promotion policies. We expect a negative sign for this variable's coefficient.

In the cross-sectional model, the convergence term is expressed by the level of the dependent variable of the region in the year 2006. In the panel model,

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[23] Further information about the regions is given in the data description.

as observations for several periods are available, the convergence term is defined as the level of the dependent variable of the region, delayed by one period. The dependent variable, as defined in the beginning, is or the ratio of commercial passengers to the population or the ratio of cargo to the real GDP.

Error correction term
For the error correction term, the same applies as in the section on economic performance. If the panel model can be represented as a cointegrated level equation, the difference equation is extended by the error correction term. It reflects the growth effects, which result from the cointegration of the variables that makes them moving towards their long-term equilibrium condition. For this reason, the sign of the error correction term is expected to be negative.

In order to measure the error correction term, first, the level equation is estimated and defined as the cointegration equation. Then, the residual of the same regression, but delayed by one period, is introduced to the difference equation as an additional right hand variable, the error correction term.

2.4.11 Empirical results

After having discussed the key components of the empirical analysis, this chapter presents the results of the econometric estimations. The first section shows the results of the models, divided into the cross-sectional and the panel model, which investigate the relationship from accessibility to economic prosperity. In the second part, the results of the models that set airport attributes as the dependent variable are presented.

The results are shown in order of priority according to our research plan. Within the structure models we are more interested in the cross-sectional model. The panel model is only used to test the plausibility of the first model. In both structural models, the level equation is more relevant than the difference equation. To conclude, we have this sequence:

- Structure models
    - Cross sectional model
        - Level
        - Difference
    - Panel model
        - Level
        - Difference

2.4.12 Economic performance (dependent variable)

Cross-sectional models

Total accessibility

Tab. 0-1 shows an exemplary regression output. The indicator of interest is the total accessibility. The dependent variables in the level equations represent the mean values of real GDP per capita, of real hourly productivity of labour or of the participation rate. For the difference equations continuous growth rates are used. The investigated period is 2000-2008.

Tab. 0-1   Regression output: Cross-section, Total accessibility

Coefficient	GDP per capita				Hourly productivity of labour				Participation rate	
	Level		Difference		Level		Difference		Level	
Constant	4.42	***	0.11	***	-1.77	***	0.03	***	-2.99	***
Accessibility	1.13	***	0.18		1.07	***	0.13		0.41	***
Regulation	0.04		0.05	***	0.08	***	0.06	***	-0.03	*
Taxation	-0.45	***	-0.05		-0.21	***	0.02		-0.26	***
Innovation	0.06	***	0.01		0.10	***	-0.02		0.02	
Convergence			-0.009	***			-0.005	**		
R^2	0.38	***	0.11	***	0.46	***	0.04	**	0.28	***

Notes:
- Dependent variables: mean (natural logarithm) or growth rate (over the period 2000-2008); real GDP per capita (real GDP / population), real hourly productivity of labour, participation rate (employment / population)
- Level values are in logarithms. The growth rates are continuous.
- 336 observations
- ***, **, * means significance at the 1%-, 5%-, 10%-level
- Two-sided Hypothesis: H0: β1 = 0, H1: β1 ≠ 0
Source: BAKBASEL

In the level equations, the coefficient of accessibility is positive for all dependent variables and highly significant. In the long-run equilibrium, accessibility has therefore a significant positive impact on the economic prosperity of a region. The coefficient of accessibility around 1.1 in the level equations is similar for the dependent variables real GDP per capita and the hourly productivity, whereas the coefficient in the model including the participation rate as dependent variable is lower by more than half. This means that the accessibility has a lower impact on the participation rate.

In the difference equations, the coefficient of the accessibility growth is positive, but there is no significance and it is clearly smaller than in the level equations. It follows that the long term impact of accessibility is much higher than the short term impact. This applies to the two dependent variables, the real GDP per capita and the real hourly productivity of labour. Nevertheless, we can assume that accessibility growth exerts a positive influence on the economic prosperity in a long-term growth process.

Real GDP per capita

In order to show how to interpret the regression output, we further investigate the results for the model including the real GDP per capita as the dependent variable. As mentioned before, the level coefficient of accessibility is 1.13 and highly significant. Accessibility has therefore in the long-run equilibrium a significant and positive impact on the real GDP per capita of a region. Also taxation and innovation show the expected signs and the coefficients are significantly different from zero. So we can conclude that low taxes and high innovation lead to a higher real GDP per capita (see also chapters 0 and 0 on transmission mechanisms). Regulation does not display the expected sign, but the coefficient is very small and not significantly different from zero[24]. The regression's R^2, which indicates the fraction of the sample variance of the dependent variable explained by the independent variables, is 0.38.

The model in the difference equations gives worse results. The coefficient of accessibility growth is slightly positive, but it is not significantly different from zero. The coefficients of the taxation, innovation and the convergence term also show the expected sign, but only the convergence term is highly significant. Consequently, there is a slight convergence movement between the regions. Regions with an already high real GDP per capita grow less than regions with a low real GDP per capita. As in the first model, the regulation coefficient has the "wrong" sign. In addition, the coefficient is significantly different from zero. The regression's R^2 of 0.11 is rather low.

The coefficients of the level and difference equations can be interpreted reasonably well. For this purpose the following equations are recalled: By differentiating the level equation with respect to time, we get an expression for the "average region", under the assumption that all other regressors remain constant over time (ceteris paribus).

1) $g\overline{X} = \beta_1 \cdot g\overline{AC}$

In the level equation, a one percent improvement in the level of accessibility (on average an improvement of one point, respectively 0.1 standard deviations) therefore leads to an approximately 1.1 percent improvement in the GDP per capita level.

The estimated difference equation (assuming again that all other regressors remain constant over time) is:

2) $g\overline{X} = \beta_0 + \beta_1 \cdot g\overline{AC}$

Ignoring the temporal trend, a one percent improvement in the accessibility level leads to an improvement in GDP per capita of 0.18 percent.

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[24] A positive sign for the regulation coefficient is possible, as here the variable labour market regulation is included. It can be argued that a high labour market regulation (employment protection, minimum wage) makes it especially unattractive to hire poorly qualified people. Therefore it is possible that a high labour market regulation leads to higher productivity of labour, which can cause higher real GDP per capita. However, high labour market regulation always lowers employment. If we use the participation rate as the dependent variable, the coefficient should be negative. This is comfirmed in the regression output shown above.

These considerations allow the following conclusions: A part of the growth effect, which is attributed to the accessibility in the level equation, could be explained by a temporal trend ($\beta_0 t$). However, the second equation shows that even by taking into account temporal trends the accessibility still exerts a positive impact on the economic prosperity.

Transport and geographical accessibility

As described in chapter 0, the total accessibility can be divided into:

the geographical accessibility, which measures the geographical location of a region and
the transport accessibility, which measures the transportation efforts (transport infrastructure and services) of the region.

The results in Tab. 0-2 provide information about which part of the total accessibility has a decisive influence on the economic prosperity. The growth of geographical accessibility is not included in the regression, since it is assumed to take the value zero.

Tab. 0-2   Regression output: Cross-section, geographical and transport accessibility

Coefficient	GDP per capita			Hourly productivity of labour		Participation rate
	Level		Difference	Level		Difference	Level
Transport	0.84	***	0.14	0.43	***	0.08	0.41	***
Geographical	0.31	***		0.58	***		0.03

Notes:
• Dependent variables: mean (natural logarithm) or growth rate (over the period 2000-2008); real GDP per capita (real GDP / population), real hourly productivity of labour, participation rate (employment / population)
• Level values are in logarithms. The growth rates are continuous.
• 336 observations
• ***, **, * means significance at the 1%-, 5%-, 10%-level
• Two-sided Hypothesis: H0: β1 = 0, H1: β1 ≠ 0
Source: BAKBASEL

Tab. 0-2 reveals the differences between the indicators. Regarding GDP per capita and participation rate, the transportation efforts are more important than the geographical accessibility. This is reasonable, because the air traffic limits the influence on the total accessibility by the geographical location. Also peripherally located cities such as Madrid, Dublin or Stockholm can achieve a good total accessibility. Concerning the hourly productivity of labour, the coefficient of geographical accessibility exceeds the one of transport accessibility. This is an undesirable result for politicians, as it means that the geographical location, which is unchangeable, has a greater impact on the productivity. To conclude, the level of hourly productivity that regions can achieve is partly predetermined. Further it is interesting that the coefficient of geographical accessibility is not significantly different from zero, while there is a significant relationship between employment and transportation efforts. Unlike previously this is a good result for policy makers. It shows the

possibility to achieve higher employment by improving the transport infrastructure and services.

In the difference equation similar results for the growth of transport accessibility as for the growth of total accessibility can be derived: The coefficients of the growth rates are clearly smaller than those of the level values and the coefficients of the accessibility indices are not significantly different from zero. As concluded before, this means that the long term impact of transport accessibility is much higher than the short term impact.

The following conclusions can be drawn: By dividing the total accessibility in geographical location and transportation efforts, which rely to a large extent on transport infrastructure, the latter is shown to be more important than the exogenous geographical location. This effectively means that the disadvantage of peripherality can be made up by good transport connections.

Peripheral regions
In order to identify differences between peripheral and non-peripheral regions, we are working with dummy variables. Tab. 0-3 shows the coefficient of the accessibility dummy. The dummy takes the value 1, if the region is peripheral. In this sample, the 60 most remote regions in terms of accessibility are marked as peripheral. The coefficient of the dummy represents the difference in the impact of accessibility between peripheral and non-peripheral regions. For example, the coefficient of the level equation, where GDP per capita is the dependent variable, is 0.06. This means that the coefficient of accessibility is 0.06 higher for peripheral regions than for non-peripheral regions. However, none of the coefficients of the accessibility dummy is significantly different from zero.
In summary, it can be said that the impacts of accessibility on the dependent variables are similar for peripheral regions and for the non-peripherals.

Tab. 0-3   Regression output: Cross-section, accessibility dummy for peripheral regions

Coefficient	GDP per capita		Hourly productivity of labour		Participation rate
	Level	Difference	Level	Difference	Level
Accessibility Dummy	0.06	0.33	0.20	0.76	-0.41

Notes:
• 60 observations (the most peripheral regions)
• ***, **, * means significance at the 1%-, 5%-, 10%-level.
• Two-sided Hypothesis: H0: $\beta_1 = 0$, H1: $\beta_1 \neq 0$
Source: BAKBASEL

Panel models
As shown in the schedule in Fig. 0-1, statistical inference in panel model analysis is risky, if certain properties of the stochastic processes are ignored. Therefore, before interpreting the results of the panel regressions, we

undertake statistical tests in order to clarify which conclusions can be drawn from the estimations. The following questions have to be answered:

- Which variables are stationary? ➔ Unit root tests
- Are the first differences of the non-stationary variables stationary? ➔ Unit root tests
- Is there a long-term cointegration relationship between several non-stationary variables? ➔ Cointegration tests

It has to be mentioned that for the panel model analysis the total accessibility is not divided into geographical location and transportation efforts. The Fixed Effects that are used in the regressions already capture the impact of the geographical accessibility. Therefore, defining the specific transportation accessibility as regressor would not result in additional information. In the following explanations the term accessibility is generally defined as the total accessibility.

Unit root tests
If the dependent and several independent variables are non-stationary, which means they contain a unit root, this jeopardizes the statistical inference. Just the case of two variables, each following a trend over time, can result in an illusive correlation between these variables (spurious regression). For this reason, the variables have to be tested for stationarity before undertaking any panel regression. Tab. 0-4 shows the results of two unit root tests:

- The test according to Levin, Lin and Chu (2002, LLC) considers the cross-sectional entities as homogenous and therefore assumes the same autoregressive coefficients for all of them in the equations to be tested. The null hypothesis (H0) states: All the cross-sectional time series contain the same unit root.
- The test according to Im, Pesaran and Shin (2003, IPS) deems the cross-sectional entities as heterogeneous and allows for different autoregressive coefficients in the equations to be tested. The null hypothesis (H0) says: All the cross-sectional time series contain a unit root, which does not have to be the same.
- The test according to Hadri (2000) allows the same flexibility as IPS. In contrast to the previous two tests, the null hypothesis (H0) is: All the cross-sectional time series do not contain a unit root and are therefore stationary.

The unit root tests are undertaken for various specifications. They differ in the deterministic components that are included into the ADF (Augmented Dicky-Fuller) specifications.
- With cross-sectional-specific constant and cross-sectional-specific trend
- With cross-sectional-specific constant
- Without cross-sectional-specific constant
The third option is only considered in the LLC test.

In the table below the stars indicate the significance level at which the null hypothesis can be rejected.

Tab. 0-4   Unit root tests

		Constant and trend			Constant			None
		LLC	IPS	Hadri	LLC	IPS	Hadri	LLC
GDP per capita	Level	***		***	***		***	
	Growth	***	**	***	***	***	***	***
Hourly productivity of labour	Level	***	***	***	***		***	
	Growth	***	***	***	***	***	***	***
Participation rate	Level	***		***	***		***	***
	Growth	***	***	***	***	***	***	***
Accessibility	Level	***		***			***	***
	Growth	***		***	***	***	***	***
Transport accessibility	Level	***		***			***	***
	Growth	***		***	***	***	***	***
Regulation of labour markets	Level	***	***	***			***	***
	Growth	***	***	***	***	***	***	***
Regulation of product markets	Level	***		***	***	***	***	***
	Growth		***	***	***	***	***	***
Tax burden for companies	Level	***	***	***	***	***	***	
	Growth	***	***	***	***	***	***	***
Tax burden for manpower	Level	***		***	***		***	
	Growth		***	***	***	***	***	***
Research & Development	Level	***	***	***	***		***	
	Growth	***	***	***	***	***	***	***
Secondary education	Level	***	***	***	***	***	***	***
	Growth	***	***	***	***	***	***	***
Tertiary education	Level	***	***	***	***		***	***
	Growth	***	***	***	***	***	***	***

Notes:
- LLC: H_0: All cross-sectional time series contain a common unit root.
- IPS: H_0: All cross-sectional time series contain a unit root (but not necessarily the same).
- Hadri: H_0: All cross-sectional time series do not contain a common or distinct unit root (they are stationary).
- ***, **, * means significance at the 1%-, 5%-, 10%-level.
Source: BAKBASEL

As the LLC-test is based on the asymptotic properties assuming that the factor time (t) tends towards infinity for the given number of cross-sections (n), the IPS-test suits our sample better (n>t). The IPS-test including the

individually specific constant leads to relatively explicit results: In most of the cases the logarithms of the level variables contain unit roots, while its' differences (the constant growth rate of the non-logarithmized levels) do not. The majority of the variables is therefore integrated by order one (I(1)). The exceptions are the variables regulation of product markets, tax burden for companies and secondary education. These three variables do not contain any unit root (at least until the significance level of 10%) and should therefore be stationary (I(0)).

The Hadri-test rejects the null hypothesis of no unit root for all the variables and its' growth rates. However, it is known that for small t and in the presence of autocorrelation, the Hadri test reveals significant size distortions when there is no unit root. As a result, the Hadri test tends to be over-reject the null hypothesis and may yield contradicting results compared to alternative tests (Hlouskova and Wagner, 2006).

Although the results of the unit root tests are not completely coinciding, we can observe a strong tendency towards unit roots in the log-levels, while the differences of the variables (the growth rates) are stationary. Concluding, it seems to be reasonable to suppose unit roots for the logarithmized levels and stationarity for the first differences of the variables. The assumption I(1) will be the basis of the following parts of this study.

Cointegration tests

A regression using non-stationary regressands and regressors may jeopardize the statistical inference and lead to the mistake of interpreting spurious regressions as real relationships between variables. This is avoided, if the dependent variable is cointegrated with one or several of the independent variables. Cointegration means that the so-called "cointegrated" variables follow a common trend, which results in stationary residuals and therefore normal inference is valid interpreting the conclusions as properties of a long-run equilibrium relationship.

In the subsequent parts we test, if the variables that are used in the panel level equations are cointegrated. These tests are undertaken for the following variables:

- GDP per capita (in logs)
- Hourly productivity of labour (in logs)
- Participation rate (in logs)
- Accessibility (in logs)
- Transport accessibility (in logs)
- Regulation of labour markets (in logs)
- Tax burden for manpower (in logs)
- Research & development (in logs)
- Tertiary education (in logs)

For this purpose the test statistics of Pedroni (1999, 2004) are applied. These tests examine the residuals of a spurious regression[25]: If the residuals are I(0), the variables are cointegrated. If they are I(1), the variables are not cointegrated. Pedroni (1999) suggests the same distinction as between the LLC- and the IPS-test for his test statistics:

■ The Within-dimension (panel statistics) considers the cross-sectional entities as homogenous and assumes a common autoregressive coefficient in all the equations to be tested. The null hypothesis (H0) states: All the (residual) cross-sectional time series contain the same unit root.

■ The Between-dimension (group statistics) regards the different cross-sectional entities as heterogeneous and therefore allows for different autoregressive coefficients in the equations to be tested. The null hypothesis (H0) is: All the (residual) cross-sectional time series contain a unit root, which is not necessarily the same for the different series.

Pedroni (1999) proposes seven different test statistics: Four statistics for the Within-dimension (v, PP-ρ, PP-t, ADF-t) and three statistics for the Between-dimension (PP-ρ, PP-t, ADF-t). The panel statistics (Wihtin-dimension) can be calculated by a weighted or a non-weighted method. Towards the limit both methods of calculation follow the same distribution function. However, Pedroni (2004) shows by Monte Carlo simulations, that for small samples the non-weighted statistics outperform the weighted ones. Due to these findings we only consider the non-weighted panel statistics in the present study.

In the following, four of the seven mentioned test statistics are shortly discussed in the framework of already known (time series) unit root tests:

■ v: According to its form a non-parametric variance-ratio-statistics.

■ PP-ρ: Panel versions of the (non-parametric) Phillips-Perron-rho-statistics.

■ PP-t: Panel versions of the (non-parametric) Phillips-Perron-t-statistics.

■ ADF-t: Panel versions of the (parametric) Augmented-Dickey-Fuller-t-statistics.

These four statistics are commented here, because the other three test statistics are identical to test statistics of the Between-dimension. For the theoretical derivation of the test statistics the reader is advised to consult the original articles. Tab. 0-5 lists the seven test statistics. Like it was the case for the LLC- and the IPS-tests, the cointegration tests can be undertaken for different specifications. These specifications differ in the deterministic components that are included into the equations to be tested:

■ With cross-sectional specific constant and cross-sectional specific trend

■ With cross-sectional specific constant

■ Without deterministic component

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[25] Pedroni extends the Engle-Granger (1987) «two step residual based cointegration tests» to panel data.

In the table below the stars indicate the significance level at which the null hypothesis can be rejected. The tests have been undertaken for all the possible combinations of regressands and regressors, while in the table only the following standard model is presented:

$$\ln X_{it} = \beta_0 + \beta_1 \ln AC_{it} + \beta_2 \ln RE_{it} + \beta_3 \ln TC_{it} + \beta_4 \ln FE_{it} + \varepsilon_i$$

Tab. 0-5   Cointegration tests

		Within-dimension (panel statistics)			Between-dimension (group statistics)		
		Constant and trend	Constant	None	Constant and trend	Constant	None
GDP per capita	v	***					
	PP-ρ						
	PP-t	***	***	***	***	***	***
	ADF-t	***	***	***	***	***	***
Hourly productivity of labour	v	***					
	PP-ρ						
	PP-t	***	***	***	***	***	***
	ADF-t	***	***	***	***	***	***
Participation rate	v						
	PP-ρ						
	PP-t	***	***	***	***	***	***
	ADF-t	***	***	***	***	***	***

Notes:
- Within-dimension: H_0: All cross-sectional time series contain a common unit root.
- Between-dimension: H_0: All cross-sectional time series contain a unit root (but not necessarily the same).
- ***, **, * means significance at the 1%-, 5%-, 10%-level.

Source: BAKBASEL

According to Pedroni (1997) the statistical power of the ADF-t group and panel test statistics exceeds the other statistics' power in the case of short time series (t<100), followed by the PP-ρ panel statistics. In this study's framework we therefore focus on the ADF-t statistics. The test results in Tab. 0-5 show that for all the dependent variables (and the possible combinations of independent variables which are not shown here) only the tests based on the PP-t and ADF-t statistics, panel and group statistics, clearly reject the null hypothesis for all the specifications. This suggests cointegration amongst the variables. However, this conclusion cannot be drawn unambiguously,

because based on the PP-ρ panel statistics it is impossible to reject the null hypothesis for any specification. Finally, the Within-dimension statistics strongly suggest cointegration for the specification including constant and trend for three of the four tests, with the exception of the dependent variable participation rate.

The results of the cointegration tests are not very clear. However, due to the transmission mechanisms of the economic theory described above the existence of a long-term cointegration relationship among the considered variables is very likely. Nevertheless we are going to discuss the version of cointegrated variables, as well as the alternative of no cointegration. The cointegration decision node in the schedule in chapter 0 can therefore not be clearly answered. Based on the economic theory, the focus of the following analysis lies on the level cointegration equations.

Regressions

Summing up the results of the previous chapters, we conclude:

- All the variables (the regressands and the regressors) are I(1), which means stationary in differences.
- The cointegration relationship between the regressands and the regressors cannot be clearly established.

Consequently, we decide to try both ways leaving from the cointegration decision node. The main focus, however, will be on the cointegration relationship.

The panel structural models are specified as Fixed-Effects (FE) models. Thereby the Fixed Effects are assumed only over the cross-sections. This means that every cross-sectional entity is given an individual intercept on the axis, which stays constant over time.

First, we need to test if the FE model with individually specific intercepts outperforms the Pooled model, which only allows one common intercept. For this purpose the Likelihood-Ratio test is undertaken. It compares the fits of the Pooled and the FE models or said differently, how probable the observed data is according to both models. The null hypothesis states: The Fixed Effects are redundant. Tab. 0-6 presents the significance levels at which the null hypothesis can be rejected. The tests have been undertaken for all the possible combinations of regressands and regressors. The table lists the results for the standard model:

$$X_{it} = \beta_0 + \beta_1 AC_{it} + \beta_2 RE_{it} + \beta_3 TC_{it} + \beta_4 FE_{it} +$$
$$+ \left\{ CT_{it-1} \; oder \; ECT_{it-1} \right\} + \varepsilon_{it}$$

Tab. 0-6   Likelihood-Ratio Tests

Cointegration	Dependent variable	Specification

		Level	Difference
YES	GDP per capita	***	***
	Hourly productivity of labour	***	
	Participation rate	***	**
NO	GDP per capita		***
	Hourly productivity of labour		***
	Participation rate		***

Notes:
- H_0: The Fixed Effects are redundant.
- Level values are in logarithms. The growth rates are continuous.
- The level equations do not include CT or ECT.
- ***, **, * means significance at the 1%-, 5%-, 10%-level.

Source: BAKBASEL

The null hypothesis is rejected in all the cases except for the cointegrated specification in differences with the productivity of labour as the dependent variable. In this case the specific intercepts are redundant. In all the other cases, however, Fixed Effects allow to derive significantly more information from the data compared to the pooled model.

Further it has to be tested if the individually specific axis intercepts are fix or random. This corresponds to the choice between the Fixed-Effects and the Random-Effects (RE) model. If both is feasible, the RE model tends to be better, because the estimators are more efficient than the ones of the FE models. It is important to keep in mind that the RE model takes the assumption of Random Effects being uncorrelated with the regressors. If the assumption does not apply, the RE estimators are inconsistent. A current method of testing this assumption is the Hausman test (1978). Its null hypothesis says: The Random Effects and the regressors are uncorrelated. If the null hypothesis of the Hausman test is rejected, the Fixed-Effects model is more appropriate. Tab. 0-7 presents the significance levels at which the null hypothesis of the Hausmann test can be rejected for the same equations as above.

Tab. 0-7   Hausman Tests

Cointegration	Dependent variable		Specification
		Level	Difference
YES	GDP per capita	***	(***)
	Hourly productivity of labour	***	(***)
	Participation rate	**	(***)
NO	GDP per		***

capita			
Hourly productivity of labour			***
Participation rate			***

Notes:
- H_0: The Random Effects and the regressors are uncorrelated.
- Level values are in logarithms. The growth rates are continuous.
- Level equations do not include CT or ECT.
- ***, **, * means significance at the 1%-, 5%-, 10%-level.
- (***) means that the estimated variance of the Random Effects is zero.

Source: BAKBASEL

The null hypothesis of uncorrelated Random Effects and regressors is significantly rejected for the specifications tested above. The stars in the brackets point out that the estimated variance of the (cross-sectional) Random Effects is zero.

The test results are rather clear except the estimated zero variances for the Random Effects in the case of the cointegrated specification in differences. It is important to remind that by choosing the FE model one only risks to get inefficient (but consistent) estimators. Applying the RE model in the inappropriate case, however, can lead to inconsistent estimators. Therefore, the consequence of a potential mistake in the choice of the model is less serious in the case of using the Fixed Effects. For the reasons above, the FE model is chosen for this study.

The coefficients of the panel models are estimated as follows: In a first step the estimation equations are rewritten by using a Within-transformation. Then, the coefficients are estimated by the linear regression and the method of least squares (OLS). In order to avoid potential heteroscedasticity over the regions and autocorrelation within the regions (cross-section clustering), the covariance matrix is corrected by the procedure of Arellano (1987).

Regression output
Tab. 0-8 shows in analogy to Tab. 0-3 (cross-section results) the estimated coefficients of the indicators and the corresponding significance levels. Only the total accessibility is considered. The coefficients can be interpreted in the same manner as in chapter 0. As we use panel models to test the robustness of the results of the cross-sectional estimations, only the differences to Tab. 0-1 (cross-section results) are highlighted. When interpreting the significance levels of the level equation, it is important to keep in mind that the OLS estimators in the cointegration equation do not follow the normal distribution and that the interpretation of the t-tests must be taken with caution.

Tab. 0-8   Regression output: Panel, Total accessibility

Coefficient	GDP per capita	Hourly productivity of	Participation

	Level		Difference		Level		Difference		labour rate Level	
Constant	2.13	***	0.01	***	2.28	***	0.01	***	-2.28	***
Accessibility	0.19		0.07		0.22		0.10		0.29	*
Regulation	-0.12	***	0.00		-0.09	***	0.01		-0.04	***
Taxation	-0.26	***	-0.04	***	-0.21	***	-0.03	***	-0.11	***
Innovation	0.03	***	0.01	**	0.03	***	0.00	*	0.01	*
Error-correction			-0.18	***			-0.26	***		
R^2	0.97	***	0.25	***	0.96	***	0.27	***	0.96	***

Notes:
- Dependent variables: real GDP per capita (real GDP / population), real hourly productivity of labour, participation rate (employment / population)
- Level values are in logarithms. The growth rates are continuous.
- 336 observations
- ***, **, * means significance at the 1%-, 5%-, 10%-level.
- Two-sided Hypothesis: H0: β1 = 0, H1: β1 ≠ 0
Source: BAKBASEL

In comparison to the cross-sectional level equations it is remarkable that the coefficients of accessibility in the panel-level equation are all smaller than the cross-sectional coefficients. However, the signs of the coefficients remain the same (positive). It is striking that the coefficients have lost their significance. Only in the equation with the participation rate as the dependent variable, the coefficient of accessibility is significantly different from zero.

The plausibility of the cross-section equations in levels can be evaluated in the light of the panel results as follows: It is possible that the observed relationship in the cross-sectional models partly arises from unobservable fixed effects. However, this conclusion needs to be treated with caution, since the cross-sectional models seem to be "trustworthier" for the reasons listed in chapter 0.

In terms of the difference equations the story is similar. The panel coefficients of the accessibility are all smaller than the cross-sectional coefficients and no coefficient is here significantly different from zero.

In summary, the panel results (panel regression with a cointegration) weaken the conclusions that were drawn from the cross-sectional results.

2.4.13 Airport performance (dependent variable)

Cross sectional models and panel models

Dependent variable: Commercial passengers
In Tab. 0-9 an exemplary regression output is shown. The indicators of interest are the performance variables: labour productivity, participation rate and share of tourism by GDP. The dependent variable is the number of commercial passengers. The difference equation in the cross-sectional model includes the continous growth rates. In terms of the panel models the same assumptions are made as in the previous chapter. The investigated period is from 2006 until 2010.

Tab. 0-9   Regression output: Cross-section and panel

Coefficient	Cross section					Panel	
	Level		Difference		Level		Difference
Constant	-23.94	***	-0.02	***	6.80	***	-0.01	***
Productivity	2.82	***	0.36		0.78	*	0.81	***
Participation	4.87	***	1.89	***	2.06	***	2.49	***
Tourism	0.86	***	-0.40		0.33	*	0.17	
Convergence			0.0089	**				
Error-correction							-0.98	***
R^2	0.22	***	0.11	***	0.99	***	0.56	***

Notes:
- Dependent variables: mean (natural logarithm) or growth rate (over the period 2006-2010)
- Level values are in logarithms. The growth rates are continuous.
- 200 observations
- ***, **, * means significance at the 1%-, 5%-, 10%-level.
- Two-sided Hypothesis: H0: $\beta 1 = 0$, H1: $\beta 1 \neq 0$
Source: BAKBASEL

In the level equation of the cross-sectional model, the coefficients of all the independent variables are positive and highly significant. The performance indicators have therefore in the long-run equilibrium a significant, positive impact on the performance of airports. The participation rate has the highest coefficient and the highest significance in explaining the number of commercial passengers. For example, a one percent improvement of the participation rate leads to an approximately 4.9 percent increase in the number of commercial passengers.

In the difference equation of the cross-sectional model, the results are worse. Only the coefficient of the participation rate growth is highly significant with the correct sign (positive). The coefficient of productivity growth is indeed positive, but not significantly different from zero. Additionally, the coefficient of the share of tourism displays the wrong sign (negative), while there is also no significance. Considering these results we conclude that especially the

growth of the participation rate exerts a positive influence on the performance of airports in a long-term growth process.

An interesting outcome is the positive convergence term, which is significant at the 5 percent-level. This means that the regions diverge from each other instead of converging. These are rather bad news for the politicians, because it means that large airports tend to grow faster than smaller ones.

As we use panel models in order to test the robustness of the cross-sectional models' results, the differences in the results are highlighted. In comparison to the cross-sectional level equations it is remarkable that the coefficients of the panel level equations are all smaller. However, the signs of the coefficients remain the same (positive) and although the coefficients of productivity and tourism have lost significance, they are all still significantly different from zero.

Regarding the difference equations, the results of the panel model outperform the regression output of the cross-sectional model. The sign of the coefficients of all performance indicators is positive and the coefficients of the growth of labour productivity and of the participation rate are even highly significant.

To conclude, the panel models confirm the plausibility of the results of cross-sectional models. The panel results only slightly weaken the conclusions that were drawn from the cross-sectional outcomes. Particularly the impact of the participation rate is obvious in each model. It is therefore proved that regional economic activity is very relevant for airport performance.

Dependent variable: Cargo (freight & mail)

By taking cargo as the dependent variable we achieve worse results. This is not surprising, since there are less cargo hub airports and the regional differentiation is difficult. Further the available data on airport cargo is limited. In addition there are regions with high GDP per capita and large export sectors, but the exports are transported by ships or trucks. For this reason, we dispense with the presentation of the results, where cargo is the dependent variable.

2.5 Frontier analysis

The third method used is frontier analysis. It shows the degree of production efficiency for each region and brings out limiting factors for economic development. This will give answer to the question whether an insufficient traffic infrastructure is a limiting factor for the economic performance of a region.

The results indicate that supply side effects are indeed relevant. Most areas are well below their individual efficiency frontier: If they were efficient, they could either increase output (and thus welfare) considerably using the same

amount of inputs, or they could reach the same output level with much lower inputs. Focusing on the latter, the models indicate that qualified manpower is on average used most efficiently. This means that an increase in the amount (or number) of qualified labour force would increase output and also the degree of efficiency of the other input factors. Thus, on average, qualified manpower is the most limiting factor for economic performance of regions. In the second place we find already transport accessibility. From this result we may conclude for policy that improvements in qualified manpower and accessibility are most promising for regional economic development. Note that transport accessibility does not include only air travel but roads and rails as well.

The results further indicate that the vast majority of airports are far below their efficiency frontier. Given the economic performance and the framework conditions, most of them should do much better. The bottleneck is unlikely to be the physical infrastructure but rather the distribution of airports in space. In other words: the airport of Athens is bigger than adequate for the Athens region while the airport of Patras is smaller than adequate for Western Greece. As airports profit a lot from economies to scale and passengers profit substantially from large hubs, this is to some extent a "natural" phenomenon (similar to a natural monopoly). Thus, regional airports will always be also relatively small, but they should have good connections to at least one nearby hub.

2.5.1 Research plan

This chapter presents the research plan for the frontier analysis models, which is pursued in the present study. First, a brief overview of the general procedure is given. This is followed by the detailed description of the data envelopment methods.

2.5.2 Overview

It is relevant for regional policy makers to understand the role of regional airports and to what extent they can help peripheral European regions grow. As this issue is truly multidimensional in many ways, a mix of several methods should be applied in order to bring the results of all these methods together into one coherent view of the role of regional airports for a balanced polycentric economic development in European peripheral regions. The analytical tool called "Frontier analysis" (such as DEA) looks for limiting factors in all regions and can identify them. This is particularly interesting for the three stakeholder regions, in order to know the efficiency and limiting factors of the regions. The method will analyze data derived by Bak Basel Economics.

Regions' policymakers need to know, whether transport services or transport infrastructures contribute to better economic performance, or consist limiting factors in their respective regions. Accessibility constitutes a very crucial factor for the economic attractiveness of each region. It is now widely accepted that, transport is a key factor in modern economies since it facilitates economic growth. Although, highways, fast train networks and airports, are now very common to capitals or major cities, this is not the case for smaller or peripheral cities. Therefore, big metropolitan areas and far

peripheral areas grow in an unequal way, even in the same country. This leads to an imbalance of wealth due to this difference in the accessibility. Thus, the more we increase the accessibility of the more remote areas, respecting their economic specialization and enhancing their competitiveness, the smaller becomes this gap (measured, e.g., by GDP per capita). The analytical approach called "Frontier analysis", e.g., "Data Envelopment Analysis (DEA)", is able not only to identify potential limiting factors in each region, but also to propose specific ways of improvement. This is of particular interest for any stakeholder region.

2.5.3 Research objectives

Transport (especially existing airport) infrastructure, available transport services, traffic in terms of passengers and freight, land use and specific location factors, are the factors that define the performance of the transport system of a region. Therefore, a number of very interesting research questions arise in the context of the economic growth of the regions. More precisely, two research questions are as follows:

a) Is transportation is a limiting factor to the economic growth of certain regions?
b) Is transport infrastructure the limiting factor for transport services?

The optimal design of any transport system is vital for the economic success of any region, since peripherality or remoteness could lead to economy stalling. Were the existing transport system be undersized or underperforming, or if it could not efficiently serve the current and the future demand, then the economic performance and sustainable economic growth of a region could not be achieved (Rephann & Isserman 1994; Alfonso 2007). The aims of the proposed study is as follows:

• Identify the star performers to locate best practices,
• Identify the underperformers,
• Identify the limiting factors in terms of linking the transport system with the economic development,
• Uncover greatest potential efficiency gains,
• Propose realistic improvement targets and better allocation of the transport resources (considering the infrastructure limitations),
• Identify possible trends and common issues that the regions examined.

A better understanding of the current situation of the transport systems, as also the corresponding impact on the economic growth and accessibility of the peripheral regions examined, can be achieved by the results of the proposed frontier analysis. The analysis will also highlight the limiting factors, potential future scenarios and targets which will contribute to the policy decisions.

2.5.4 Introduction to DEA

To analyze these research questions we apply DEA, which is a widely used frontier analysis method (Charnes, A., Cooper, W. W., Lewin, A. Y., Seiford

1995). DEA constitutes a non-parametric approach based on mathematical optimization models and methods, in order to construct a non-parametric surface over the available data. Performance -or efficiency- measurement of each DMU can be computed, regarding its position on this surface. DEA evaluates the relative performance of Decision Making Units (DMUs) (e.g., airports, regions) and can easily handle multiple input and output of each DMU. The efficient DMUs define an efficient production possibility surface or frontier.

A large number of DEA models has been reported in the literature during the last 30 years (Emrouznejad et al. 2008; Cook & Seiford 2009). The majority of these DEA models belong into four main categories: i) radial, ii) non-radial and oriented, iii) non-radial and non-oriented, and iv) composite of radial and non-radial. The classification between radial and non-radial models depends whether we are interested in a proportionate change of input/output or not. The classification between oriented and non-oriented models depends whether we are mainly interested rather in input reduction or output expansion, or not (e.g., input reduction and output expansion at the same time).

A short example of the mathematical formulation of the radial, input-oriented CCR DEA model (Charnes, A., Cooper, W. W., Rhodes 1978), assuming constant returns to scale, will now follow. Assume, we have n DMUs (organizations, business firms or airports in our case), with data on s and m output and input respectively, for each one of them. The data for all these n DMUs, can be represented with an mxn input matrix X and an sxn output matrix Y. The efficiency measure of the oth DMU (denoted by DMU_o), is computed by the ratio of all outputs over all inputs, such as u·y / v·x, where u is an 1xs row vector that denotes the output weights, v is an 1xm row vector that denotes the input weights, y is sx1 column vector that denotes the output data, and x is mx1 column vector that denotes the input data. By doing this way, the DEA problem seeks to find optimal values for the decision variables u_r (r = 1,2,…,s) and v_i (i = 1,2,…,m), in order to maximize the efficiency measure for the DMU_o. The constraints of this optimization model require that the efficiency measures for each DMU should be less than or equal to unity. Therefore, our DEA model requires the solution of the following mathematical programming problem:

$$\max_{P,u} \theta = \frac{u_1 y_1 + u_2 y_2 + \cdots + u_s y_s}{v_1 x_1 + v_2 x_2 + \cdots + v_m x_m}$$

subject to

$$\frac{u_1 y_{1j} + \cdots + u_s y_{sj}}{v_1 x_{1j} + \cdots + v_m x_{mj}} \subseteq 1 \quad \forall j = 1, 2, …, n$$

$$u_1, u_2,…, u_s \geq 0$$

$$v_1, v_2,…, v_m \geq 0$$

A reformulation of the above DEA model can be made in order to convert this fractional programming problem into a linear problem (LP). This can be done, if we arbitrarily set the sum of inputs for the DMU_o equal to one:

$$v_1 x_1 + v_2 x_2 + \ldots + v_m x_m = 1$$

Thus, the DEA CCR model is reformed to an equivalent LP:

$$\max_{v,u} \theta = u_1 y_1 + u_2 y_2 + \ldots + u_s y_s$$

subject to

$$v_1 x_1 + v_2 x_2 + \ldots + v_m x_m = 1$$

$$u_1 y_{1j} + \ldots + u_s y_{sj} - v_1 x_{1j} - \ldots - v_m x_{mj} \leq 0 \qquad \forall \, j = 1, 2, \ldots, n$$

$$u_1, u_2, \ldots, u_s \geq 0$$

$$v_1, v_2, \ldots, v_m \geq 0$$

Since we need to solve one LP per DMU, we need to optimize totally n LPs in order to establish an overall performance ranking. The previous LP, in matrix format can be written as:

$$\max_{u,v} uy_o$$

subject to

$$vx_o = 1$$

$$-vX + uY \leq 0$$

$$u, v \geq 0$$

where u and v are the row vectors for output and input multipliers respectively (this LP is also known as the "multiplier form").

It is noteworthy to mention here that, the above CCR DEA model has more constraints (number of DMUs) rather than variables (number of input and output of the DMUs). According to the duality theory, every (primal) LP can be converted to another (dual) LP (Bazaraa et al. 2009). Moreover, if an optimal solution exists, then these two previously mentioned LPs have the same objective value. Since the computation time for the simplex algorithm (which is widely used for the solution of LPs) depends more on the number of constraints than on the number of variables, it is preferable –from a computational point of view– to solve the corresponding dual LP, (which will have fewer constraints). The dual problem of our DEA CCR model is as follows:

$$\min_{\theta, \lambda} \theta$$

subject to

$$\theta x_o - X\lambda \geq 0$$

$$Y\lambda \geq y_o$$

$$\lambda \geq 0$$

where:

θ is a real variable denoting the efficiency score for the DMU_o ($0 < \theta \leq 1$),

λ is a non-negative vector $(\lambda_1, \lambda_2, \ldots \lambda_n)^T$.

In order to discover the possible input excesses s^- and output shortfalls s^+ of the DMU_o, we need to introduce the slack variables as $s^- = \theta x_o - X\lambda$ and $s^+ = Y \cdot \lambda - y_o$ into our model. This LP can be solved using the two-phase method, where the variable θ is replaced with a fixed value of min $\theta = \theta^*$ in phase II.

Therefore, our CCR model for DMU_o requires the solution of the following two-stage LP:

$$\text{Phase I min } \theta$$

$$\text{Phase II min} - es^- - es^+$$

subject to

$$\theta x_o = X\lambda + s^-$$

$$y_o = Y\lambda - s^+$$

$$\theta, \lambda, s^-, s^+ \geq 0$$

where e is a row vector of ones $(1, \ldots, 1)$. If the optimal solution of the two-phase method satisfies $\theta = 1$ and is zero-slack ($s^- = 0$, $s^+ = 0$), then the respective DMU is CCR-efficient.

The assumption of constant returns to scale is only appropriate when all DMUs operate at an optimal scale. If this assumption does not hold, then the variable returns to scale (BCC) model should be rather used. The BCC model (Banker, R. D., Charnes, A., Cooper 1984) differs from the CCR model only in that the former incorporates the convexity condition in its constraints:

$$\sum_{j=1}^{n} \Theta_j = 1$$

Thus, the "envelopment form" for variable returns to scale of the input-oriented BCC model is given below:

$$\min_{N,\lambda} N_B$$

subject to

$$\theta_B x_o - X\lambda \geq 0$$

$$Y\lambda \geq y_o$$

$$e\lambda = 1$$

$$\lambda \geq 0$$

where θ_B is a scalar denoting the efficiency score for the BCC model ($0 \le \theta_B \le 1$). The two-phase method described for the CCR model could also be applied to the BCC model. Therefore, if the optimal solution satisfies $\theta_B = 1$ and has no slacks ($s^- = 0$, $s^+ = 0$), then the respective DMU_o is BCC-efficient.

2.5.5 Frontier analysis models

DEA models have been applied for the measurement of the relative performance in many situations, such as in the food production industry (Stiakakis & Sifaleras 2010), e-health providers (Stiakakis et al. 2009), and many more diverse types of DMUs. Moreover, a plethora of research articles in the literature, describes the airports performance measurement using DEA, (Adler & Berechman 2001; Pestana Barros & Dieke 2007; Ming-Miin 2010), the airport economics (Graham 2008), as also the socio-economic impacts assessment of transportation systems (Juan et al. 2003). This approach have several advantages, since DEA does not require any prior assumption concerning any specific functional form relating outputs to inputs (e.g., misspecification problems).

DEA does not only provide us with a ranking of the DMUs regarding their efficiency. What is more important is the fact that, DEA can propose specific ways of improvement for the inefficient DMUs. On the other hand, the efficient airports (that are located on the frontier), cannot further improve their output, unless they increase their input corresponding. Additionally, the region policy makers are able to evaluate the limiting factors regarding each DMU.

In our case study, this frontier is derived from empirical observations form BAK Basel Economics, and it measures the relative performance obtained using the existing technology or management strategy. More specifically, this technical report aims to analyze data for a large number of airports and regions, in order to compute the efficiency frontier. The efficient airports have an efficiency score of unity, whereas the inefficient airports have an efficiency score below one.

The dataset used, contains data from 336 European regions and 453 European airports regarding the time period from 1991 to 2010. However, the number of reporting airports declines as we go back in time. For example, there is only data on 205 airports available, in the year 1991. More precisely the dataset description is as follows:

Data on economic performance	Data on airport performance	Data on population and area	Data on location factors
XXn: *nominal GDP, in Mio Euro*	**AXP**: *number of commercial passengers*	**PO**: *population*	**AC**: *accessibility*
XXr: *real GDP (for growth), in Mio. Euro PPP*	**AXC**: *cargo (freight & mail) in metric tonnes*	**FL**: *area in square miles*	**RGEP**: *national regulation of labour markets (Scale)*
NN: *employment (jobs), in thousand persons*			**RGPM**: *national regulation of product markets (Scale)*
XAn: *nominal hourly productivity of labour, in Euro*			**TXCO**: *tax burden for companies (in %)*
XAr: *real hourly productivity of labour, in Euro PPP*			**TXMP**: *tax burden for manpower (in %)*
			FEGP: *research & development (in % of GDP)*
			IVSE: *secondary*

education (in % of labour force)
IVTE: *tertiary education (in % of labour force)*
Pat: patents

Our study will use the DEA method, in order to provide answers to two research questions. First, we are interested in assessing a regional economic performance (e.g., GDP) regarding their airports as an input. Second, we need to evaluate the airport services (as an output) given their infrastructure etc.

Therefore, the first DEA model that will be used in our study will have as output variables the five indicators of the economic performance (i.e., XXn, XXr, NN, XAn, and XAr). The input variables of the first DEA model will be the two indicators of the airport performance (i.e., AXP and AXC).

Similarly, the second DEA model that will be used in our study will have as output variables the two indicators of the airport performance (i.e., AXP and AXC). The input variables of the second DEA model will be the two (non-controllable) indicators regarding population and area (i.e., PO and FL) as also the nine indicators regarding the location factors (i.e., AC, RGEP, RGPM, TXCO, TXMP, FEGP, IVSE, IVTE, and Pat).

Due to the large number of DMUs, a state-of-the-art DEA software package is required to be used. Although, there are a number of efficient DEA software packages, such as PIM-DEAsoft v.3 (Thanassoulis 2001), Frontier Analyst v.4 (Banxia Software Ltd 2011), KonSi DEA Analysis (Konsi 2011), in this study we will use the well-known DEA-Solver Professional v.8.0b (Cooper, W. W., Seiford, L. M., Tone 2007). The latest version of DEA-Solver Professional consists of 41 clusters including totally 175 DEA models (SAITECH 2011). Apart from the basic CCR and BCC DEA models, the eighth version of DEA-Solver Professional includes dynamic DEA models, network DEA models, hybrid DEA models, undesirable output models, super efficiency models, and many more.

2.5.6 Results for the three Stakeholder regions regarding Frontier Analysis

The project is specifically targeted to the situation and needs of three stakeholder regions:

1. City of Jyväskylä – Finland.
2. Province of Savona – Italy,
3. Region of Western Greece – Greece.

Following, the results of the three DEA models that were applied are presented for the three stakeholders.

2.5.7 Results of a DEA model regarding regional economic performance

In this subsection, we are interested in assessing a regional economic performance (e.g., GDP) regarding accessibility, R&D per GDP, tertiary education (share), and patent density as input variables. Twenty six out of

336 regions were efficient. All these regions were fully efficient since θ* = 1 and all the input and output slacks were zero. The average efficiency score was 0.7678. The reference set gives us the opportunity to identify the efficient regions and the extent to which they operate similarly to a given inefficient region. Let us examine the example of the first stakeholder i.e. the City of Jyväskylä – Finland. The peers of the City of Jyväskylä – Finland are those efficient regions that define the facet of the frontier against which the (inefficient) region of Jyväskylä is projected. Thus, the reference set of this region comprises region NO011 (Oslo), NO022 (Oppland), and NO073 (Finnmark). Based on the lambda values given in Table 1, the City of Jyväskylä (or FI193) operates much closer to NO073 (Finnmark) than any other region of its reference set. Taking into consideration the reference frequency of the efficient regions, it is deduced that the region UKM4 (Highlands and Islands) has the highest reference frequency to other DMUs, i.e. 227 times. Regions IT311 (Bolzano), NO011 (Oslo), LUX (Luxemburg), and FI20 (Åland) have also high values of reference frequency, i.e. 205, 153, 135, and 100 times respectively.

Table 1: Score, Rank and the Reference Set for the stakeholder regions
(using normalized data)

No	Region	Score	Rank	Reference set** (lambda)
1	Jyväskylä	0.7465	188	NO011 (0.1214), NO022 (0.2809), NO073 (0.5975)
2	Savona	0.8056	131	FI20 (0.1024), IT311 (0.4877), NO011 (0.0649), NO073 (0.1658), ED42 (0.1789)
3	Western Greece	1	1	-

The differences between the actual and expected data of input and output items are presented in Table 2. By saying expected data, we mean the expected values of input and output items, when each inefficient region is projected onto the efficient frontier. The differences represent the required reductions for each of the input items, as well as the required increases for each of the output items. Therefore, an inefficient region could be aware of the exact improvements it has to make in order to operate fully efficiently. A perusal of Table 2 shows that the improvements required in some cases are particularly high. Let us examine the cases of the City of Jyväskylä (or FI193) and Savona. The percentage of the required increase of GDP per Capita for the City of Jyväskylä and Savona is about 35.25% and 24.12% respectively.

Table 2: Projection of the stakeholder regions onto the Efficient Frontier
(using normalized data)

No	Region	Score Data	Projection	%
1	Jyväskylä	0.7465		
	Transport accessibility	82.3047	82.3047	0.00%
	Geographical accessibility	74.5576	74,5576	0.00%
	Research & development (*in % of*	2.7706	1.6723	-39.64%

	GDP)			
	Tertiary education (*in % of labour force*)	0.3377	0.3204	-5.12%
	Patent density (*Patents / Employment in thousand person*)	0.2703	0.0394	-85.42%
	GDP per Capita real, in EUR PPP (*real GDP / population*)	25392,2547	34342.6350	35.25%
	Participation rate (*Employment / Population*)	0.3990	0.5345	33.95%
2	Savona	0.8056		
	Transport accessibility	88.5540	88.5540	0.00%
	Geographical accessibility	107.0860	92.6024	-13.53%
	Research & development (*in % of GDP*)	1.186	0.9015	-23.99%
	Tertiary education (*in % of labour force*)	0.19	0.19	0.00%
	Patent density (*Patents / Employment in thousand person*)	0.1265	0.1265	0.00%
	GDP per Capita real, in EUR PPP (*real GDP / population*)	28252.8318	35067.0439	24.12%
	Participation rate (*Employment / Population*)	0.4190	0.5201	24.12%
3	Western Greece	1		
	Transport accessibility	75.4103	75.4103	0.00%
	Geographical accessibility	76.7790	76.7790	0.00%
	Research & development (*in % of GDP*)	0.9614	0.9614	
	Tertiary education (*in % of labour force*)	0.2300	0.2300	0.00%
	Patent density (*Patents / Employment in thousand person*)	0.03308	0.03308	0.00%
	GDP per Capita real, in EUR PPP (*real GDP / population*)	17864.4695	17864.4695	0.00%
	Participation rate (*Employment / Population*)	0.3832	0.3832	0.00%

The third stakeholder region (i.e., Western Greece) proved to be efficient. This is due to the fact that it achieved "high" output with relatively "small amount" of input. In other words, the big difference in the values of the indicators of the airport performance (input variables) of the region of Western Greece compared with Jyväskylä or Savona, resulted only in a small difference in the corresponding values of the economic performance (output variables).

Apart from a ranking of regions according to their efficiency, and also the specific guidelines for the inefficient regions, it is equally important to identify the limiting factors of the inefficient regions. Thus, the average required improvements were computed for each input or output variable. Those factors requiring large improvements on average are those that are currently being used inefficiently by the regions. On the other hand, a small figure (like -2%)

indicates that this input is used efficiently. Consequently, in order to produce more output more of this input is required. Therefore, this input tends (on average) to be limiting. By using the above mentioned methodology, the models indicate that first underline transport accessibility, second underline tertiary education, and third underline geographical accessibility, constitute the most limiting factors for the three stakeholder regions. However, if we would consider all the regions, then qualified manpower is also an important limiting factor for economic performance of regions.

2.5.8 Results of a second DEA model regarding regional economic performance

Furthermore, we are also interested in assessing a regional economic performance (e.g., GDP) using a different combination of input variables. Following, a modified DEA model having the same output variables as previously mentioned and also accessibility, R&D per GDP, tertiary education (share), patent density, taxation, regulation, and decentralization as input variables is presented. This new DEA model has 88 efficient regions out of 335 in total (excluding Luxenburg). The average efficiency score was 0.8582. The new score, rank and the reference set for the stakeholder regions (using normalized data) are presented in Table 3. The interpretation of the numerical values of Table 3, is exactly as in the previous Table 1. For example, the region of Savona (or IT132) operates much closer to IT311 (Bolzano) than any other region of its reference set. Taking into consideration the reference frequency of the efficient regions, it is deduced that the region UKM4 (Highlands and Islands) has, again, the highest reference frequency to other DMUs, i.e. 189 times.

Table 3: Score, Rank and the Reference Set for the stakeholder regions
(underline using normalized data)

No	Region	Score	Rank	Reference set** (lambda)
1	Jyväskylä	0.7695	254	FI20 (0.0020), IR25 (0.2011), NO011 (0.0101), NO073 (0,6388), SE08 (0,0464), UKM4 (0,1014)
2	Savona	0.8373	203	IR25 (0,1103), IT12 (0.1389), IT311 (0.4823), NO073 (0,0660), UKI1 (0.0071), UKM4 (0.0821), ED42 (0.1130)
3	Western Greece	1	1	-

The differences between the actual and expected data of input and output items in our new DEA model are presented in Table 4. A perusal of Table 2 shows that the improvements required in some cases are particularly high. Let us examine the cases of the City of Jyväskylä (or FI193) and Savona. The percentage of the required increase of participation rate for the City of Jyväskylä and Savona is about 29.95% and 19.43% respectively.

Table 4: Projection of the stakeholder regions onto the Efficient Frontier
(underline using normalized data)

No	Region	Score Data	Projection	%

1	Jyväskylä	0.7695		
	Tax burden for companies (*in %*)	0.2335	0.2335	0.00%
	Tax burden for manpower (*in %*)	0.5155	0.4428	-14,1%
	National regulation of labour markets (*scale*)	1.5787	1.5787	0.00%
	National regulation of product markets (*scale*)	1.1878	1.0877	-8.43%
	Decentralisation (*index*)	44.8169	41.7229	-6.9%
	Transport accessibility	82.3047	82.3047	0.00%
	Geographical accessibility	74.5576	74.5576	0.00%
	Research & development (*in % of GDP*)	2.7706	1.7595	-36.49%
	Tertiary education (*in % of labour force*)	0.3377	0.3342	-1.04%
	Patent density (*Patents / Employment in thousand person*)	0.2703	0.0415	-84.62%
	GDP per Capita real, in EUR PPP (*real GDP / population*)	25392.2547	32997.4011	29.95%
	Participation rate (*Employment / Population*)	0.3990	0.5186	29.95%
2	Savona	0.8373		
	Tax burden for companies (*in %*)	0.2669	0,2444	-8.42%
	Tax burden for manpower (*in %*)	0.505	0,4672	-7.48%
	National regulation of labour markets (*scale*)	1.1181	1,1181	0.00%
	National regulation of product markets (*scale*)	1.3773	1,3773	0.00%
	Decentralisation (*index*)	49.5258	48,4303	-2.21%
	Transport accessibility	88.5540	88,5540	0.00%
	Geographical accessibility	107.0860	100,1657	-6.46%
	Research & development (*in % of GDP*)	1.186	0,7902	-33.37%
	Tertiary education (*in % of labour force*)	0.19	0,19	0.00%
	Patent density (*Patents / Employment in thousand person*)	0.1265	0,1265	0.00%
	GDP per Capita real, in EUR PPP (*real GDP / population*)	28252.8318	33742,2692	19.43%
	Participation rate (*Employment / Population*)	0.4190	0,5004	19.43%
3	Western Greece	1		
	Tax burden for companies (*in %*)	0.2085	0.2085	0.00%
	Tax burden for manpower (*in %*)	0.3351	0.3351	0.00%
	National regulation of labour markets (*scale*)	1.6239	1.6239	
	National regulation of product markets (*scale*)	2.3742	2.3742	0.00%
	Decentralisation (*index*)	31.4932	31.4932	0.00%
	Transport accessibility	75.4103	75.4103	0.00%

Geographical accessibility	76.7790	76.7790	0.00%
Research & development (*in % of GDP*)	0.9614	0.9614	0.00%
Tertiary education (*in % of labour force*)	0.2300	0.2300	0.00%
Patent density (*Patents / Employment in thousand person*)	0.0330	0.0330	0.00%
GDP per Capita real, in EUR PPP (*real GDP / population*)	17864.4695	17864.4695	0.00%
Participation rate (*Employment / Population*)	0.3832	0.3832	0.00%

The third stakeholder region (i.e., Western Greece) proved again to be efficient. This is due to the fact that it achieved "high" output with relatively "small amount" of input. In other words, the big difference in the values of the indicators of the airport performance (input variables) of the region of Western Greece compared with Jyväskylä or Savona, resulted only in a small difference in the corresponding values of the economic performance (output variables).

Similar to the previous sub section, it is equally important to identify the limiting factors of the inefficient regions. Thus, the average required improvements were computed for each input or output variable. Those factors requiring large improvements on average are those that are currently being used inefficiently by the regions. On the other hand, a small figure (like -2%) indicates that this input is used efficiently. Consequently, in order to produce more output more of this input is required. Therefore, this input tends (on average) to be limiting. By using the above mentioned methodology, the models indicate that first transport accessibility, second tertiary education, and third geographical accessibility, constitute the most limiting factors for the three stakeholder regions. However, if we would consider all the regions, then qualified manpower is also an important limiting factor for economic performance of regions.

2.5.9 Results regarding the TOBIT Regression Analysis

A tobit regression analysis was applied, in order to determine the factors affecting efficiency. The left-hand side variable is the degree of efficiency (score data according to the first DEA model) and the right-hand side variables are the framework conditions and policy type variables such as taxation (TXCO, TXMP), regulation (RGEP, RGPM), and decentralization. The results of the tobit regression analysis, that were obtained through the statistical software package STATA, are as follows:

```
. tobit  c2  c3 c4 c5 c6 c7, ll(0) ul(1)


Tobit regression                          Number of obs   = 335

                                          LR chi2(5)      = 92.44

                                          Prob > chi2     = 0.0000

Log likelihood =  198.59434               Pseudo R2       = -0.3033
```

```
-------------------------------------------------------------------------------
        Score  |      Coef.   Std. Err.       t    P>|t|     [95% Conf. Interval]
-------------+-----------------------------------------------------------------
+------
        TXCO   |  -1.390599    .2104053    -6.61   0.000    -1.804504 -.9766944
        TXMP   |  -.5455276    .1212829    -4.50   0.000    -.7841127 -.3069424
        RGEP   |   .0117918    .0106827     1.10   0.270    -.0092231 .0328066
        RGMP   |    .056899    .0238164     2.39   0.017     .0100478 .1037502
        DEC    |  -.0008081    .0007413    -1.09   0.276    -.0022664 .0006501
        _cons  |   1.331695    .0914441    14.56   0.000     1.151808 1.511582
-------------+-----------------------------------------------------------------
+------
        /sigma |   .1158498     .004745                     .1065155 .1251841
-------------------------------------------------------------------------------
  Obs. summary:           0   left-censored observations
                        310      uncensored observations
                         25 right-censored observations at c2>=1
```

The dependent variable (efficiency score) in the regression model is (double) censored (lower limit = 0, upper limit = 1). Accordingly, a Tobit analysis is applied. The results of the Tobit regression analysis can be found in Table 5. We find strong support for the negative impact of tax burden for companies (in %) (or TXCO) and tax burden for manpower (in %) (or TXMP) on the dependent variable. First, the parameter of TXCO is significant and negative (-1.39). In addition, the parameter of TXMP is significant and negative (-0.54). On the other hand, the parameter for national regulation of product markets (Scale) (or RGMP) is significant and positive (0.056). The other two independent variables national regulation of labour markets (Scale) (or RGEP) and Decentralisation (Index) (or DEC) are non-significant.

Table 5: Tobit Regression

Dependent variable: Score/ Independent variables	Coefficient	Std. Err.	t	P > |t|
TXCO	-1.390599	.2104053	-6.61	0.000
TXMP	-.5455276	.1212829	-4.50	0.000
RGMP	.056899	.0238164	2.39	0.017
DEC	-.0008081	.0004362	-1.09	0.270
RGEP	.0117918	.0106827	1.10	0.270

2.5.10 Conclusions

This study presented the application of Data Envelopment Analysis models in order to assess a regional economic performance (e.g., GDP) regarding mainly the endowment (e.g., accessibility, R&D per GDP, tertiary education (share), patent density) as input variables. Furthermore, tobit regression analysis was applied in order to identify factors have a significant effect on relative efficiency. Guidelines for the inefficient stakeholders regions, in order to improve and become efficient are as follows:

From the tobit regression analysis results we found strong support for the negative impact of the parameter for tax burden for companies (in %) (or TXCO) and also of the parameter for tax burden for manpower (in %) (or TXMP) on the efficiency score of all the regions. On the other hand, the national regulation of product markets (Scale) (or RGMP) had a significant positive impact. Therefore, appropriate improvements in framework conditions and policy type variables are expected to improve the regional economic performance.

Moreover, from the frontier analysis results we may conclude for policy that improves transport accessibility, tertiary education, and geographical accessibility, since these are the most promising factors for the three stakeholders' regional economic development. Therefore, we strongly believe that an improvement of these factors would help boosting the economic performance of the three stakeholders regions.

2.6 Summary

As we are well aware that this ESPON project is a targeted analysis, the final goal is to produce policy recommendations, which are solidly based on all project results.

The goal is to build a consistent view of all empirical analyses done within this project and described in this chapter. Thus, we will take the results of the three preceding chapters and present them in a kind of synopsis:

- Panel causality models and tests
- Structural regression analysis and econometric tests
- Frontier analysis and identification of limiting factors

Using the results above, we can draw the following conclusions which are summarised in the following table:

Table 1: Summary results of the empirical analyses

	Supply side effects: Accessibility enhances economic performance	Demand side effects: Economic performance improves accessibility
Causality analysis	YES, but only true for peripheral regions	YES, for all regions, but rather weak
Structural regressions	YES, mostly positive effects (especially for GDP)	YES, strong positive effects (especially for the participation rate)
Frontier analysis (DEA)	YES, it is one of the limiting factors (following qualified labour)	YES (but this seems to be less relevant)

The three different ways of analysing the relation between accessibility and economic performance shows that supply side effects are relevant, especially in peripheral regions. However, the influence is either limited or other factors seem to have a stronger effect on economic performance than accessibility. Nonetheless, better accessibility has a positive influence on the attractiveness of a region for people and business and therefore on economic performance. On the other hand, the demand side effects are rather strong in all regions. This means that a good economic performance leads to more demand for transportation services which in turn results sooner or later in better transport infrastructure, more transport services and better accessibility.

The political conclusion is that the improvement of accessibility may help improving the economic situation of a region. However, each region must carry out a thorough analysis what is the most efficient way to improve accessibility. In some cases (like in a remote area in Finland) this might be the strengthening of an airport (expansion of the structures and good offer of scheduled flights). In other cases (like in Greek regions), it might be the subsidy of scheduled flights to the next large hub. In few cases, it is recommended to completely abandon airport activities in order to transform it into an urban facility that will have stronger effects on the economic performance of the region. In even other cases (like in Italian regions) it might be best to integrate urban functions in the airport areas and to improve the highway or rail network system to better reach a nearby airport with a good offer of scheduled flights.

All in all, however, the empirical analyses show that both supply side and demand side effects are relevant. As a consequence, better economic performance leads to higher demand for transportation services, thereby enhancing the supply of transportation which leads, in turn, to better economic performance. For policy makers it seems to be relevant that such an upward circle may be initiated (or at least influenced in a positive way) by an improvement of transportation services. At last, supply side effects do play an important role.

3. CASE STUDIES

3.1 Introduction and methodology

Throughout the world, there are hundreds of second and third tier obsolete airports stuck in a pre-decline phase. It is urgent to think about their future. What does it mean to transform airports' infrastructure into urban re-activators? What are the strategies? How the city can prepare itself before the airport infrastructure arrives in its obsolete phase?

The ADES research case studies are: *Jyväskylä Airport*, City of Jyväskylä, Central Finland; *Araxos Airport*, *Aktion Airport*, *Andravida Airport*, Region of Western Greece; *Villanova d'Albenga Airport*, Province of Savona, Italy. These airports show different examples of the widespread situation of underused airports structures that have never managed to reach their potential or have lost their central role.

Figure 1. Jyväskylä Airport, Finland

Figure 2. Entrance at Jyväskylä Airport, Finland

Figure 3. Aktion Airport, Western Regions, Greece

Figure 4. Araxos Airport, Western Regions, Greece

Figure 5. Andravida Airport, Western Regions, Greece

Figure 6. Airport of Villanova d'Albenga

3.2 Benchmarking the stakeholder regions

The geographical situation of the three stakeholder regions is very different (Map 1). Jyväskylä in Central Finland is very central to Finland but very peripheral relative to Central Europe. As the economic centre of Finland is south of Jyväskylä, Central Finland is even more remote and Helsinki becomes a natural gateway to "Europe" for the whole of Finland.
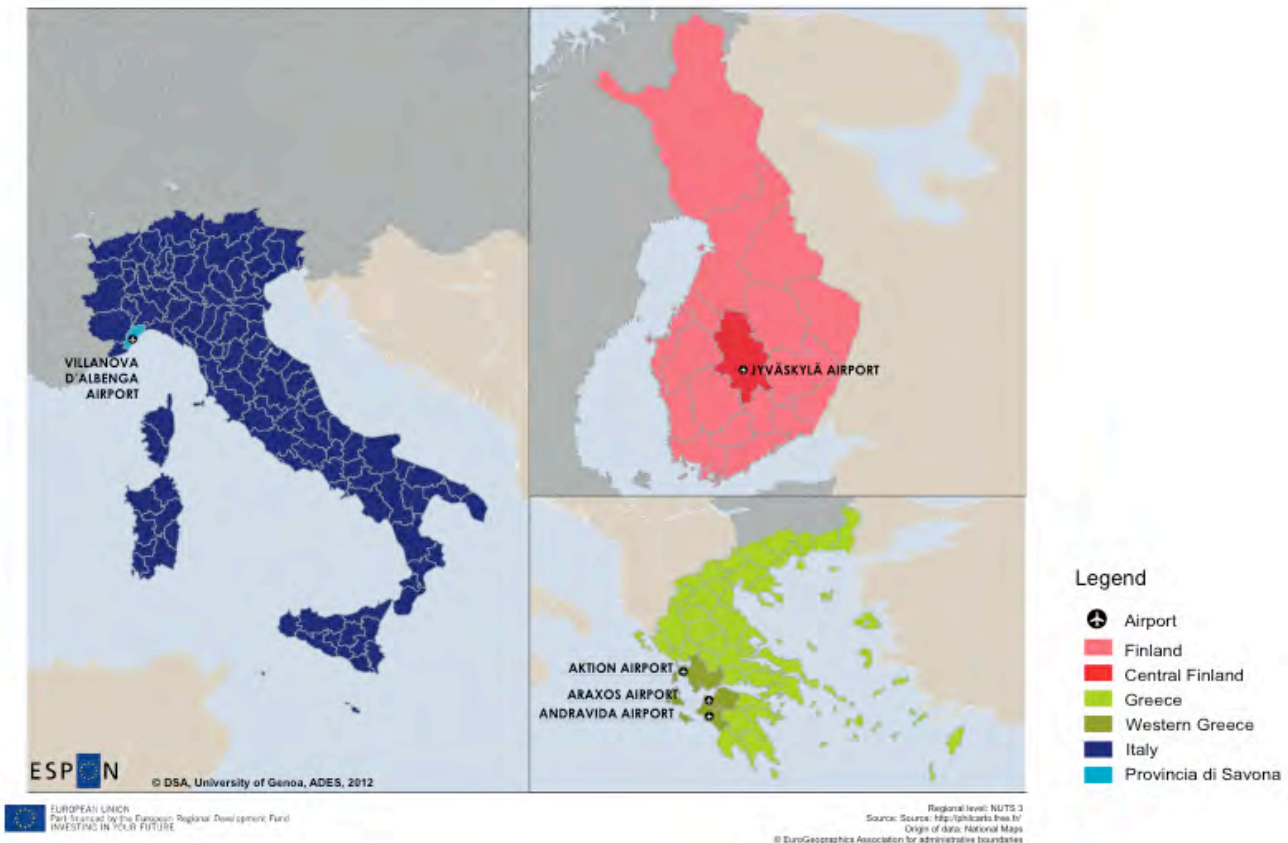
Map 1: Context_Nation_Stakeholder regions

Patras in Western Greece is also rather central to Greece, but Greece as a whole is at the southern periphery of Europe. Despite the fact that Patras is even closer to Central Europe than the capital Athens, almost all air traffic goes through Athens. The situation of Savona differs considerably. It is rather central in Europe, but very peripheral in an Italian context. The airports of Genoa, Nice, Torino and Milano are relatively close. Thus, the air link situation of the three stakeholder regions also differs substantially.

The objective of this chapter is to provide an overview of the main economic indicators and the industry structure of the stakeholders regions. Then, we describe the regional contexts of each case study areas through the same descriptive categories

We start with a brief comparison of the three regions. In each case, the

cognitive framework for socio-economic and territorial aspects is based on specific databases, indicators and elaborations that define the potential economic impacts of airports.

Economic overview of the Stakeholder Regions

In socio-economic terms, Central Finland and the Province of Savona are of about the same size, while Western Greece is about twice as big. The following table presents some economic key figures:

Table 1: Economic performance, 2010

	Central Finland	Western Greece	Province of Savona
Nominal GDP (in million €)	7'395	13'056	8'168
Real GDP-Growth (2000-2010)	1.4% p.a.	2.1% p.a.	0.8% p.a.
GDP per capita (in €)	27'007	17'516	28'367
Hourly productivity (in €)	38.27	19.28	34.14
Employment	109'282	285'695	120'667
Employment Growth (2000-2010)	0.3% p.a	0.3% p.a	1.5% p.a.

Source: BAKBASEL

For a better understanding of the three stakeholder regions we present a benchmarking exercise with a systematic comparison of these three regions with similar regions in the respective countries and additional rather peripheral regions in some other countries. The regions selected for this analysis can be seen from the following graph. (For a description of the data used please refer to *Annex 1*). The most relevant results regarding economic performance are:

- GDP per capita level as an indicator of general welfare: Central Finland (Keski-Suomi) and the Province of Savona (Savona) are in the midfield, while West Greece is in the lower third (of this rather week sample). As the participation rates in the three stakeholder regions are rather similar, this result reflects to a large extent the differences in the level of productivity.
- Real GDP per capita growth (2000–2008) as a central economic performance indicator: West Greece is among the best, Central Finland in the middle and Savona at the lower end of the scale. Although the participation rate in Savona grew more rapidly leading to a relatively large increase in employment, GDP growth was very low as productivity hardly grew. In Central Finland the participation rate did not change much, but an average increase of labour productivity led to an average output growth. Finally, a small increase in the participation rate combined with a large increase in productivity results in a high real GDP growth in West Greece.

Figure 1: A comparison of welfare (measured as nominal GDP per capita)
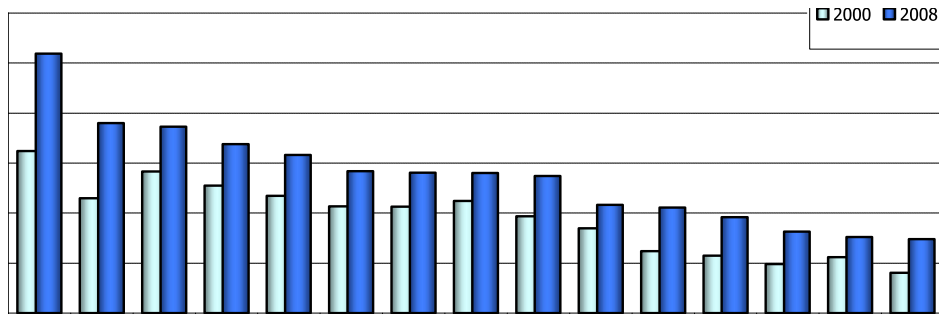
Note: In EUR PPP (at current prices and exchange rates)
Source: BAKBASEL

Part of the differences in the economic performance may be explained by the quality of the framework conditions. Here, the most relevant results are:

- Accessibility: Savona is in quite a good position, particularly because of its geographic proximity to the large European economic centres. Central Finland is in a middle position within the sample under consideration. Western Greece is in a relatively bad position, particularly because of its low transport accessibility.
- Innovation: Using the share of research and development expenditures in GDP as an indicator for the innovation potential of a region, Central Finland is in a top position, while Savona is below average and Western Greece almost last in the ranking of the 15 regions of the benchmark.
- Taxation: For both taxes for qualified manpower and companies Western Greece exhibits a rather low burden, and Savona quite a high tax rates. In Finland, company taxes are below, manpower taxes above the sample average.
- Regulation: Regulation for both product and labour markets is quite liberal in Finland and quite strict in Greece. In Italy, labour market regulation is distinctly more liberal than product market regulation.

In the following paragraphs, the three stakeholder regions will be presented individually, followed by a systematic and detailed comparison of these three regions with a benchmarking sample of other regions.

Economic overview of CENTRAL FINLAND

Table 2: Economic performance, 2010

	Central Finland	Finland	Western Europe
Nominal GDP (in million €)	7'395	179'891	11'591'738

Real GDP-Growth (2000-2010)	1.4% p.a.	1.8% p.a.	1.5% p.a
GDP per capita (in €)	27'007	33'453	28'314
Hourly productivity (in €)	38.27	39.81	35.48
Employment	109'282	2'435'412	182'485'506
Employment Growth (2000-2010)	0.3% p.a	0.5% p.a.	0.6% p.a

Source: BAKBASEL

In 2010, the region of Central Finland achieved a nominal Gross Domestic Product (GDP) of more than 7'390 million Euros and there were approximately 109'000 employed. The level of GDP in capita in the region was slightly below the national and Western European average. This is reflected in values of 27'000 Euro per capita in Central Finland, 33'500 Euro per capita in Finland and 28'300 Euro per capita in Western Europe. In contrast, hourly productivity in the region was higher than the Western European average, while the average hourly productivity in Finland exceeded the value of the region (see table 2).

Figure 2:   **Real GDP- and Employment Growth**
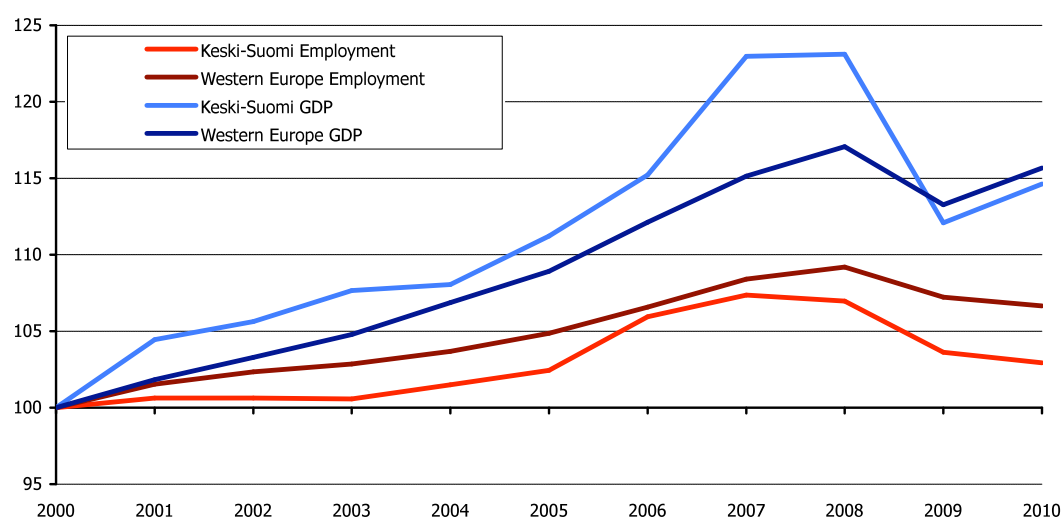
Index, 2000 = 100 (GDP: at constant prices and exchange rates)
Source: BAKBASEL

Figure 2 displays the growth of GDP and employment in the period 2000-2010. Despite the sharp decline of GDP in 2009 it is visible that the region had a dynamic development. The region grew by 1.4 percent per annum, which is similar to the Western European average (1.5% p.a.) It strikes the eye that in contrast to GDP growth Central Finland performed in terms of employment growth worse than the Western European average. So the region achieved only an augmentation of 0.3 percent per annum. The last two years the employment even shrank by 3.8 percent.

Figure 3: Industry structure, 2010
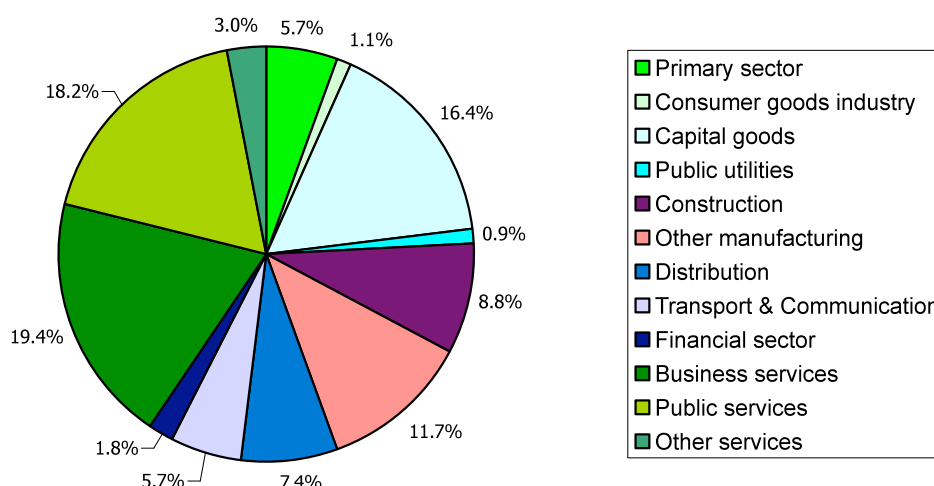
Share of total economy, in %
Source: BAKBASEL

The pie chart shows the industry structure of Central Finland's economy in the year 2010 as shares in GDP (using the NACE classification). The service sector had the largest share with 55.4 percent, while the primary and the secondary sector contributed 5.7 and 38.9 percent to total GDP. The most important industries in the service sector were the business services and the public services. Most important for the industry sector was the production of capital goods.

Economic overview of WESTERN GREECE

Table 3: Economic performance, 2010

	West Greece	Greece	Western Europe
Nominal GDP (in million €)	13'056	226'991	11'591'738
Real GDP-Growth (2000-2010)	2.1% p.a.	2.3% p.a	1.5% p.a.
GDP per capita (in €)	17'516	20'001	28'314
Hourly productivity (in €)	19.28	20.51	35.48
Employment	285'695	4'647'826	182'485'506
Employment Growth (2000-2010)	0.3% p.a	0.9% p.a	0.6% p.a.

Source: BAKBASEL

In 2010, West Greece achieved a nominal Gross Domestic Product (GDP) of more than 13'050 million Euros and there were approximately 285'700 employed. The level of GDP in capita in the region was slightly below the national average, but more than one-third smaller than the Western European average. This is reflected in values of 17'516 Euro per capita in West Greece, 20'001 Euro per capita in Greece and 28'314 Euro per capita in Western Europe. A resembling picture is drawn by hourly productivity. So, hourly productivity of the region was clearly lower than the Western European average, while the national average recorded a slightly higher value (see

table 3).

Figure 4:   **Real GDP- and Employment Growth**
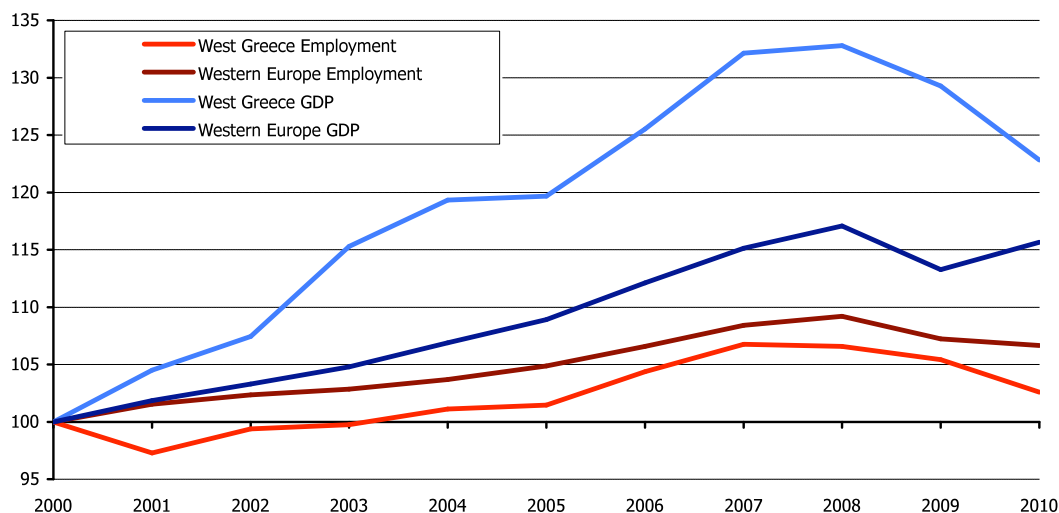
Index, 2000 = 100 (GDP: at constant prices and exchange rates)
Source: BAKBASEL

Figure 4 displays the growth of GDP and employment in the period 2000-2010. Despite the decline of GDP in the years 2009 and 2010 the region grew by 2.1 percent per annum in the period 2000-2010, which was clearly above the development of the Western European average (1.5% p.a.) In contrast to GDP growth West Greece performed in terms of employment growth worse than the Western European average. So the region achieved only an augmentation of 0.3 percent per annum, while Western Europe recorded an increase of 0.6 percent per year.

Figure 5: Industry structure, 2010
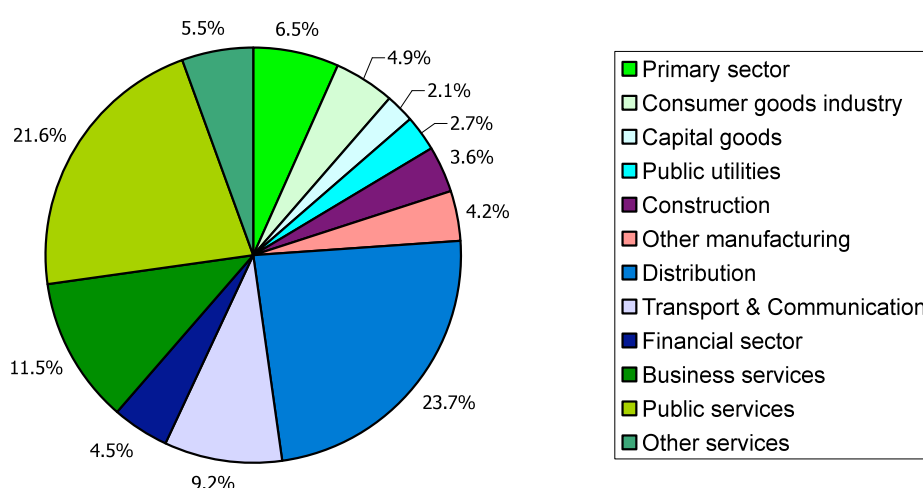
Share of total economy, in %
Source: BAKBASEL

The pie chart shows the industry structure of the economy in West Greece in the year 2010 as shares in GDP (using the NACE classification). The industry

structure is dominated by the service sector which accounts for more than 75 percent of total economy in 2010. The most important industries in the service sector were public services (21.6%) and distribution (23.7%). The primary and the secondary sector contributed 6.5 and 17.5 percent to total GDP. Most important for the industry sector was the consumer goods industry.

Economic overview of PROVINCE OF SAVONA

Table 4: Economic performance, 2010

	Savona	**Italy**	**Western Europe**
Nominal GDP (in million €)	8'168	1'555'034	11'591'738
Real GDP-Growth (2000-2010)	0.8% p.a.	0.2% p.a.	1.5% p.a.
GDP per capita (in €)	28'367	25'667	28'314
Hourly productivity (in €)	34.14	31.81	35.48
Employment	120'667	24'482'065	182'485'506
Employment Growth (2000-2010)	1.5% p.a.	0.7% p.a.	0.6% p.a.

Source: BAKBASEL

In 2010, the region of Savona achieved a nominal Gross Domestic Product (GDP) of more than 8'160 million Euros and there were approximately 120'000 employed. The level of GDP in capita in the region was similar to the Western European average and above the national average. This is reflected in values of 28'3567 Euro per capita in Savona, 25'667 Euro per capita in Italy and 28'314 Euro per capita in Western Europe. A resembling picture is drawn by hourly productivity. So, hourly productivity of the region was only slightly lower than the Western European average, while the national average recorded a lower value (see Table 4).

Figure 6:   **Real GDP- and Employment Growth**
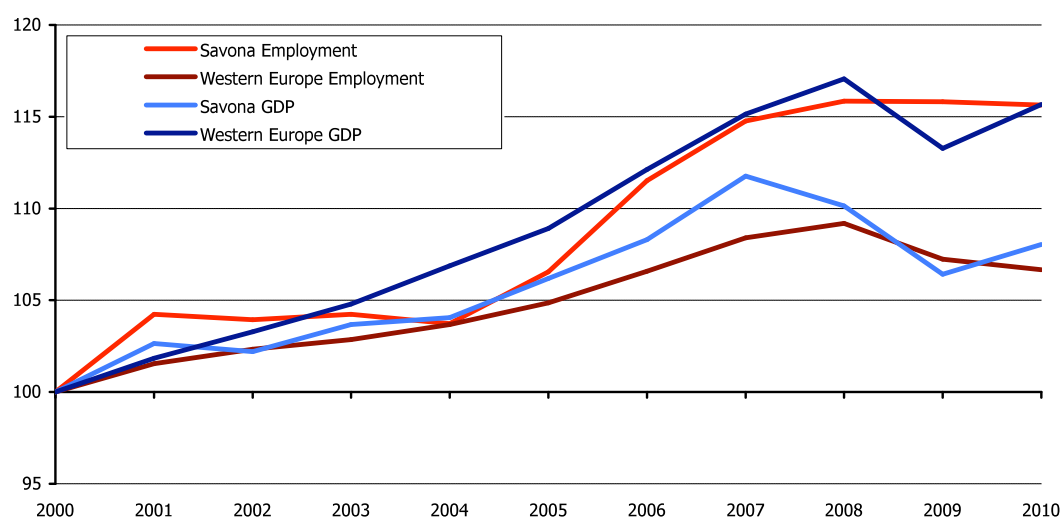
Index, 2000 = 100 (GDP: at constant prices and exchange rates)
Source: BAKBASEL

Figure 6 displays the growth of GDP and employment in the period 2000-

2010. Despite the decline of GDP in the years 2008 and 2009 the region grew by 0.8 percent per annum in the period 2000-2010. However, this increase was clearly below the development of the Western European average (1.5% p.a.) It strikes the eye that in contrast to GDP growth Savona performed in terms of employment growth much better than the Western European average. So the region achieved a significant increase in employment by 1.5 percent per annum. Especially in the period 2004-2007 the growth rates were high.

Figure 7: Industry structure, 2010
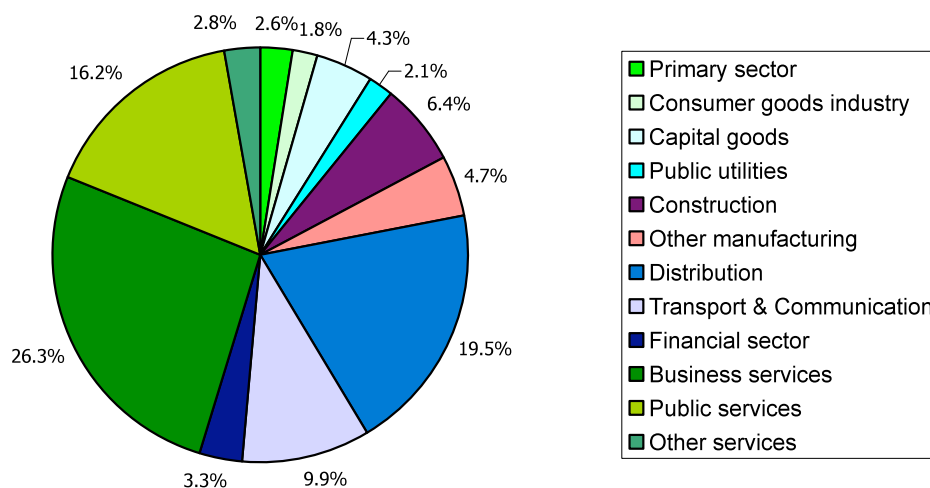
Share of total economy, in %
Source: BAKBASEL

The pie chart shows the industry structure of the economy in Savona in the year 2010 as shares in GDP (using the NACE classification). The industry structure is dominated by the service sector which accounts for more than 75 percent of total economy in 2010. The most important industries in the service sector were business services (26.3%) and distribution (16.2%). The primary and the secondary sector contributed 2.6 and 19.4 percent to total GDP. Beside construction there can not be identified any important (export-oriented) industry cluster in the secondary sector.

Economic Benchmarking of the three regions

The following table shows the three stakeholder regions and the **regions** chosen to perform the benchmarking exercise. These regions are either similar regarding their structure or peripherality or simply neighbouring regions.

Table 5 Benchmarking-Regions

	Shortcut	Accessibility	Rank
West Greece	ED23	77.85	332
Keski-Suomi	FI193	77.01	335

Savona	IT132	95.17	200
Övre Norrland	SE08	79.46	326
Finmark	NO073	77.19	333
South-West Ireland	IR25	81.34	306
Alentejo	PT18	82.25	294
Lugo	ES112	78.32	330
Mecklenburg-Vorpommern	DE80	92.47	219
Nordjylland	DK05	91.51	223
Northern Ireland	UKN	96.72	191
Alpes-Maritimes	FK823	107.65	84
Genova	IT133	102.37	143
Pohjois-Savo	FI132	81.64	304
Crete	ED43	84.89	278
All regions		97.97	all 336

INDEX, average 2000-2008
Quelle: BAKBASEL

The benchmarking covers the following economic **indicators**:

- Population
- GDP per capita
- Real GDP per capita growth or real GDP growth
- Participation rate
- Employment growth
- Labour productivity
- Hourly productivity
- Accessibility
- Expenditures on research and development
- Taxation
- Regulation
- Passengers
- Cargo
- Industry structure

There are data available from 2000 (for some indicators already as from 1990) to 2008 (or 2010).

In the following graphs, the three stakeholder regions are systematically compared with the above defined set of benchmarking regions.

Figure 8   Population
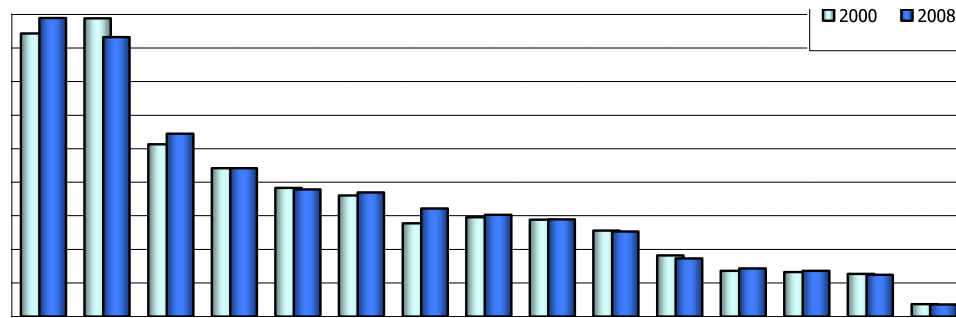
Note: Population in 1'000 persons
Source: BAKBASEL

Methodological Notes
On a given date, total population of a country consists of all persons, national or foreign, who are permanently resident in the economic territory of the country, even if they are temporarily absent. In the International Benchmarking Report population data is ascertained at the end of the year. Exception: Population data for the USA and the American regions refers to the beginning of July.
Population Breakdown
Total population of a country includes:
   •   nationals permanently resident in the country
   •   Civilian nationals staying abroad for a period of less than one year (frontier workers, seasonal workers, tourists, patients, etc.)
   •   foreign civilians resident in the country for a period of one year or more (including personnel of the Institutions of the European Communities and international civilian organisations within the geographic territory of the country)
   •   foreign military personnel working with international military organisations within the geographic territory of the country
   •   foreign technical assistance personnel on long-term assignments working in the country and deemed to be employed by their host government on behalf of the government or the international organisation which is actually financing their work
By convention, total population includes the following, irrespective of the length of their stay outside the country:
   •   national students, however long they study abroad
   •   members of the country's armed forces stationed in other parts of the world
   •   nationals on the staff of national scientific bases established outside the geographic territory of the country
   •   nationals on the staff of diplomatic missions abroad
   •   nationals who are members of the crews of fishing boats, other ships, aircraft and floating platforms operating partly, or wholly, outside the economic territory

This Figure gives an idea about the size of the benchmark regions. The ranking reveals that Keski-Suomi and Savona belong to the smallest regions in this benchmarking, meanwhile bigger West-Greece lies somewhere in the middle span.

Figure 9   Nominal GDP per capita
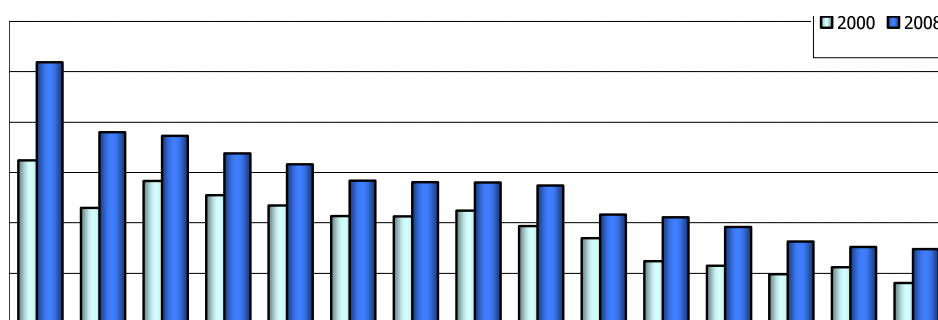
Note: In EUR PPP (at current prices and exchange rates)
Source: BAKBASEL

Methodological Notes
Gross Domestic Product per Capita
Gross Domestic Product (GDP) related to the population of a region puts the final result of the production activity of resident producer units in a relation to the size of a region. This enables comparisons between regions of different size.
Gross Domestic Product
Gross domestic product at market prices is the final result of the production activity of resident producer units.
It can be defined in three ways:
- GDP is the sum of gross value added of the various institutional sectors or the various industries plus taxes but minus subsidies towards products (which are not allocated according to sectors and industries). It is also the balancing item in the total economy production account.
- GDP is the sum of final uses of goods and services by resident institutional units (actual final consumption and gross capital formation), plus exports but minus imports of goods and services.
- GDP is the sum of uses in the total economy generation of income account (compensation of employees, taxes on production and imports minus subsidies, gross operating surplus and mixed income of the total economy).

GDP is measured at market prices. Market prices are those paid by purchasers for the goods and services they acquire, excluding deductible value added tax (VAT) (Eurostat 1996, p.44).
Current prices and exchange rates
GDP is in current prices (nominal). To compare data from different currency regions current exchange rates are used (annual average exchange rate).
Population
See methodological notes Figure 8

Nominal GDP per capita is a good measure of the wealth of regions. West Greece is clearly one of the poorest regions displayed in the figure above, independent of the year under consideration (2000 or 2008). GDP per capita of Keski-Suomi and Savona are on a very similar level and are close to the average of the benchmarking sample.

Figure 10 Growth of real GDP per capita 1990-2000, 2000-2008
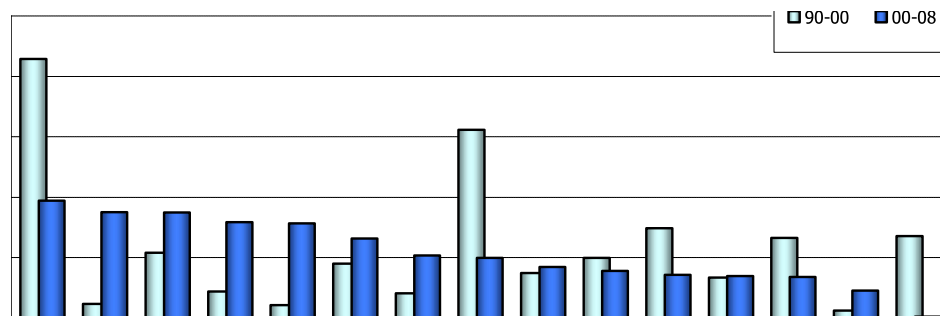
Note: In % p.a. (at constant prices and exchange rates, PPP corrected)
Source: BAKBASEL

Methodological Notes
Gross Domestic Product per Capita
See methodological notes Fig. 9
Gross Domestic Product
See methodological notes Fig. 9
Constant prices and exchange rates (Eurostat 1996, p.13)
Valuation at constant prices means valuation of flows and stocks in an accounting period at the prices of a previous period. The purpose of valuation at constant prices is to break down changes over time in values of flows and stocks into changes in price and changes in volumes. Flows and stocks at constant prices are said to be in volume terms. In the International Benchmarking Report the basic year is 2000.
Purchasing Power Parity (PPP)
PPP is an exchange rate valuing the different purchasing power of the currencies instead of financial market exchange rates, which strongly fluctuate and are vulnerable to speculations. PPPs are usually used together with current prices and are supposed to compare output in real terms, in volumes. The PPPs used are developed by the Groningen Growth Centre (Prof. Bart van Ark) and follow a "production side" and industry specific approach most suitable for GDP and GVA data.

Concerning growth of real GDP per capita the three regions in focus display very different results. Over the period 2000-2008 West Greece has been one of the fastest growing regions, though based on a low level (compare figure 9). Keski-Suomi and Savona showed a rather weak growth in the Nineties. However, whereas for the period 2000-2008 Savona is still among the least dynamic regions, Keski-Suomi is now ranked somewhere in the middle.

Figure 11 Participation rate
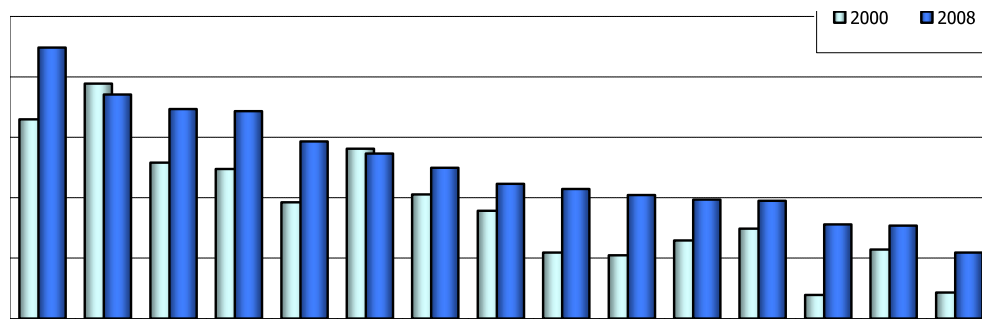
Note: Working population in % of the whole population
Source: BAKBASEL

Methodological Notes
Participation rate is defined as employment divided by population.
Employment
See methodological notes Figure 12.
Population
See methodological notes figure 8

Concerning the participation rate, all three regions Keski-Suomi, Savona and West Greece are classified in the second half of the ranking with participation rates around 40 percent. It is noticeable that the ranking of Keski-Suomi is clearly worse than the ranking of its Scandinavian neighbours Finmark, Nordjylland and Övre Norrland.

Figure 12 Growth of employment 1990-2000, 2000-2008
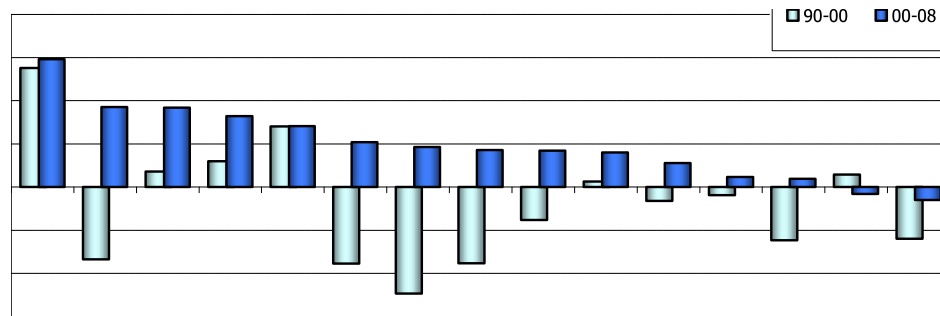
Note: In % p.a.
Source: BAKBASEL

Methodological Notes
The European System of Accounts (ESA 1995) introduced a number of measurements of employment:
- employment (= employees and self-employed)
- the number of jobs
- the full-time equivalence
- the total hours worked

Employment covers all persons, both employees and the self-employed, engaged in some productive activity that falls within the production boundary of the system.
Employees are all persons who work under contract for another resident institutional unit and receive remuneration.
Self-employed persons are defined as persons who are the sole or joint owners of the unincorporated enterprises in which they work, excluding unincorporated enterprises classified as quasi-corporations.

Meanwhile its employment figures were shrinking over the period 1990-2000, in the subsequent eight years Savona experienced a rather high growth of employment compared to other regions in this benchmarking sample. Keski-Suomi and West Greece also show a positive growth of employment for the later period (2000-2008) and are ranked somewhere in the middle.

Figure 13 Nominal labour productivity
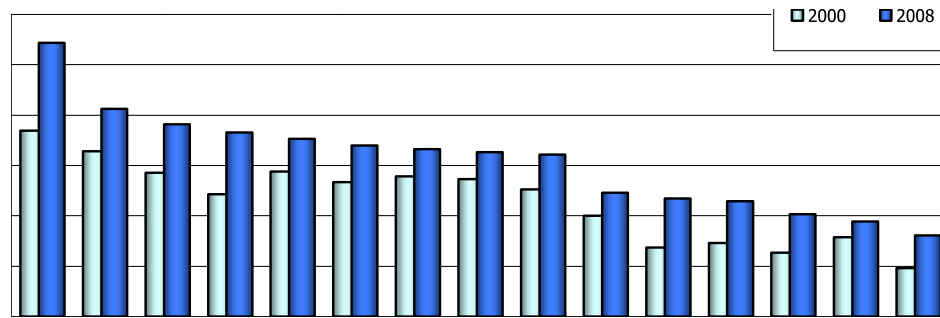
Note: In Euros per person employed (at current prices and exchange rates)
Source: BAKBASEL

Methodological Notes
Productivity is an economic key figure for the capability and competitiveness. Productivity is the ratio between inputs (production factors) and output (goods and services produced). The most common used productivity is labour productivity, as labour is easily measured. Two measures of labour productivity are available in the IBD: hourly productivity and employment productivity.
Employment productivity
Employment productivity is the output per person in employment. The IBD provides information on the economy level as well as on the level of individual industries.
Please note: Within the IB, the term «labour productivity» is used with respect to a specific measure or data, it is employment productivity.
Current prices and exchange rates
GDP is in current prices (nominal). To compare data from different currency regions current exchange rates are used (annual average exchange rate).

Concerning labour productivity Keski-Suomi reveals the best performance among the three regions in focus, though there is still a rather large gap towards South-West Ireland which is the leading region in this benchmarking. On the contrary West Greece exhibits a very low labour productivity, whereas Savona's labour productivity is around the average of the considered group and similar to the one of Keski-Suomi.

Figure 14 Nominal hourly productivity
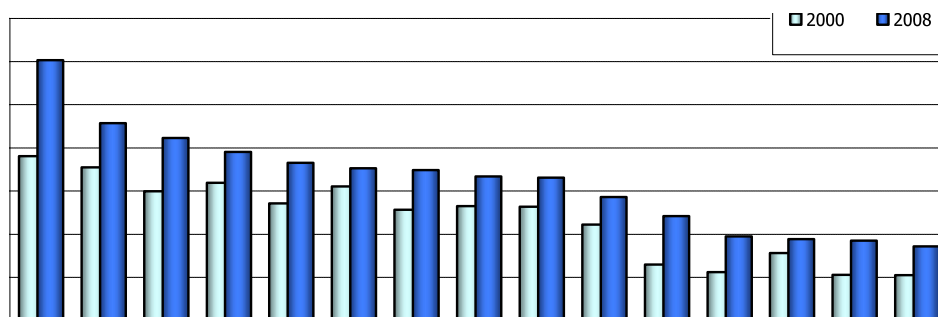
Note: In Euros per hour worked (at current prices and exchange rates)
Source: BAKBASEL

Methodological Notes
Productivity is an economic key figure for the capability and competitiveness. Productivity is the ratio between inputs (production factors) and output (goods and services produced). The most common used productivity is labour productivity, as labour is easily measured. Two measures of labour productivity are available in the IBD: hourly productivity and employment productivity.
Hourly productivity
Hourly productivity is defined as output per hour of labour input. In the International Benchmarking Report hourly productivity is calculated as real value added divided by the effective total number of hours worked over the year.
Although basically providing the same information as employment productivity, the measures can differ from one another. Reasons for differences are especially found in the usual hours worked and the part time employment structures in the different countries. Other issues like overtime, holidays, average sick leave duration and similar issues influence the results as well. The differences can be observed in the levels as well as in the dynamics of the indicators.
Current prices and exchange rates
GDP is in current prices (nominal). To compare data from different currency regions current exchange rates are used (annual average exchange rate).

The results for hourly productivity are very similar to the ones for total labour productivity, showing a weak productivity for West Greece and an average hourly productivity for Keski-Suomi and Savona.

Figure 15 Total Accessibility

Methodological Notes
See chapter 2.2"

Keski-Suomi and West Greece as peripheral regions naturally perform worse in terms of total accessibility compared to more centrally located regions like Savona. But also concerning transport accessibility West Greece and Keski-Suomi are among the weakest regions in this benchmarking, though Keski-Suomi clearly could improve its position over the period 2000-2008 (Fig).

Figure 16 Geographical Accessibility
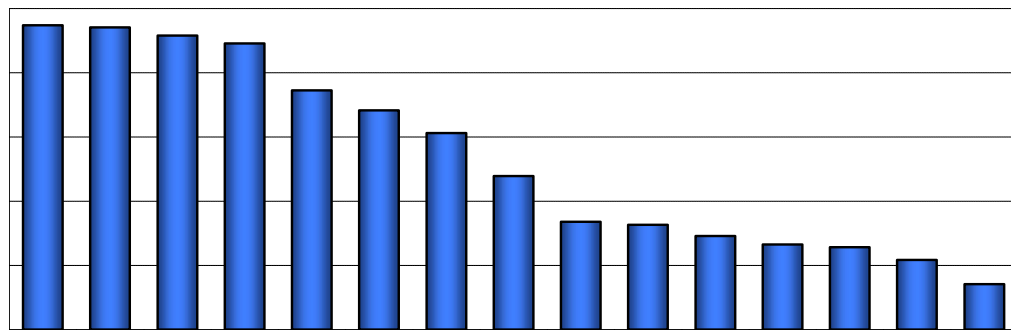
Note: Indexed (100 = sample mean)
Source: BAKBASEL

Methodological Notes
See chapter 2.2"

The more centrally located Savona clearly has a natural advantage in terms of geographical accessibility compared to the more peripheral regions West Greece and Keski-Suomi and is ranked second best in this benchmarking sample. Geographical accessibility values of West Greece and Keski-Suomi are clearly below the sample mean and are on a similar level as the ones for Alentejo or Övre Norrland.

Figure 17 Transport Accessibility

Methodological Notes
See chapter 2.2"

Concerning transport accessibility all three regions Savona, Keski-Suomi and West Greece underperform in comparison to the whole sample (values below 100 index points). Compared to this smaller benchmarking group Savona lies somewhere in the middle, while Keski-Suomi and West Greece clearly belong to the weakest regions. However, Keski-Suomi exhibits one of the highest growth rates in transport accessibility between 2000 and 2008 in this benchmarking sample.

Figure 18 Expenditures on Research & Development
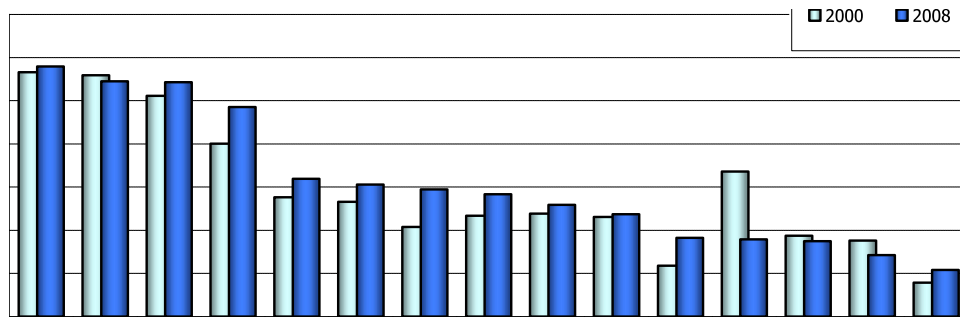
Note: In % of GDP
Source: BAKBASEL

Methodological Notes
This indicator measures the expenditures on research and development as a percentage of GDP. It comprises total intramural R&D expenditures in all sectors of performance, i.e. business enterprise sector, government sector, higher education sector and private non-profit sector.

In this benchmarking sample Alpes-Maritimes and Keski-Suomi take a leading position concerning expenditures on Research and Development, whereas Savona is ranked slightly below the average. On the other end of the ranking, West Greece exhibits the second lowest level of expenses on R&D.

Figure 19 Taxation
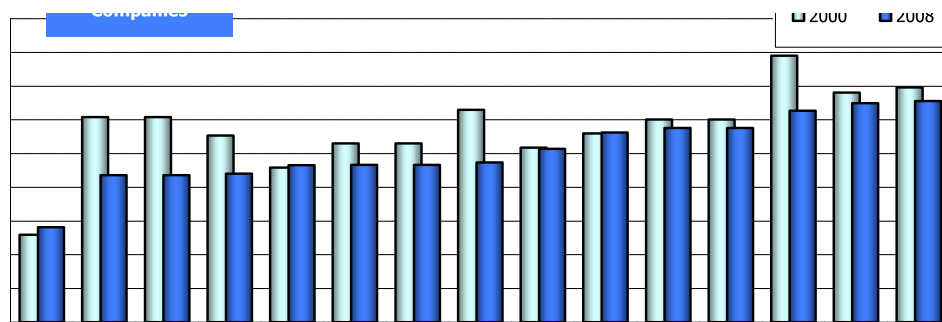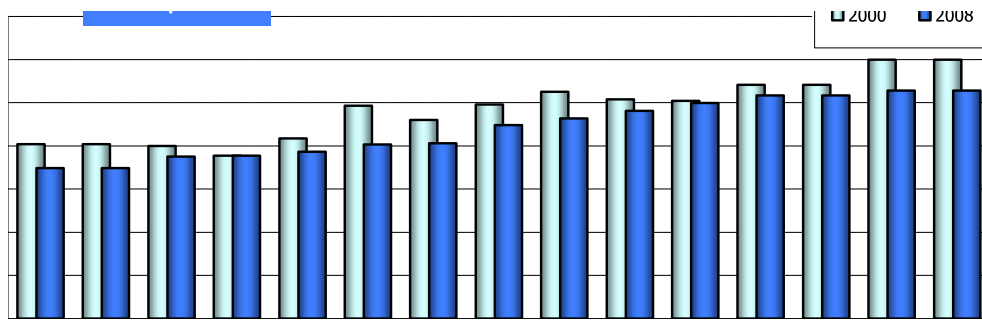
Source: ZEW/BAKBASEL

Methodological Notes
See Annex "Dataset"

Imposes a rather high tax burden West Greece exhibits rather low levels of manpower as well as company taxation. In contrary, Savona in terms of both manpower and company taxation. For Keski-Suomi especially the manpower taxation is among the highest in this benchmarking sample.

Figure 20 Regulation
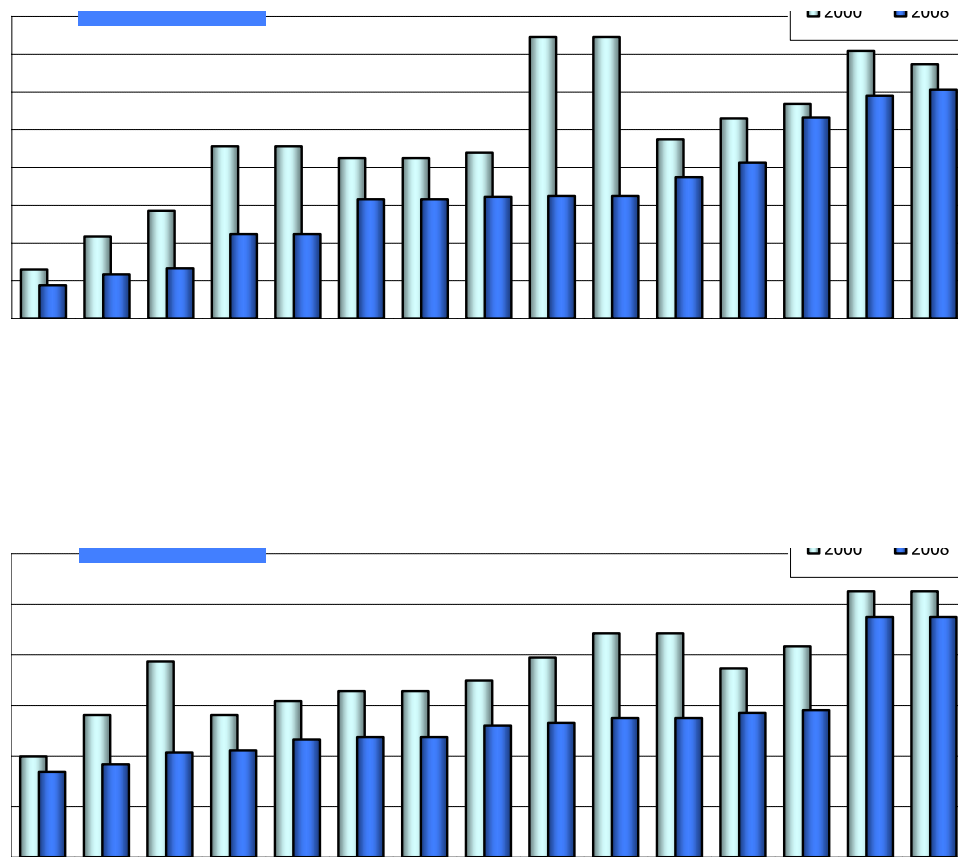
Note: Both indexes are scaled between 0 (no regulation) and 6 (restrictive).
Source: BAKBASEL

Methodological Notes
See Annex "Dataset"

Regarding labour market regulation it is noticeable by how much Savona and West Greece could improve their position from 2000 to 2008. Savona now reveals the lowest labour market regulation of the three regions under consideration. In terms of product market regulation Greece in general has some clear disadvantages. Between Keski-Suomi and Savona there is a rather small difference and both regions are ranked somewhere in the middle.

Figure 21 Transportation
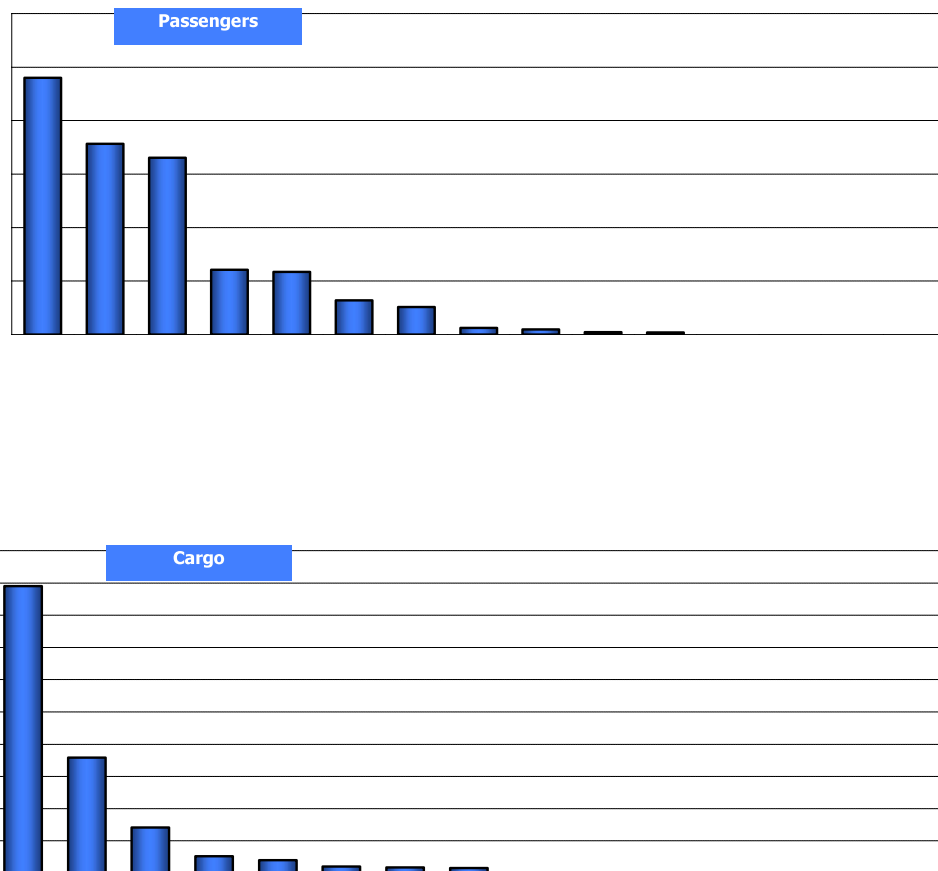
Note: Passengers are the number of commercial passengers in a region during year 2010; Cargo (freight&mail) in metric tones in 2010
Source: BAKBASEL

Regions without an international airport within its area naturally display a value of zero for both variables. This is true for Lugo, Alentejo, Savona and Nordjylland. West Greece and Keski-Suomi only have a very small number of passengers arriving each year and no (or almost no) Cargo.

In this chapter we displayed a series of economic indicators to compare the three stakeholder regions systematically with a benchmarking sample. The results are summarised at the beginning of the chapter.

3.3 Regional Context

It is fundamental to learn about ADES case study areas in order to understand the characteristics and the differences between each regions. This survey wants to answer the following questions:

- What can we learn from (and for) the three stakeholder regions?
- How much important is the role and situation of airports and accessibility in the three stakeholders regions?
- What results are the local actors (stakeholders) expected from this research?

We analyzed the situation in the regions, focusing on the spatial context and the socio-economic context. This activity was carried out simultaneously by LP, P3 and P4 and will include two parts: information gathering (analysis of the situation in the region, interviews and questionnaires, benchmarking the stakeholder regions) and SWOT analysis.

The first regional-scale map shows the three main statistical data on the peripheral regions in the studio: surface, population and density (Map 2). The comparison of these data provides an interesting insight into the sheer diversity of the three territories: Central Finland has a surface of 19950 kmq and a population of only 274.000 inhabitants, Western Greece has a surface of 11350 kmq and a population of 741.282 inhabitants, Liguria, finally, has a surface of only 5420 kmq, but also a population of 1.616.788 inhabitants.
The most significant is the density: 13,65 inhabitants/kmq for Central Finland, 66,37 inhabitants/kmq for Western Greece and even 298,3 inhabitants/kmq for Liguria.

In the next paragraphs, we describe the regional contexts of each case study areas through the same descriptive categories:

a) **geographical location**
b) **landscape**
c) **infrastructures and accessibility**
d) **economic trends**
e) **cultural and leisure services**
f) **tourism**
g) **history of the airport and passenger structure**

Context_Regions

	SURFACE km2	POPULATION inh.	DENSITY inh./km2
	19950 km2	274 000 inh.	13,65 inh./km2
	11350 km2	741 282 inh.	66,37 inh./km2
	1545 km2	287 551 inh.	186,12 inh./km2

Legend

Central Finland
Western Greece
Provincia di Savona

ESPON   © DSA, University of Genoa, ADES, 2012
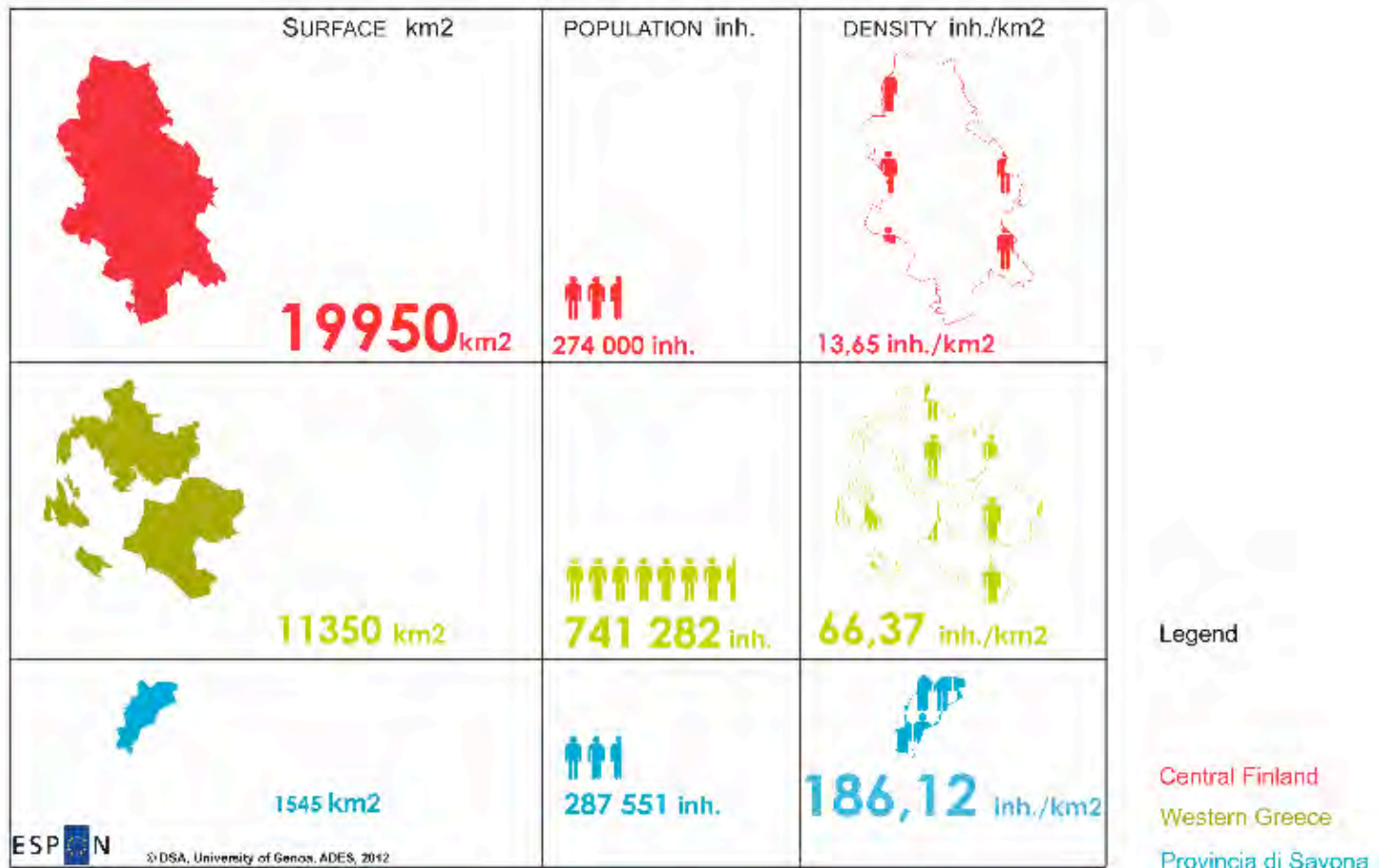
Map 2. Context_Stakeholder Regions_ Comparison of Surface,
Population and Density

The politicians in the different regions are the most important stakeholders and prime targets of the results of this targeted analysis. If they are to understand the results of the analysis, we must know what they think and why. In-depth interviews and structured questionnaires were fundamentals tools to highlight differences, specificities and problems of the Stakeholder regions but also to understand the opinion of local actors. The structure was identical for all three Stakeholder regions (in order to increase comparability).

They were gathered in local languages. This will avoid language problems and ensure maximal return and inside information on what the relevant success or failure factors are believed to be. Interviews and questionnaire focused on the transport situation of the regions and cover both the demand as well as the supply side where it addresses both the needs (necessities) and the quality of the effective services. The main issues and reflections of interviews and questionnaire are included in the analysis of each Stakeholder regions.

The results of all these analysis were input for the SWOT analysis. These analyses also provided important topics for reflection on the three case

studies that allowed to propose different renewal strategies according to the exigencies of each regions. The data supporting our findings are presented bellow. The integral version of questionnaires is presented in *Annex 2* trough graphs.

3.4 Context of Central Finland: Jyväskylä

a) Geographical location

Central Finland is one of the 20 provinces (NUTS 3) in Finland. It consists of six NUTS 4 level sub-regions (Joutsa, Jyväskylä, Jämsä, Keuruu, Saarijärvi-Viitasaari and Äänekoski) and of 23 municipalities. The region of Jyväskylä forms a central area of the province covering seven municipalities. The city of Jyväskylä is the largest city in the area and the seventh largest city in Finland. The polarized nature of economic development with focus on core regions and major cities is clearly visible in the case of Central Finland. Population in Central Finland is nearly 274,400 (in 2011; 5% of the total population in Finland) of which 64% lives in the Jyväskylä sub-region. In the city of Jyväskylä, there are 132,000 inhabitants.

Three cities in Central Finland, Äänekoski, Jyväskylä and Jämsä, form a so called development corridor in Central Finland which is now called Jyväskylä urban region. This expresses about the strengthening of the Jyväskylä region, but reflects also an aspiration towards a more polycentric development in Central Finland. Jyväskylä urban region is a combination of two industrial towns Jämsä and Äänekoski and a city of education and new technology Jyväskylä. This area of 220,000 inhabitants is a core of the province, the background to which is provided by the natural strengths of three cities and the surrounding countryside.

Distance of Jyväskylä to other cities in Greece	Distance of Central Finland to other European cities
To Helsinki (capital): 270 km	To Paris: 2300 km
To Turku: 300 km	To Rome: 3050 km
To Tampere: 150 km	To Brussels: 2050 km
To Alexandroupolis: 781 km	To London: 2090 km
To Oulu: 340 km	To Berlin: 1104 km

b) Landscape

Central Finland is located 100-200 meters above sea level. It belongs to the Finnish lake district. Much of the territory is forested and has a low population density. The total area of Central Finland is 19,950 sq km and the land area 16 700 sq km, but the built-up area only 358 sq km. Thus, the share of the densely populated area is only about 2% of the total area. In the Jyväskylä region, this share is about 4%. The length of the area is 240 km and breadth 145 km.

The hilly, forest-covered landscape of the lake plateau is dominated by drumlins and by long sinuous eskers. In all, 80% of the area of Central Finland is covered by forests and 16% by water. On average, there are 40 lakes per 100 square kilometers in the lake district. Lake Päijänne is the largest lake (second largest in Finland). It is 119 km long and 30 km wide. There are numerous holiday cottages and farm holiday locations as well as Europe's largest area of inland watercourses for fishing, hiking and paddling in Central Finland. Water is mostly flowing from north to south, and the majority of them fall into Lake Päijänne which drains into the Gulf of Finland.

Central Finland has been characterized as the "the Lapland of Finnish lake district". The scenery is dominated by uninhabited forest and marsh areas. Agricultural landscape has a minor role. Here and there, there are hills and rapid routes. Central Finland owns the best fishing rapids in southern Finland. In all, Central Finland represents at its best traditional Finnish lake and water scenery and all the attractions around them. This is what the Finns love, a sauna by the shore and a dip in the lake.
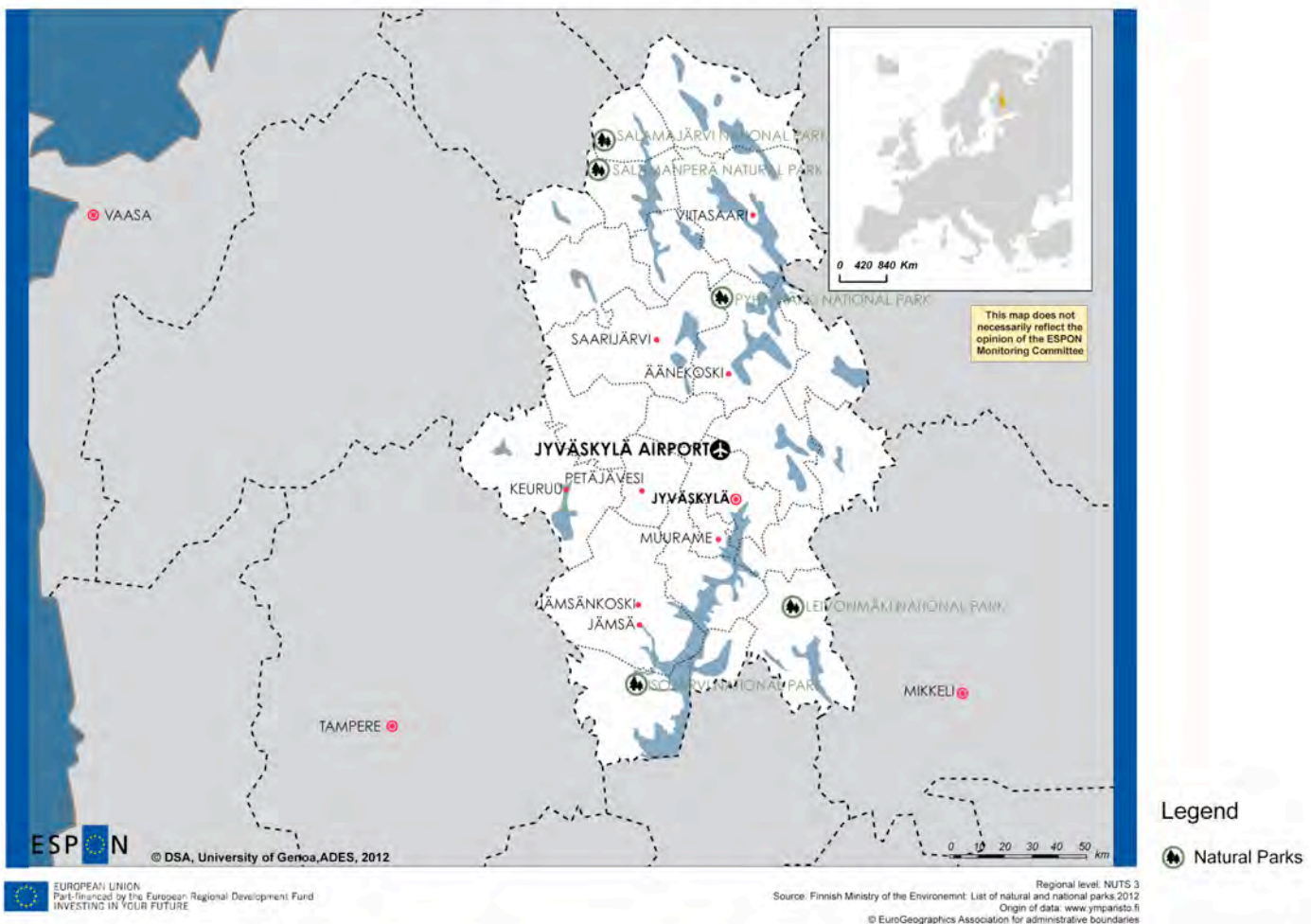
Map 3. Descriptive Maps_ Tourism_Natural Parks

c) Infrastructures and accessibility

Central Finland can be reached by different modes of transportation of which air traffic is one. The Jyväskylä airport is situated in Tikkakoski, 20 km to the north of the city of Jyväskylä. Currently, there are three daily flights between Jyväskylä and the main hub in the capital Helsinki operated by Flybe. Before October 2011, the number of daily flights was six operated by Finnair. A flight to Helsinki takes forty minutes. Both operators, Flybe and Estonian Air, have been supported financially (including marketing activities) by the city of Jyväskylä and regional authorities and other regions. The supply of flight connections from Jyväskylä has been unstable due to unprofitability problems.
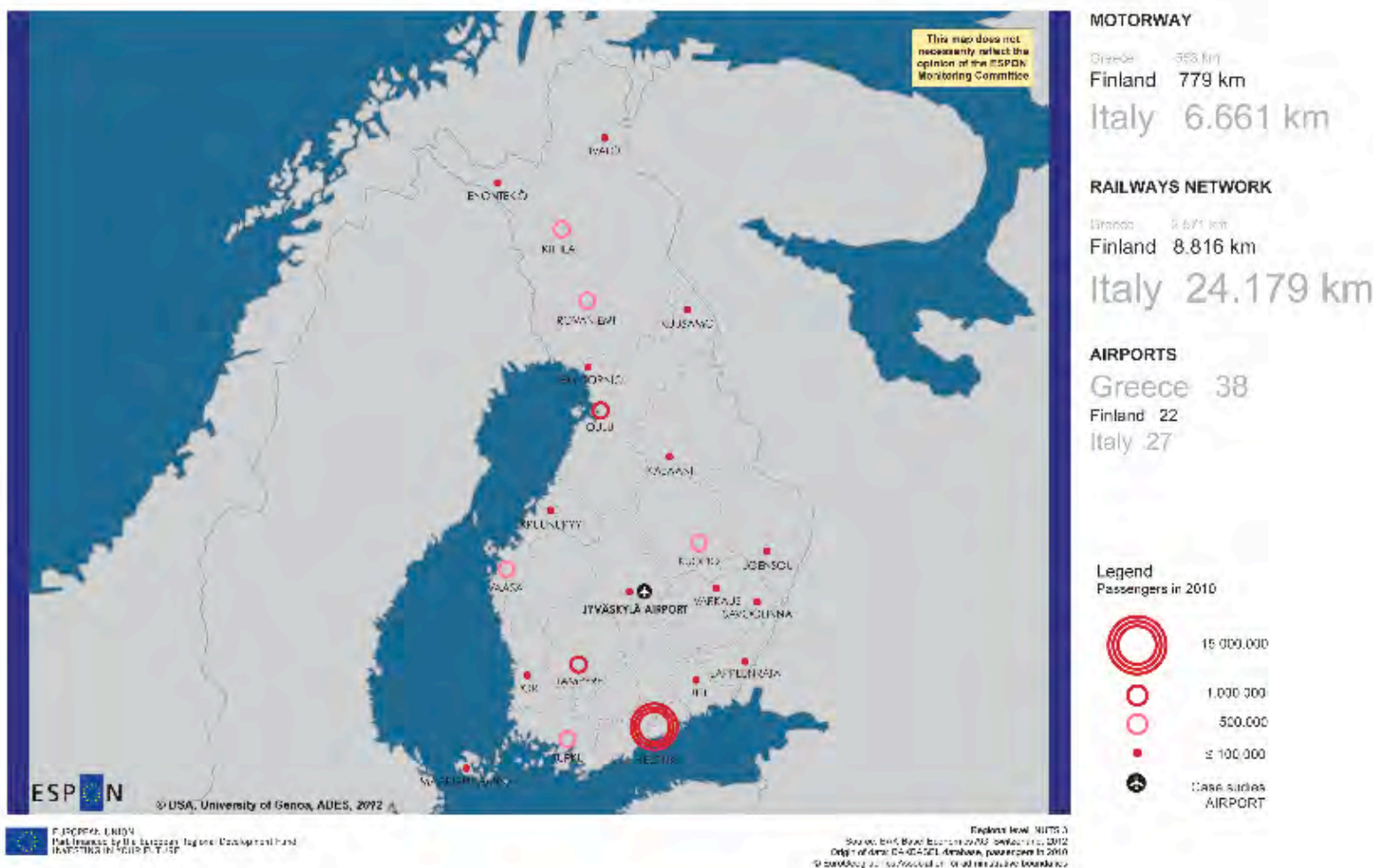
Map 3. Descriptive Maps_Aiports in Finland

There are also a few direct charter flights per year from Jyväskylä to holiday destinations. The airport busses run between Jyväskylä city centre and airport following the schedules of flights. Also regular busses from other parts of Central Finland go via airport a few times a day. According to the users, the airport is rather easily accessible. The nearest airports outside Central

Finland are located in Kuopio, Tampere and Varkaus (120-150 km from Jyväskylä).

The daily railway and bus connections from Central Finland to the capital region and other parts of the country are quite well-organized. There are four railway stations in Central Finland: in Jyväskylä, Jämsä (southern part of the province), Keuruu (western part) and Hankasalmi (50 km to north-east from Jyväskylä). Passenger trains in Finland have at their disposal 4 000 km of tracks. The network interconnects the major Finnish cities. The most important sections of line are electrified. The train connection between Helsinki and Jyväskylä takes some three hours. Due to the improvements in the track network and faster trains, the travel time today is thirty minutes less than it was at the beginning of 1990s. Due to improvements in travel times and convenience, the use of trains has partly replaced the use of airplanes.

Map 4. Descriptive Maps_Infrastructure_Secondary roads

Jyväskylä forms a crossroads for Finland's main highways (highway 4, E75, 9, E63, 13 and 23), which has helped it become an increasingly important centre of road transport. It takes approximately four hours from Jyväskylä to Helsinki by bus and there are several departures per day. The network of bus connections covers the whole Central Finland.

d) Economic trends

Employment in Central Finland covers 5% (approximately 111,000 employees) of the total employment in Finland. Central Finland is an industrial area with approximately 22 000 industrial jobs (one fifth of all employment). The role of manufacturing sector as an employer is more emphasized in Central Finland than on a national level on the average. Special expertise can be found in the fields of paper manufacturing and paper machinery as well as energy production, environmental, information and wellness technology.
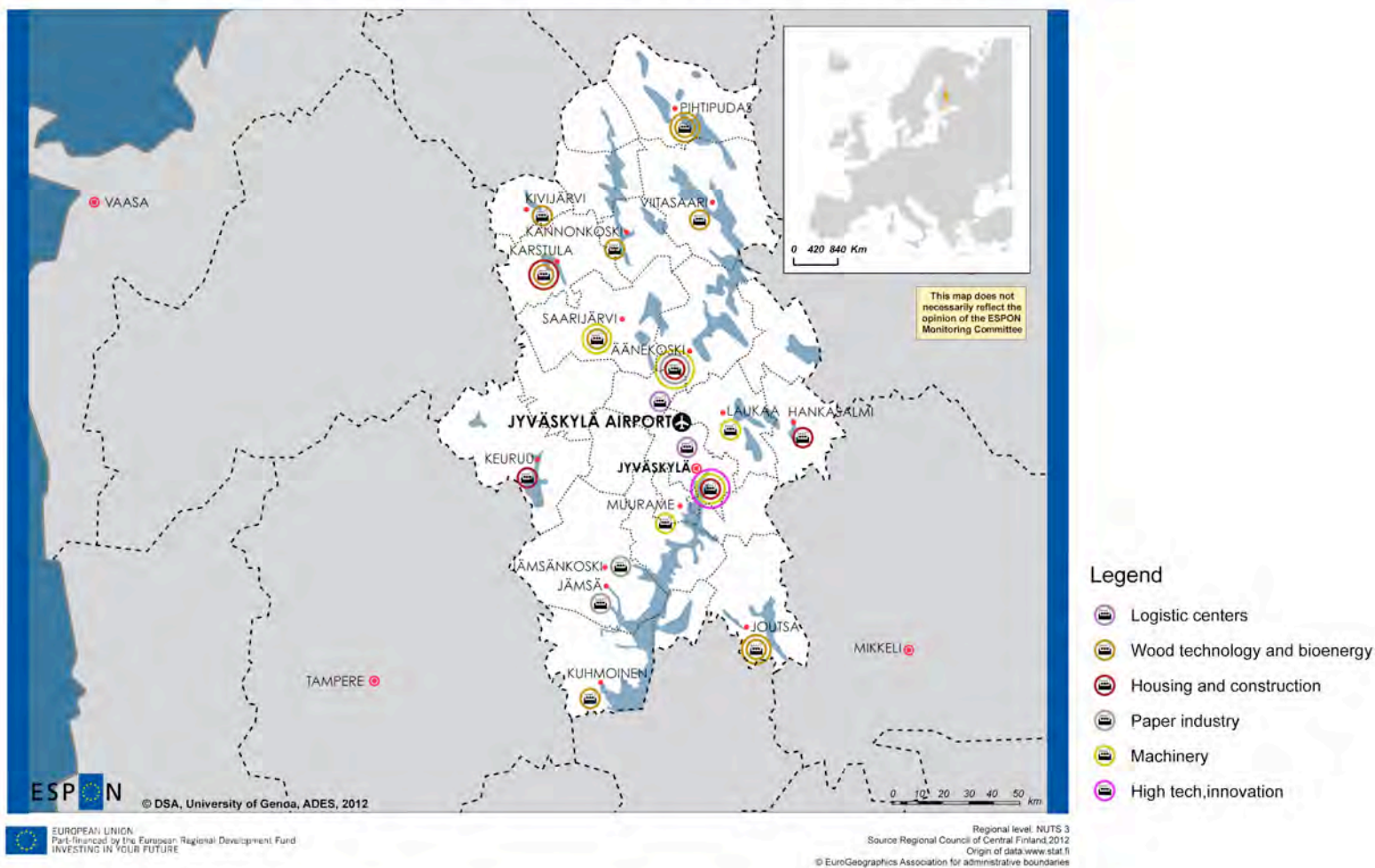
Map 5. Descriptive Maps_ Industry&Commerce_Industrial districts

The service sector is especially strong in the Jyväskylä region (approximately 72% of employment) but its role is also increasing in the other parts of the province (67% of employment). Knowledge intensive business services and wellbeing services, in particular, are rapidly expanding sectors.

The biggest firms in the province are a global major paper machinery supplier Metso Paper Oy with 1,800 employees and Keskimaa Osk with 1,700 employees. The latter engages in retail, tourism and food trade and also owns petrol stations and iron stores. The third biggest company is the UPM-Kymmene Oy that employs approximately 1,400 workers in two paper mills in the Jämsä region. Besides the few large international companies, there are a lot of small firms (less than 50 employees) in Central Finland, 99% of all firms. They employ 65% of private sectors' workers whereas the share of big firms (with more than 249 employees) is 13.5% (in Finland 62% and 16%, respectively).
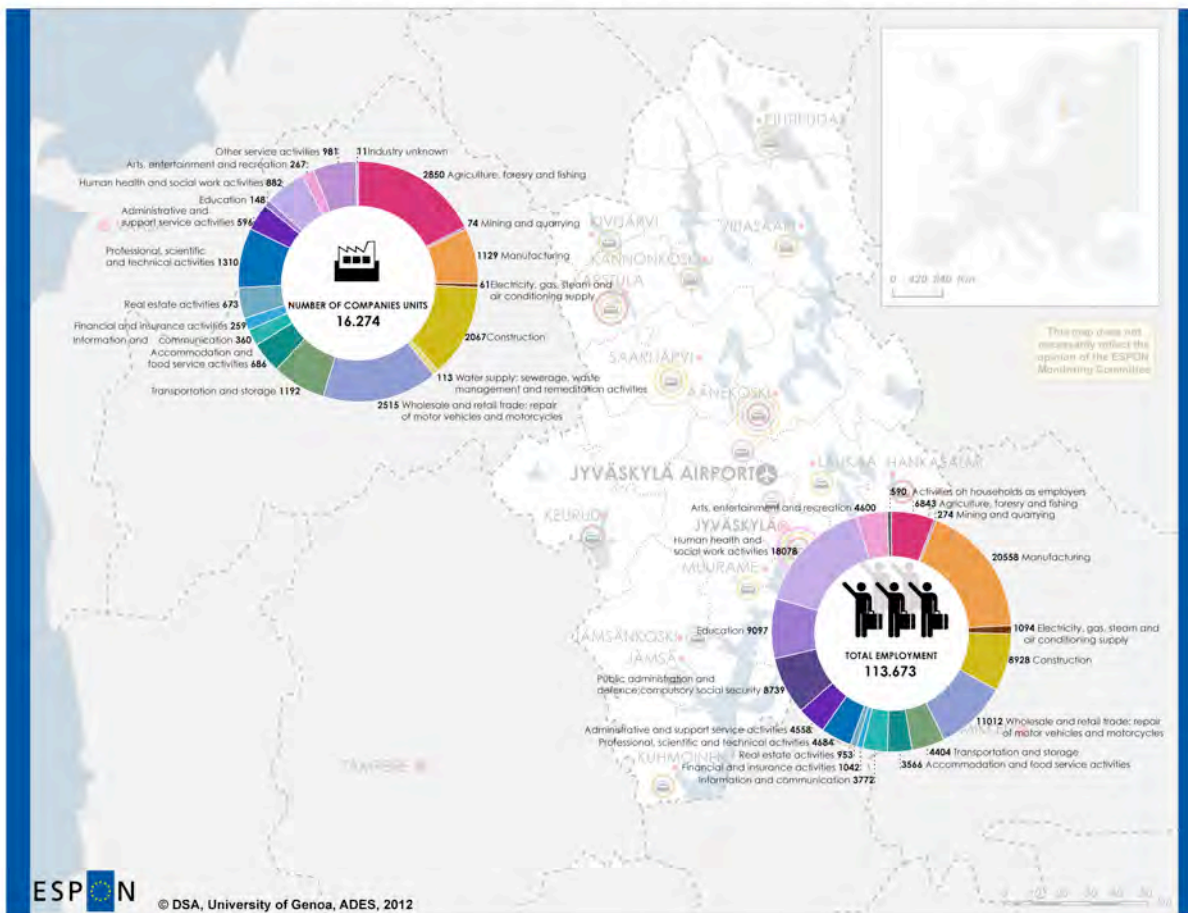
Map 6. Descriptive Maps_ Industry&Commerce_Industrial districts (graphics)

The multi-disciplinary higher education institutions, University of Jyväskylä and Jyväskylä Polytechnic, are also important actors and employers in Central Finland. They employ approximately 3,300 employees and they have 23,000 students. They are among Finland's leading research and higher educational institutions. As a whole, the jobs in the education sector cover 9% of the total employment in the Jyväskylä region.

e) Cultural and leisure services

On the cultural side, Jyväskylä is known by the world-famous architect Alvar Aalto who is widely regarded as one of the greatest innovators in western architecture. Alvar Aalto lived and attended school in Jyväskylä. The Alvar Aalto Museum and the numerous buildings designed by Aalto are to found across the city of Jyväskylä and its surroundings. Other cultural places in Central Finland are Petäjävesi Old Church included on UNESCO's World Heritage List, Keuruu Old Church and Stone-Age Village in Saarijärvi.
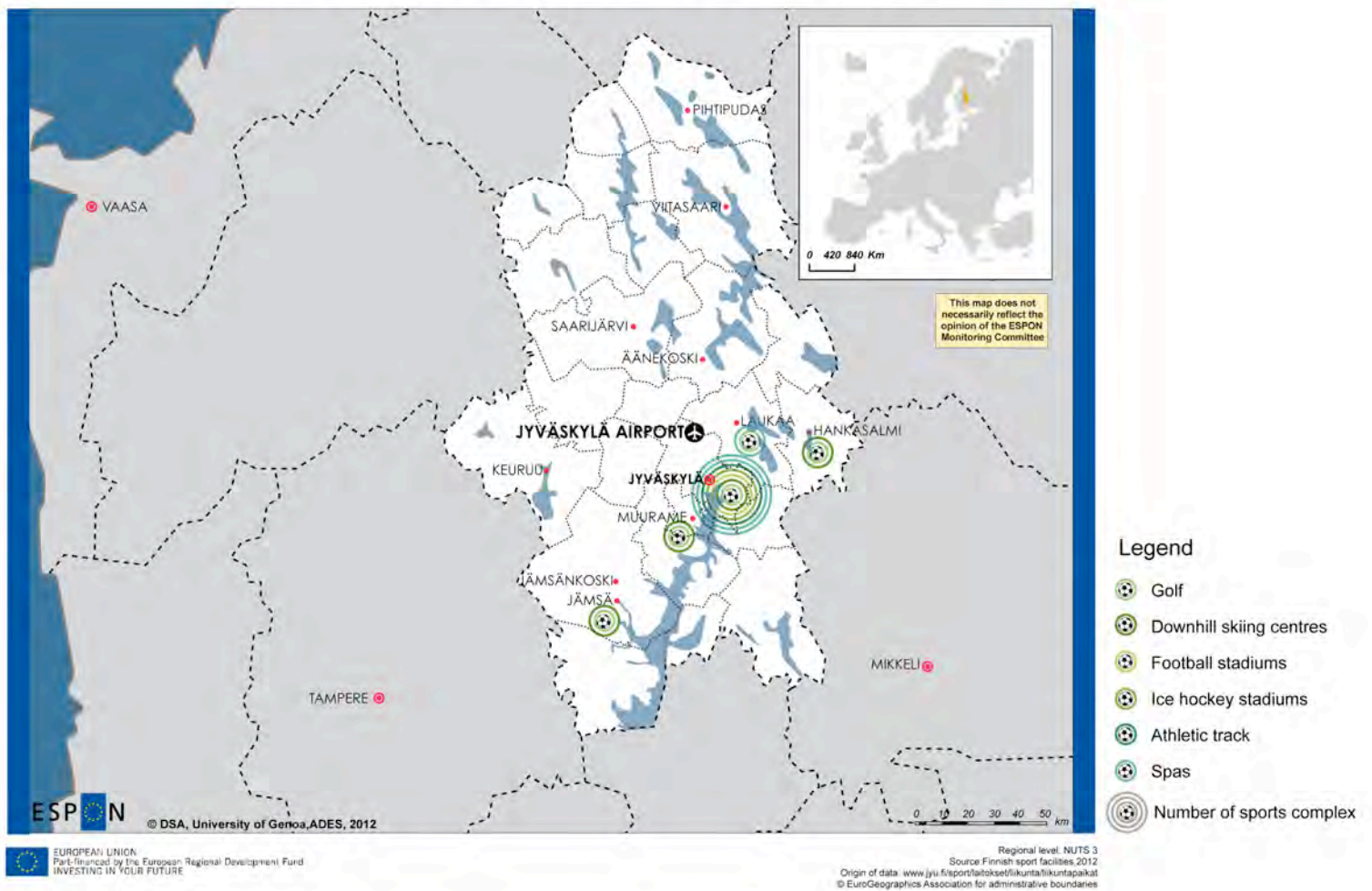
Map 7. Descriptive Maps_Public services_Sport complex

With regard to sport and leisure time activities, there are several downhill skiing centres in Central Finland. Himos, a ski center with the biggest and most comprehensive slopes in Southern and Central Finland, is one of the most popular ski resorts in Finland. It is located in Jämsä. New activities in Himos will include18-hole pay and play golf course where the opening stroke will be hit in the summer of 2013. There are also two smaller skiing centers, Laajavuori and Riihivuori, located in the Jyväskylä region. Other leisure activities include spas. Peurunka Spa provides the versatile sport facilities in Laukaa, 25 km north of Jyväskylä. Laajavuori spa is situated a few minutes' trip from the centre of Jyväskylä.

f) Tourism

There are several national and international events organized annually in Central Finland. For more than fifty years now, every summer, Jyväskylä and Central Finland host the Neste Oil Rally Finland (part of the round of the World Rally Championship) that brings numbers of tourists from Finland and abroad to the area. Jyväskylä is also Finland's second most popular city for fairs and exhibitions and a highly popular venue for congresses and conferences. Jyväskylä Paviljonki Congress Centre houses a wealth of large-scale events in Central Finland.

Paviljonki is situated quite literally in the middle of Finland and of Jyväskylä: it is right next to the railway station, at the intersection of several highways. Each year more than 700 events are organized in Paviljonki and they gather almost 400,000 visitors.

g) History of the airport and passenger structure

Jyväskylä airport was built in 1939 for military needs. Civil traffic in summer time started in 1945 and the year-round flights in 1952. Civil terminal was built in 1960 and it was renewed in 1990. New extension of the terminal was built in 2004. Jyväskylä Airport is maintained by Finavia (a state owned company) like almost all airports in Finland. There are 34 employees working in the airport. Military traffic has a very important role still today, and structural changes of the Finnish Defence Forces will strengthen further the role of Jyväskylä airport in the future. This guarantees that the airport will also provide good conditions for commercial air traffic in the future. In 2011, there were approximately 22 300 operations (take-offs and landings) in total of which 65% were military operations.

The total number of passengers in 2011 was nearly 89 000 passengers (incl. 13 500 passengers in charter flights). In 2000, the number of passengers was as high as 235 200 but after that the number has considerably decreased for which reason the continuation of flights has been threatened several times (Figure XXX). Approximately 80% of the passengers are transfer passengers. The main groups are business travelers (including firms' staff and partners) and foreign visitors of congresses and events. Big companies with international activities are the main users of flights. From the viewpoint of

free time travelling, the Jyväskylä airport is not considered critical - tourists have only a minor role. A new route between Jyväskylä and Tallinn was seen as an opportunity to attract new passengers (also tourists). Based on the passenger statistics, the share of free-time travel in the Tallinn-route was 80% during the first months (Keskisuomalainen, 21.5.2012). The route provided new flight connections to Europe and good possibilities to travel to the direction of Russia, and thus, complemented the transfer connections of Helsinki.
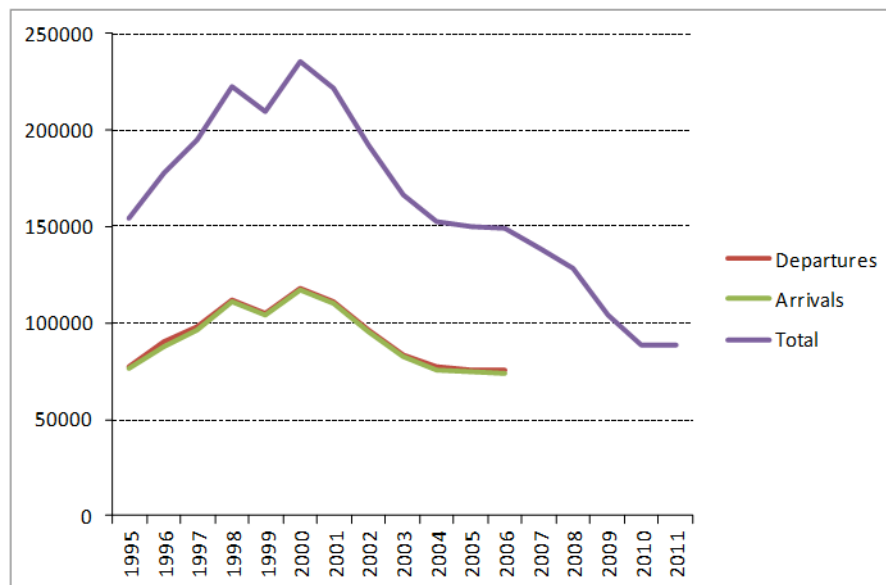
Figure Number of passengers in Jyväskylä airport in 1995-2011

Interviews and questionnaires resume

a) Data collection

To analyze the role and situation of Jyväskylä airport and accessibility in general in Central Finland, data for the case study was collected through interviews and questionnaire in March 2012.

Nine persons were interviewed. They included regional development actors, airport manager and representatives of universities and congress centre:
- Markku Andersson, Mayor, City of Jyväskylä
- Olli Hyvönen, Project Manager (air traffic), Jyväskylä Regional Development Company Jykes Ltd.
- Veli-Pekka Päivänen, Development Manager, Regional Council of Central Finland
- Uljas Valkeinen, Managing Director, Central Finland Chamber of Commerce
- Jouko Varis, Managing Director, Ääneseudun kehitys Ltd.
- Esa Kainulainen, Airport manager, Jyväskylä Airport
- Leo Potkonen, Managing Director, Jyväskylä Paviljonki International CongressCentre Ltd

- Kirsi Moisander, Director of Administration, University of Jyväskylä
- Jussi Halttunen, Rector, Jyväskylä University of Applied Sciences

Questionnaire by telephone was addressed to 100 firms of different sizes locating in Central Finland. An external service provider (research and marketing company Tietoykkönen) carried out the telephone interviews. Firms were classified according to their size into three groups, and random sample was taken as follows:

- 20 micro firms (<10 employees)
- 40 small firms (10-49 employees)
- 40 medium-sized and big firms (>49 employees)

This stratified sample aimed to reach the current and potential users of air traffic. Hence, the role of big firms is over-represented in the total sample compared to the current firm structure in Central Finland that is strongly weighted towards small firms. In the analysis, however, this has been taken into account.

b) Air and other transportation in Central Finland

Central Finland can be reached by different modes of transportation of which air traffic is one. Currently, there are three daily flights between Jyväskylä and the main hub in the capital Helsinki operated by Flybe. Before October 2011, the number of daily flights was six operated by Finnair. A flight to Helsinki takes forty minutes. Estonian Air started a daily direct flight connection between Jyväskylä and Tallinn in March 2013, but it has announced to cease the route as a part of its restructuring program in January 2013. The supply of flight connections from Jyväskylä has been unstable due to unprofitability problems. Currently, both operators, Flybe and Estonian Air, are supported financially (including marketing activities) by the city of Jyväskylä and regional authorities / other regions.

There are also a few direct charter flights per year from Jyväskylä to holiday destinations. The airport busses run between Jyväskylä city centre and airport following the schedules of flights. Also regular busses from other parts of Central Finland go via airport a few times a day. According to the users, the airport is rather easily accessible. The nearest airports outside Central Finland are located in Kuopio, Tampere and Varkaus (120-150 km from Jyväskylä).

The main users of air traffic in Jyväskylä are business travellers (including firms' staff and partners) and foreign visitors of congresses and other events. There are several national and international events organized annually in Central Finland. For more than fifty years now, every summer, Jyväskylä and Central Finland host the Neste Oil Rally Finland (part of the round of the World Rally Championship) that brings numbers of tourists to the area. Jyväskylä is also Finland's second most popular city for fairs and exhibitions and a highly popular venue for congresses and conferences. Jyväskylä Paviljonki Congress Centre houses a wealth of large-scale events in Central Finland. The Paviljonki is situated quite literally in the middle of Finland and of Jyväskylä: it is right next to the railway station, at the intersection of several

highways. Each year more than 700 events are organized in the Paviljonki and they gather almost 400 000 visitors. Universities are also important organizers of congresses and seminars.

The daily railway and bus connections from Central Finland to the capital region and other parts of the country are quite well-organized. There are four railway stations in Central Finland: in Jyväskylä, Jämsä (southern part of the province), Keuruu (western part) and Hankasalmi (50 km to north-east from Jyväskylä). Passenger trains in Finland have at their disposal 4 000 km of tracks. The network interconnects the major Finnish cities. The most important sections of line are electrified. The train connection between Helsinki and Jyväskylä takes some three hours. Due to the improvements in the track network and faster trains, the travel time today is thirty minutes less than it was at the beginning of 1990s. Due to improvements in travel times and convenience, the use of trains has partly replaced the use of airplanes.

Jyväskylä forms a crossroads for Finland's main highways (highway 4, E75, 9, E63, 13 and 23), which has helped it become an increasingly important centre of road transport. It takes approximately four hours from Jyväskylä to Helsinki by bus and there are several departures per day. The network of bus connections covers the whole Central Finland.

c) Importance and development of Jyväskylä air transportation

Air traffic, together with rail and road transportation, is seen as an important part of the regional transportation system in Central Finland. The development of all these three modes of transportation is crucial. However, at the provincial level, the development of road transportation and faster rail connection to Helsinki are more emphasized than air traffic. From the regional development perspective, regional, industrial and transportation policy should be closely connected. For example, if the region would like to be an attractive location for growing international companies, it should be able to provide not only high-level premises and good services to firms but also a well-functioning transportation infrastructure that includes air traffic. With regard to domestic accessibility the air traffic has a complementary role whereas international accessibility of Central Finland is more strongly affected by well-functioning air connections. According to the interviews and inquiry, schedules, reliability and ticket prices are very important for the use of flights. Finnair operated the flights in Jyväskylä for a long time using a high-pricing strategy which is seen as one reason for the declining number of passengers.

The schedules of flights that support usual business meeting times (domestic travel) and provide good connections to transfer flights (international travel) are highly appreciated among the firms and regional actors. Furthermore, a high frequency of flights is particularly crucial as the distance between Jyväskylä and Helsinki is 270 km. The travelling time by train and car from Jyväskylä to the city centre of Helsinki is almost the same as the travelling time by air (incl. waiting time and transitions between centres and airports). Train goes directly to the city centre of Helsinki whereas the Helsinki-Vantaa

airport is situated around 20 km from the city centre (30 minutes transition time).

The annual image surveys comparing the attractiveness of Finnish regions reveal that transportation has a very important role. According to regional actors, air traffic has a particularly crucial effect on the external image of Central Finland. Also, firms in the region (big companies in particular) consider the role of air traffic important for their own image. Besides the image, the international operations of firms are strongly affected by air connections. Firms with international operations and event organizers are supposed to suffer most from poor air connections. According to regional actors, there might be a risk that such key operations of companies as head offices or sales operations move away from the region due to deteriorating air connections.

Those firms that reported the importance of Jyväskylä air traffic to be at least very important from the viewpoint of domestic or international accessibility were analyzed more thoroughly. In line with the expectations, especially big firms (with more than 100 employees) appreciate air connections from Jyväskylä. They also use air transportation more than other firms. It also turned out that the turnover of many of the firms appreciating air transportation has been increasing. Accordingly, it seems that the growth firms in particular are most dependent on air connections. The international accessibility through air connections is important for export firms and firms having operating units abroad. Their international business contacts require well-functioning transportation. In all, although the number of the firms which are dependent on effective air transportation in Central Finland is not very high, their significance to the economy of the region is crucial.

Regional actors in Central Finland, and in the Jyväskylä region particularly, have made a strong joint effort to maintain air connections in the region. This includes one year financial subsidy to airline operators which aims at supporting the starting phase of the operators. Thus, the financial support is seen only temporary. The most acceptable way to support air traffic is considered to be an encouragement of firms' and other organizations' staff to use air connections actively.

Due to the location of the airport, a development of new economic functions or services to the airport or to its surroundings is not generally seen very important. The land use plan covering the airport area was prepared in 1992, but thus far only the supermarket chain Lidl has built a large distribution centre in the area. The area might provide a good location for logistics firms, for example, but this scenario does not seem to be very probable. The services provided currently in the airport seem to be satisfactory and there are no expectations for additional services. According to regional authorities, opening new destinations in addition to Helsinki (and Tallinn) is not seen possible at the moment because there is not enough user potential in the region. According to some firms, however, the new destinations could be to the direction of Northern Finland and e.g. to Stockholm, Copenhagen or Frankfurt.

d) Alternatives for air transportation in Jyväskylä

According to the results, the Tampere airport is the most relevant competitor for the Jyväskylä airport. Distance from southern Central Finland to Tampere is almost the same than to Jyväskylä airport. Tampere is attractive, especially due to its comprehensive supply of direct abroad flights. In addition, a cheap flight company Ryanair operates there.

With regard to domestic traffic, a car and a train are the most important competitors for flights to Helsinki. A train to Helsinki is relatively fast, ticket prices are moderate and there are several daily connections. In addition, a train provides good conditions for working. A car is the principal means of transportation used by firms. It is regarded as an attractive alternative because of good road connections, reimbursement (0.45 Euros per kilometer) and the privacy it provides (e.g. for making calls). The results also reveal that meetings in Helsinki have increasingly been replaced by ICT solutions like web conferences and telephone meetings. With regard to international travelling, the transfer flights between Helsinki and Jyväskylä are, however, considered important.

e) Future of air transportation in Central Finland - SWOT analysis

Based on appropriate documents, in-depth interviews and structured questionnaires, the SWOT analysis about the future of air traffic in Central Finland is presented below. The SWOT analysis summarizes the current situation of the airport in Jyväskylä (strengths and weaknesses) and shows rated options for possible futures (opportunities and threats)

Strengths	Weaknesses
• Jyväskylä region one of the growth areas in Finland • Strong cooperative atmosphere among regional actors with regard to air traffic development • Strong role of military operations in the airport which secures good conditions for commercial air traffic • Large international universities in the area provide user potential • Several congresses, trade fairs and other events organized annually in Jyväskylä • Competitive prices of flights • Quick security checking in the airport (saving time)	• Number of population in the coverage area of airport not very high • Low use of flights in the domestic travel (flight schedules do not support the needs of many users, e.g. with regard to business meetings) • Reliability of flights weak from time to time • Train and car are competitive alternatives with air traffic, since the distance between Jyväskylä and Helsinki is only 270 km • Location of southern Central Finland close to Tampere airport • Earlier high-pricing policy had

	negative effects on travel behavior (the use of flights) • Low number of tourists visiting the region • Unstable situation of the flights (future is unsecure) • Only few big international companies operating in the region
Opportunities • More companies with international activities and growth potential will locate in the region • Cheap airline company opens a route from Jyväskylä • New direct route from Jyväskylä to a European hub would be opened • Increasing the number of daily flights which attracts gradually more passengers • Employers in the region encourage intensively their staff to use flights	**Threats** • Ceasing financial support to airline companies will halt the flights • Increasing role of ICT-solutions decreases the need for travelling • Quicker train connections decrease the use of air traffic • Low frequency of flights encourage to the use of other modes of transportation (which may also have an effect on adopted travel behavior) • One or more key users (companies) of flights leave the area or close down important operations with regard to the use of air transportation

Table . SWOT Analysis– Future of air transportation in Central Finland

f) Political implications of the results in Central Finland
A summary of the main results and conclusions of the case study was delivered to regional actors and all interviewed persons in August 2012. The timing of publishing the results was opportune, since the city and other regional actors have to decide on their upcoming policy related to the development of air transportation in Central Finland. The results were utilized in this decision-making as well as in future plans of transportation of the region.

3.5 Context of Western Greece: Western Greece

a) Geographical location
The Region of Western Greece stretches from the northwest part of the Peloponnese to the western tip of the Greek mainland. It is one of the 13

Regions of Greece, is separated in 3 administrative districts, the Prefectures of Aitoloakarnania, in Central Greece and Achaea and Elia in the Peloponnese, which are further subdivided into 19 municipalities. It covers an area of 11.350 square kilometres (8,6% of the total area of Greece) and the administrative capital of the region is Patras. For the most part the terrain is mountainous (45,3%) or hilly (25,6%), while only 29,1% consists of plains. All three prefectures have extensive coastal areas along the Ionian Sea and the Gulfs of Ambrakia, Patras and Corinth.

According to the 2001 census, the population of the Region of Western Greece is 741,282. This makes it the fourth most populated Region of Greece, with 7% of the country's total population. The West Greece region was established in the 1987 administrative reform. With the 2010 Kallikratis plan, its powers and authority were redefined and extended. Along with Peloponnese and the Ionian Islands regions, it is supervised by the Decentralized Administration of the Peloponnese, Western Greece and the Ionian Islands based at Patras. Major communities of the region are Mesolóngi, Agrínio, Aígio, Amaliáda, Pátra and Pýrgos.

Today the Region of Western Greece is a modern communications and transport hub that connects Greece to the rest of Europe. The busy port of Patras is not only the Region's capital but also the country's main gateway to Western Europe.

Distance of Patras to other cities in Greece	Distance of Patras to other European cities
To Athens (capital): 211 km	To Paris: 2350 km
To Ioannina: 226 km	To Rome: 1100 km
To Thessaloniki: 472 km	To Brussels: 2800 km
To Alexandroupolis: 781 km	To London: 3150 km
To Heraklion: 541 km	To Berlin: 2300 km

b) Landscape
For the most part the terrain is mountainous (45,3%) or hilly (25,6%), while only 29,1% consists of plains. All three prefectures have extensive coastal areas along the Ionian Sea and the Gulfs of Ambrakia, Patras and Corinth.

In the northern area of the Delta of Acheloos numerous riverside forests are preserved, remnants of the vast forests that once existed in these areas. The forests are formed by plane trees (Platanus orientalis), Kavakia (Populus nigra), Klithra (Alnus glutinosa) and various bushes, such as Armyrikia and Ligaries.
The mountain of Panachaiko reaches 1.926 meters of altitude. The rivers of Glafkos and Selinounta are the natural borders of the mountain. It is characterised by the alternation of two types of biotopes, mountain meadows and heaths, while numerous species of birds and mammals live in the area. Moreover, it has joined the NATURA 2000 network in order to preserve the habitats and the wild fauna and flora.

The cave of the lakes is situated close to the village of Kastria and constitutes a rare creation of the nature. Apart from the labyrinth of corridors, mysterious rooms and strange stalactite formations, the 'Cave of the Lakes' has repeated graded and even three-floor-lakes, which highlight its uniqueness in the world. During winter, when the snow melts, the cave is converted into an underground river with natural waterfalls. In summer months it is partially dry and reveals a lace-work of stone basins and dams. The rest of the cave reserves water permanently in thirteen lakes. The developed length of the cave, which is ideal for a visit, is 500 feet. In the lower level fossilized human and animal bones including hippopotamus were found.

The gulf of Kyparissia is marine area expands from Cape Katakolo to Kyparissia, a town in western Peloponnisos and belongs to NATURA network. The substrate is sandy and the seabed is covered by fine-grained sand with scattered eroded calcareous rocks. Wide beaches of fine sand are backed by dunes along the coastline. The bay is not deep. Patches of Cymodocea nodosa in the shallows are followed by the beds of Posidonia. The latter are very well developed with high density population and robust plants. On the calcareous rocks a few species of macrophytes grow. The beds of Posidonia in the site are probably the best developed of all around Peloponnisos. They constitute an unseparable part of the marine ecosystem as they offer ground for fish to lay eggs, to find food and shelter. Studies have shown that the adjacent sandy beaches of the bay are very important nesting areas for the loggerhead turtle Caretta caretta.

Beaches awarded the blue flag for 2011 in the region of Western Greece are in Ileia, Skafidia, Kourouta, Kastro/Chryssi Akti, Loutra Kyllinis 1 and Loutra Kyllinis 2. In Achia, instead, are Kalogria, Lakkopetra, Alyki, Psani and Grimbovo.

The Prefecture of Arta with the Preveza Prefecture promotes the project "Management, restoration and enhancement of wetland of international importance Amvrakikos Gulf", which has been approved under the Program of the EOX Financial Mechanism (Financed by 75% from XM and 25% by PDE). The Development Agency of South Epirus Amvrakikos SA Municipality (ETANAM SA) constitutes the technical and scientific supporter of the project, which is a continuation of activities implemented under the LIFE Nature and INTERREG II, prepared and submitted for funding by ETANAM SA Local Authorities and the Prefectures of Arta and Preveza. The wetland of Messolonghi – Etoliko and the Delta of Acheloos and Evinos is one of the most important wetlands in the Mediterranean, situated at the westerner edge of the mainland of Greece in Aitoloakarnania. Its area covers 250,000 acres

and has been created over the years from the debris of the two rivers.

Map 8. Descriptive Maps_Tourism_Natural Park

The cultural heritage is, of course, one of the major actaction of Greece. It is reflected in archeologic places and temples. In particular, in Western Greece is possible to visit the archaeological museums of Agrinio, the Temple of

Zeus and the Ancient Theater of Staros. The temple of Lafria Artemis and Lafrios Apollo constitutes a very important sanctuary in ancient Calydonia, which is known as Lafriaio and where Artemis and Apollo were worshiped. In Patra, the ancient Odeum of Patra is located in the West of the Acropolis, in the upper city of Patra and was built at an earlier date than the Athens Odeum (Herodion 160 AD). Earthquakes, wars and invaders destroyed the odeon and covered it with soil and other buildings.

The Ancient Olympia, a sanctuary of ancient Greece in Ilia, is known for having been the site of the Olympic Games that were held every Olympiad (every four years). The first Olympic Games were in Olympia in honor of Zeus.

Another cultural attraction that reflects another age is the Ottoman castle of Rio is located at the north edge of the Rio peninsula in the prefecture of Achaia, at the entrance of the Corinthian Gulf. Today it is used for cultural purposes, especially for concerts and it is a tourist attraction.

c) Infrastructures and accessibility

The Region of Western Greece is situated in a strategic geographical position, connecting the Peloponnese with Central Greece and Epirus and constitutes one of the main gates of the country. With regard to transport infrastructure, the strategic development of the previous programme periods has led to considerable improvement of the Region's infrastructure.

The road network of the Region is particularly extended and continually improved (Map 12). The central road that connects the city of Patra with Athens is part of the basic national axis (axis Patra-Athens - Thessaloniki - Evzoni) and belongs to the European network. The national network extends to 895 km, while the provincial road extends to 3,520 km. On the coast and lowlands, it is developed, however it is relatively insufficient, both quantitatively and qualitatively, in less favored mountainous areas. Among the major technical works that have been completed in the Region, the most important was the connection of Rio- Antirio through the homonymous suspended bridge of 2.5 km that connects Peloponnese with the mainland. Through this work, the whole transport system of Western Greece was upgraded.

The Region's rail network has a length of 300 km and crosses the coastal zone of Achaia and Ileia through the connection of Athens- Patra- Pyrgos- Kalamata. In addition, there is the picturesque railway that connects Diakopto with Kalavryta and constitutes a tourist attraction. Apart from the above mentioned rail network, there is also the connection of Kiato with Patra, a work that is being constructed during the last years.

The airports (Map 9) that serve the Region of Western Greece are military and are located in Araxos, in Aktio and in Andravida. However, they have the appropriate infrastructure to serve commercial flights and charter. The potentials of the existing airport infra are considered to be out of date, regarding the operational data of the aircraft areas (runways, tracks for aircraft parking), the building installations as well as other facilities.

Greece_Airports
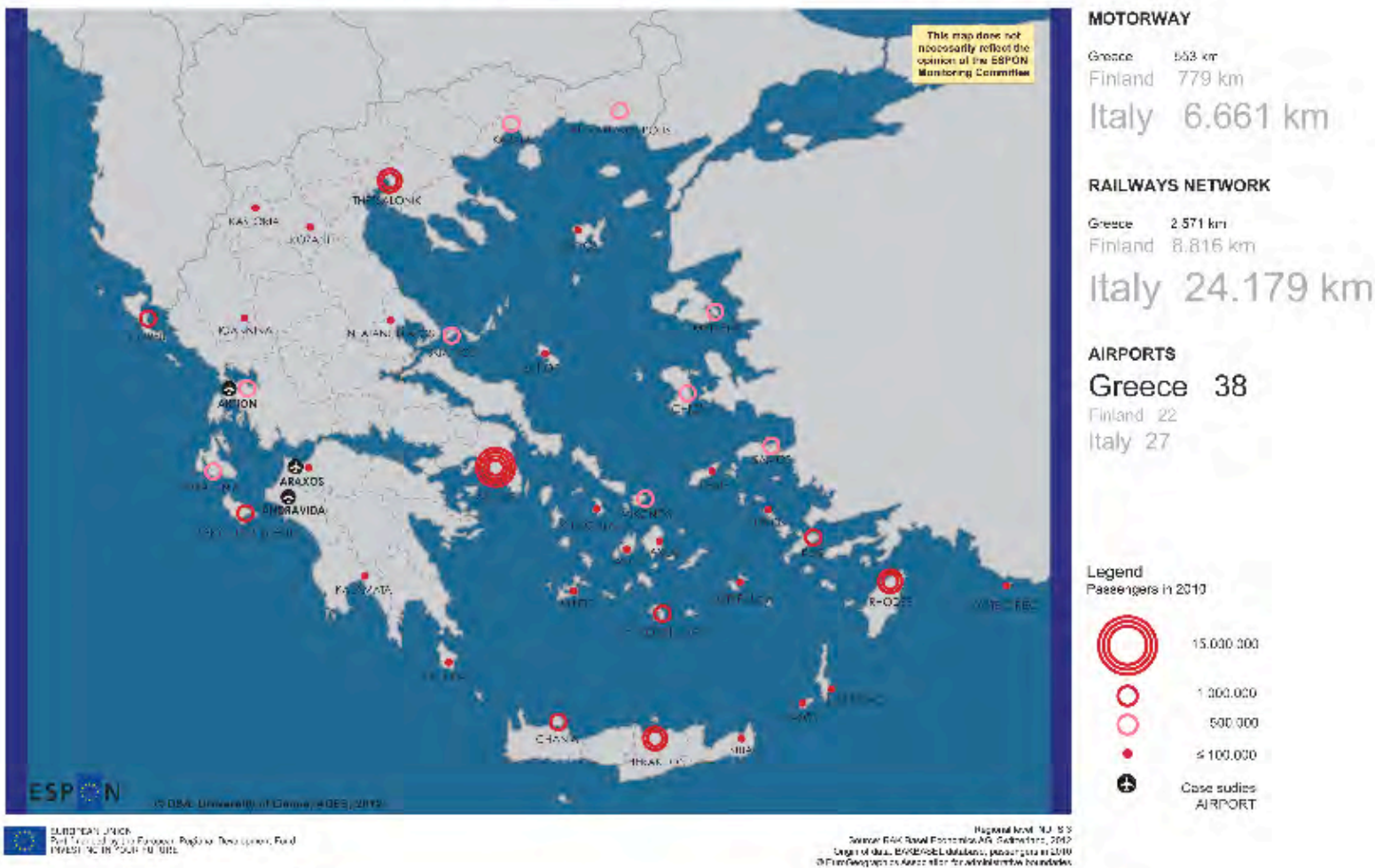
Map 9 Descriptive Maps_Aiports in Greece

As far as port infrastructures are concerned, the port of Patra in Achaia dominates because of its strategic position, being the Western Gate of Greece towards Adriatic and West Europe. The harbour's infrastructure can serve cargo of up to 25,000 tons, and passenger ships of up to 16,000 tons and 220 meters long. Other important ports of the Region are those of Aigio, Kyllini, Katakolo, Messolonghi, Astakos and Amphilochia.

Infrastructure 🚗 Secondary roads
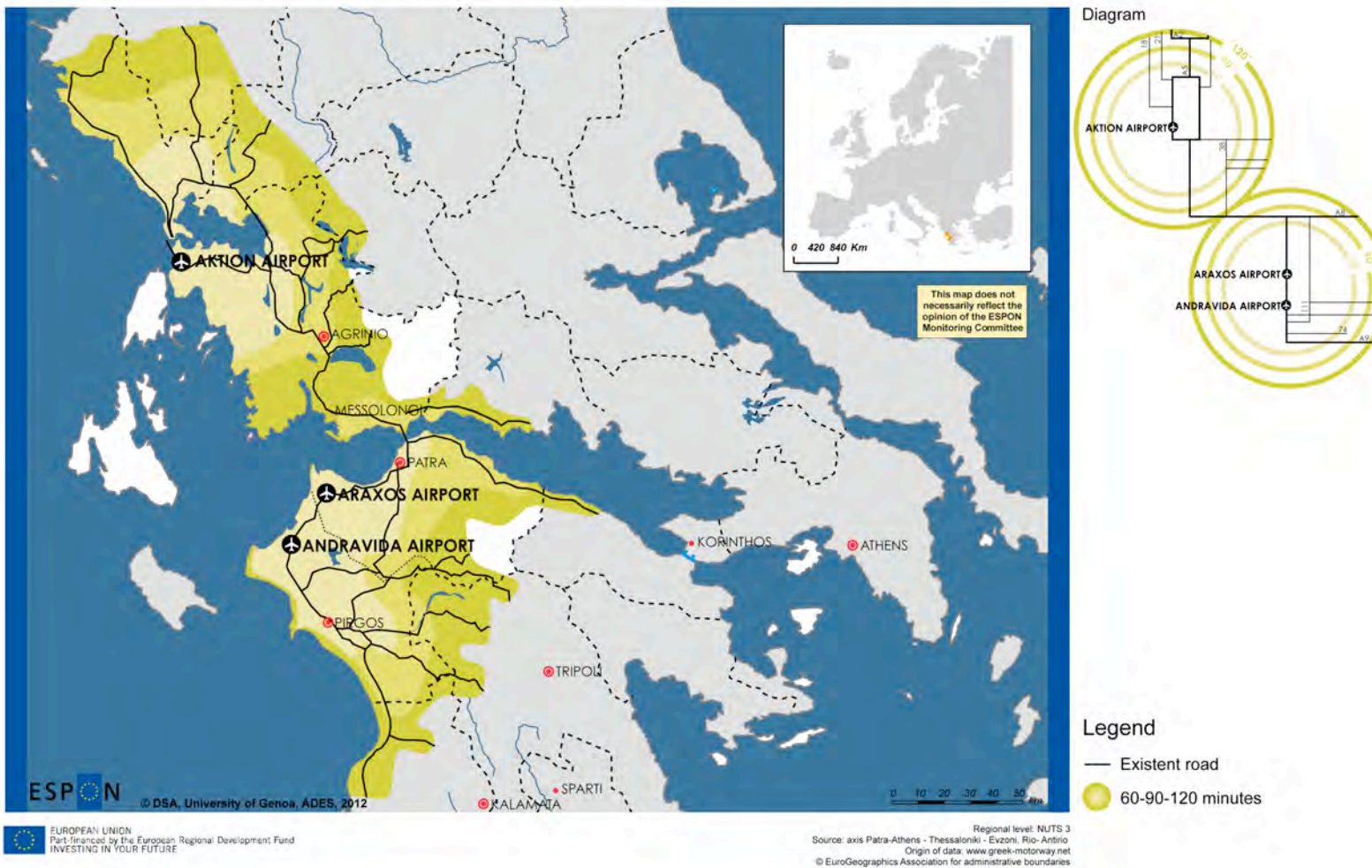
Map 10 Descriptive Maps_Infrastructure_Secondary roads

d) Economic trends

Employment in the region of Western Greece in around 75%, and approximately 40.000 firms operate in the region. Employment is mainly concentrated on the primary economic sector (especially in agriculture), since almost 25% of the regional population is employed in this sector. However the uprising economic sector in the region is tourism. Manufacturing firms have limited.

The industrial discrict (Map 11) of Patra- Achaia is composed by different types of industries, in particular food and beverage, leather and fur clothes, tires and plastic products.

Industry&Commerce_Industrial districts

Legend
- Products of processing materials
- Transport
- Machine and mechanical equipment
- Cosmetic industry
- Metals and metalic pruducts
- Naval industry
- Agricolture and industrial products
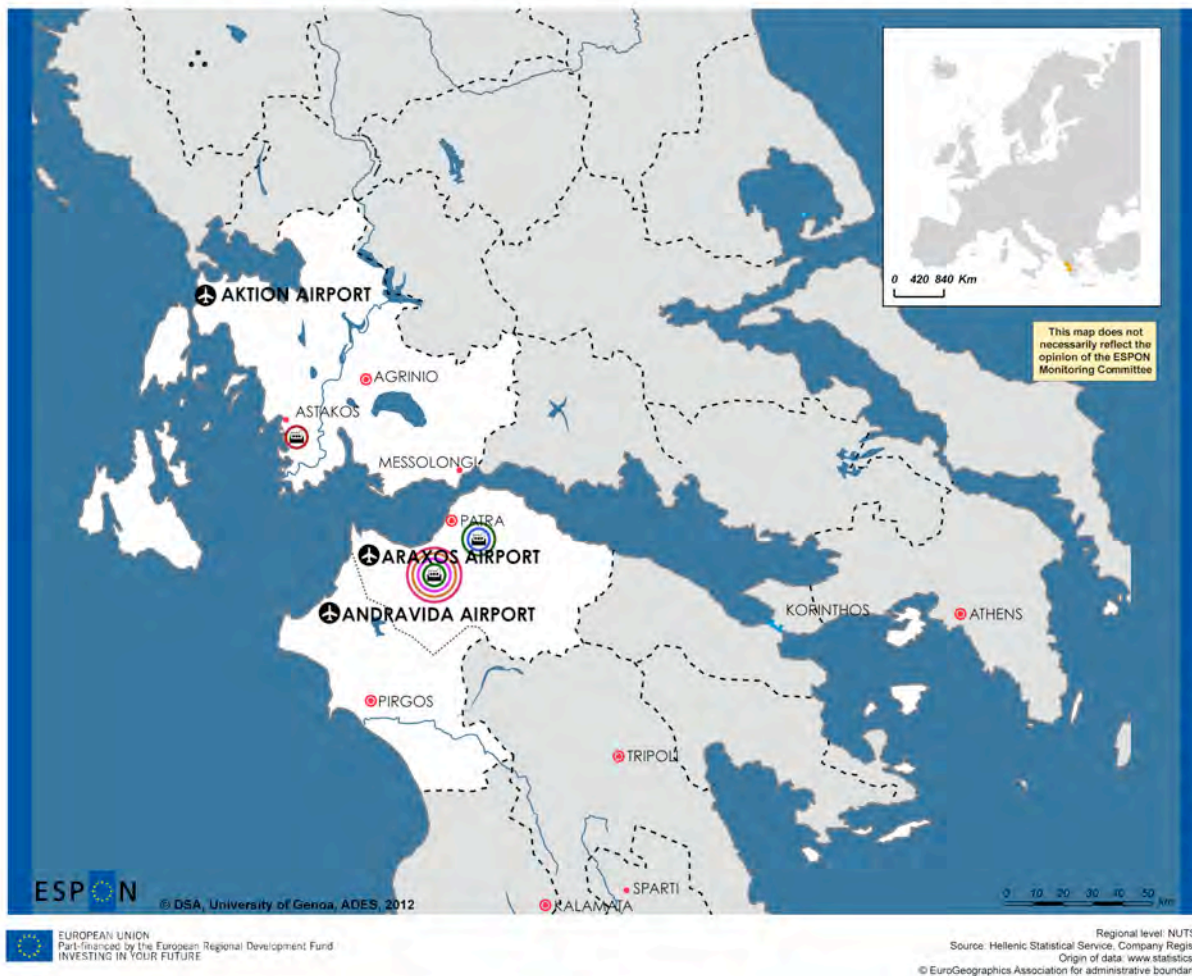
Map 11. Descriptive Maps_ Industry&Commerce_Industrial districts

Also in Western Greece are produced electrical equipment, metal products and constructions, petroleum products and, finally, building materials and prefabricated buildings. There are also many companies engaged in manufacturing of furniture, decorative products, bottling liquid gasses and chemicals.

Imports and exports of agricultural products produced in Western Greece are principally maize, potatoes, lemons, barley and apples. Moreover in the region are traded beef, pork, milk and other dairy products, like cheese.

The *Industrial Systems Institute (ISI)* was established in Patras on February 1998. The main aims of ISI are the active participation and substantial contribution at high-technology sectors, which relate to integrated industrial systems, with the objective of increasing the competitiveness of the Greek industry, through application of state-of-the-art technologies.
Among the general aims of ISI are implementation of applied and

technological research, development of methodologies, products and services, relevant to scientific and technological sectors of particular interest, such as information and communication systems for production processes, modeling and automation of industrial systems, contemporary methods and production technologies, management / design of production systems, electronic systems, intelligent microsystems, machine vision, and information technology for production processes.

Industry&Commerce_Industrial districts_Companies&Employees
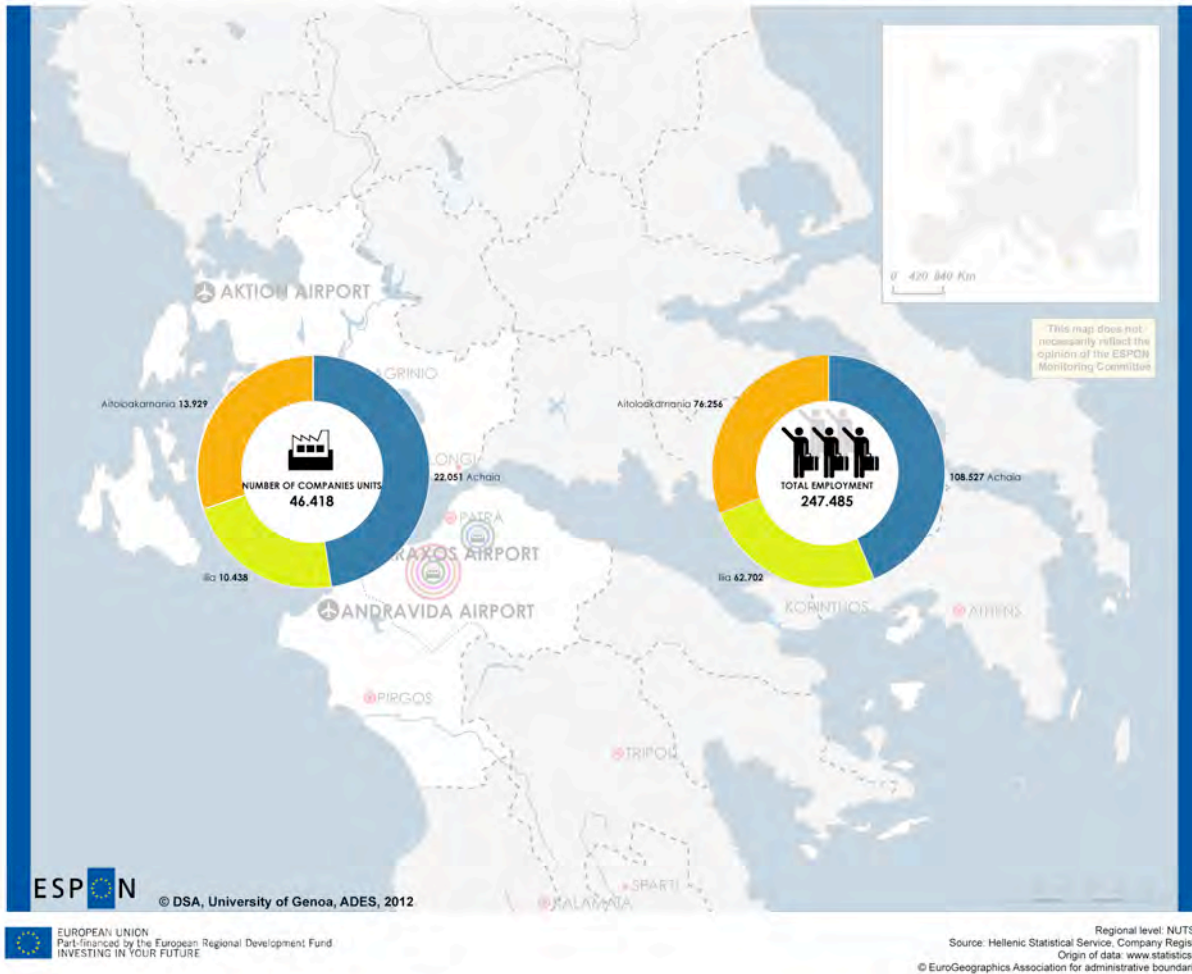
Map 12. Descriptive Maps_ Industry&Commerce_Industrial districts (graphics)

Patras Science Park (PSP) is an active organization established 15 years ago. Today, a remarkable number of new and strong enterprises are operating under the auspices of PSP, most of them are inventors, adepts and users of new technologies, and PSP deserves to look forward in the future with trust and optimism. The strategic target of PSP is to establish an Innovative Business Area in the Region of West Greece, which will be a development and guidance tool for this Region towards the "rising innovative economic-productive frame" by facilitating – additively and alternatively- new economic, productive and business activities in the region. Thus, it aims at

contributing essentially to the "innovative area" prominence.

Industrial Systems Institute (ISI) and Patras Science Park (PSP) are also research institutes.

e) Cultural and leisure services
In Western Greece, the University offer is divided into University of Patra, Hellenic Open University, Technological Educational Institute of Patra, and Technological Educational Institute of Messolonghi.
University of Patra is mainly a scientific school and is divide into School of Natural Sciences, School of Engineering, School of Health Sciences and School of Humanities and Social Sciences. Hellenic Open University is formed by different structures, in particular The School of Humanities, School of Social Sciences, Science & Technology and Applied Arts.

There are also research institutes located in the region, such as Computer Technology Institute and Press "Diophantus", Institute of Chemical Engineering and High Temperature Chemical Processes (ICE-HT).
The *Computer Technology Institute and Press "Diophantus" (CTI)* has its headquarters in the city of Patra. A particular emphasis is placed on education, by developing a conventional and digital media in education and lifelong learning; publishing printed and electronic educational materials; administrating and managing the Greek School Network; and supporting the organization and operation of the electronic infrastructure of the Greek Ministry of Education, Lifelong Learning and Religious Affairs and all educational units. *Institute of Chemical Engineering and High Temperature Chemical Processes (ICE-HT)* comproses institutes all around Greece. This institute conducts fundamental and technological research that is focused on cutting-edge areas of science, specific needs of industry and the environment.

In Patra there are also two sports complex: Pampeloponisiako Stadium and National Sports Center of Patra "Tofalos". The main facilities are track, football fields, indoor basketball, volleyball, indoor swimming pools, tennis fields and indoor gym. There is another sport complex in Nafpaktos (Aitoloakarnania), Pancharalampio National Stadium of Nafpaktos, with a stadium and open - air fileds.

Public servicies_Sport Complex

Map 13. Descriptive Maps_ Public servicies_Sport Complex

f) Tourism

The Region of Western Greece is ranked among the privileged areas of Greece in terms of existing natural, cultural and tourism advantages. Its strategic position with key advantage the fact that it is the western gateway of the country, its rich cultural heritage, the archaeological treasures of ancient Olympia, the countless natural attractions of the inland and the mountainous areas, the large areas and the purity of the sea, the rich and rare ecosystems, the monasteries, the modern sports facilities, the convention centers, the growing and modernized tourist facilities compose a variety of comparative advantages.

The infrastructure of the region has been upgraded to a large extent due to the Olympic Games. The majority of the projects was completed as well as those that were in the implementation phase, supporting the development of tourism.

Its climate has hot summers and mild winters. Sunny days dominate during the summer months in areas within the beaches and partially cloudy and rainy in the mountains. Snow is very common during the winter in the mountains of Erymanthus, Panachaicus and Aroania. Winter high temperatures are around the 10 °C mark throughout the low lying areas.

Furthermore under the *Regional Operational Programme*, under the priority of Tourism several actions aiming SMEs have been enhanced: the modernization of tourism enterprises, the improvement of the quality of services, the enrichment of the composition of tourism product and the development of new tourism products with high added value, reducing seasonality. The maintenance and enhancement of competitiveness of tourism businesses and destinations and therefore the tourism product, impose new rules and new forms of strategy, management and administration, and new modern information tools of the international economic and tourism market. In a tourism market saturated with similar products and standard tourist packages (sand-sea-sun), the Region of Western Greece has the unique ability to offer modern alternative forms of tourism, high quality, developing innovative products and services. More specifically in the prefecture of Achaia: City Tourism, Conference-Sports-Religious-Marine tourism. In the prefecture of Ilia: Spa-Marine-Archaeological-Cultural tourism. In Aitoloakarnania: Agrotourism-Ecotourism-Sea-Diving-Guided Diving tourism etc.

This role will be developed by Tourism Development Region of Western Greece, which has a leading role in the future of tourism in the region. It aims at coordinating activities and processes of all entities that serve the tourist development of the region, contributing significantly to local economic development and based on the overall strategy of the Ministry of Tourism in conjunction with the selection of the Region of Western Greece for mild tourist development (along with an emphasis on alternative forms of tourism) and highlight areas of tourist interest. All the strengths and comparative advantages are highlighted, so that the tourists leave the area completely satisfied and having a vivid recollection of the region. The effort to upgrade the tourism profile of the economy of Western Greece coincides with the effort to introduce alternative forms of tourism in specific parts of the market. Moreover, the improved composition of service quality in all sectors of tourism enterprises will contribute to expanding the tourism season by promoting and highlighting new destinations that will satisfy modern and demanding needs.

The high targets and optimism that exist in this effort due to the comparative advantages, the plurality of destinations and services, the human resources of the region, the unifying role under the umbrella of the region for the three counties, the creation of modern infrastructure, as well as the scientific and technological background that is developed between the Research / Technology and Business entities support the role of the Region in the management and implementation of innovation.

g) History of the airport and passenger structure
The three airports operating in the Region of Western Greece share a common background. All three were initially targeted to serve military needs. From the three airports, Aktion, Araxos and Andravida, the first two now offer both military and civilian transport services. The third one remains a solely military one but the usage of the airport for civilian transport is also

considered. All three airports have a satisfactory capacity, especially the Aktion airport which can be used by any type of airplane. They operate under governmental rules implemented by the Hellenic Civil Aviation Authority (HCAA), along with the Hellenic Air Force Command. The airports of Aktion and Araxos serve mainly national routes, with the exception of international routes during the summer months, in order to facilitate touristic services. To this end a significant amount of the international flights are chartered ones.

According to data provided by HCCA, the airport of Aktion served 311.000 passengers in 2009 and is expected to rise to 665.000 by 2035. The airport of Araxos served 82.000 passengers in 2009 and is expected to rise to 197.000 by 2035. The airport of Andravida is expected to have a dual usage in the next few years and is expected to serve 35.000 passengers by 2035. Major projects that involve the airports of Aktion and Araxos include the increase of the air station to double the current size and increase of the runaway length for both of them.
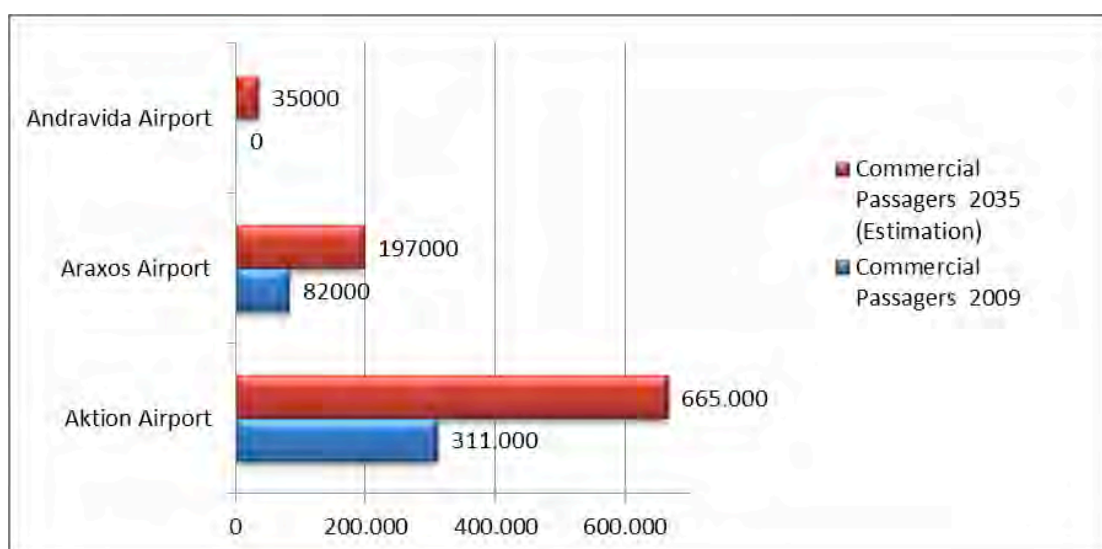
Figure 1: Current and future estimation of civilian passangers served per airport in the Region of Western Greece

Interviews and questionnaires resume

a) Data collection
In order to analyze the role and situation of the airports and accessibility in the Region of Western Greece data was collected by usage of a structured questionnaire, administered to firms operating in the region and semi structured interviews with stakeholders. The data was collected through the second quarter of 2012.
Five interviews were conducted with representative regional authorities, representatives of the Ministry of transport, transportation experts, and regional actors.

List of interviews:
- Dr. Michalis Mandas, Transportation Systems and Logistics Laboratory

- Mr. Theodoris Dionysopoulos, Ministry of Infrastructure, Transport and Networks
- Dr. Christos Tzomakas, Regional Development Fund, Western Greece Region
- Mr. Stathis Papachristopoulos, Regional Development Fund, Western Greece Region
- Mr. Achilleas Pappas, Researcher on Local Tour Operators in Western Greece

Additionally, a total of 93 completed questionnaires were retained from firms in all three prefectures. The firms were mainly SMEs, the dominant form of firms in the region. The basic information about the questionnaire research is presented bellow.

b) Air and other transportation in Western Greece
The region of Western Greece can be accessed through air, sea and land. By air, the Region is served by three airports, Aktion, Araxos and Andravisa, two of which have commercial usage. Aktion National Airport (IATA: PVK, ICAO: LGPZ) is an airport serving Preveza and Lefkada in Greece. It is also known as Lefkada Airport. The airport is also used by NATO and Hellenic Air Force Command. Araxos Airport (IATA: GPA, ICAO: LGRX) is a Greek international military / civilian airport located near Araxos cape, Achaea Prefecture and serves the city of Patras as well as the western part of the Peloponnese region. It is also known as Araxos National Airport or Agamemnon Airport. It serves (primarily) as an active air base for the Hellenic Air Force, with some civilian services to Europe in the summer months. Andravida Airport is a Greek military airport located in the municipality of Andravida-Kyllini, 55 km southwest of Patras.

By sea the region is served mainly by the ports of Patras and Astakos, which can also serve as commercial transport ports. The ports of Aigion, Killini, Katakolo, Messolongi and Amphilohia mainly serve the region as hubs for touristic and local transport.

By land the region is served by railroad services which cover the coastal zone of Achaia, and Elia, through the route Athens- Patras- Pyrgos – Kalamata. It is also served by the road axes of the National road Patras-Athens - Thessaloniki – Evzoni part of the pan European road network with length of 895 km, and the Ionian Odos network, which connects Antirio to Ioannina with length 196 km.
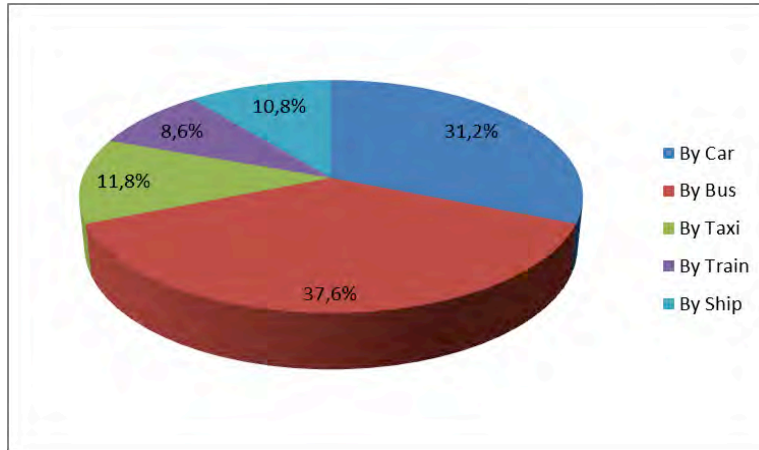
Figure 5: Alternative to airplane usage

c) Importance and development of Western Greece air transportation

The accessibility of the focal airports by the local companies is assessed as adequate with the majority of the companies answering that there is no need or relatively low need for further enhancement of the accessibility (60%). (Figure 3).
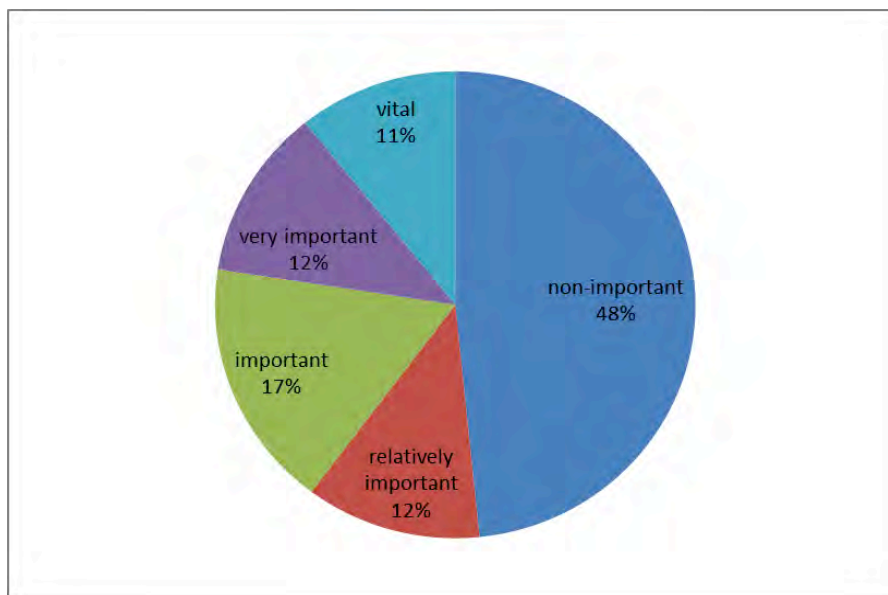

Figure 3: Need for further enhancement of the accessibility

Specifically, 36% of the companies answered that there is very easy accessibility to the airport. On the other hand, only 3% of the companies answered that they have no access to the airports. This could be explained by the low distance of the airports from most of the companies in these three prefectures. An airport is located in a distance of less than 170 km for most of the companies' location in our sample.
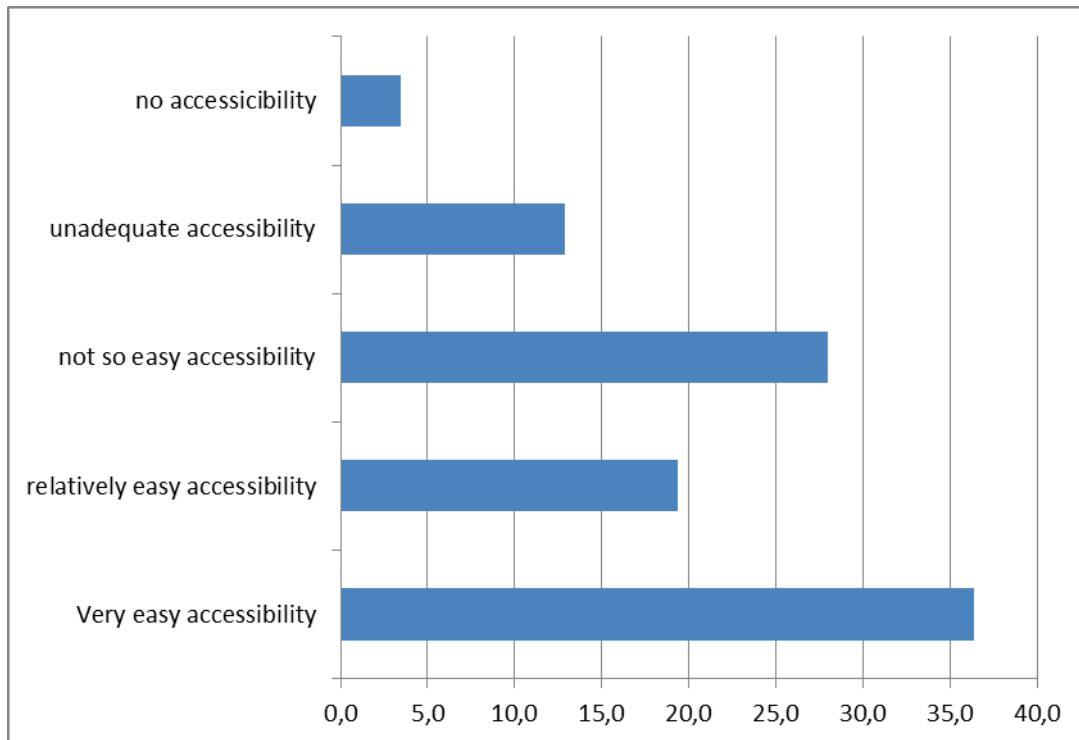
Figure 4: Assessing airports' accessibility

The airports are almost exclusively used for international destinations. On the other hand, for domestic destinations, the companies seem to use other transportation rather than the airport (Figure 1). However, this result is contingent to the flights that the local airports offer. For example, the Araxos Airport has three times more flights for international destinations than to domestic destinations (based on the data published by the Association of Hellenic Civil Aviation Authority http://www.hcaa-eleng.gr/araxos.htm). More research on this area is needed to study why the local businesses prefer alternative transportation when they travel domestically. Our research shows that this could be partially explained by the low number of weekly flights of these airports. Specifically, the majority of the companies (55%) in our sample answered that there is only 1 to 5 flights per week to their preferred destinations (Figure 2). Therefore, the use of the airports could be enhanced by more weekly flights to their preferred destinations. Further research is needed to discover which are the preferred destinations.
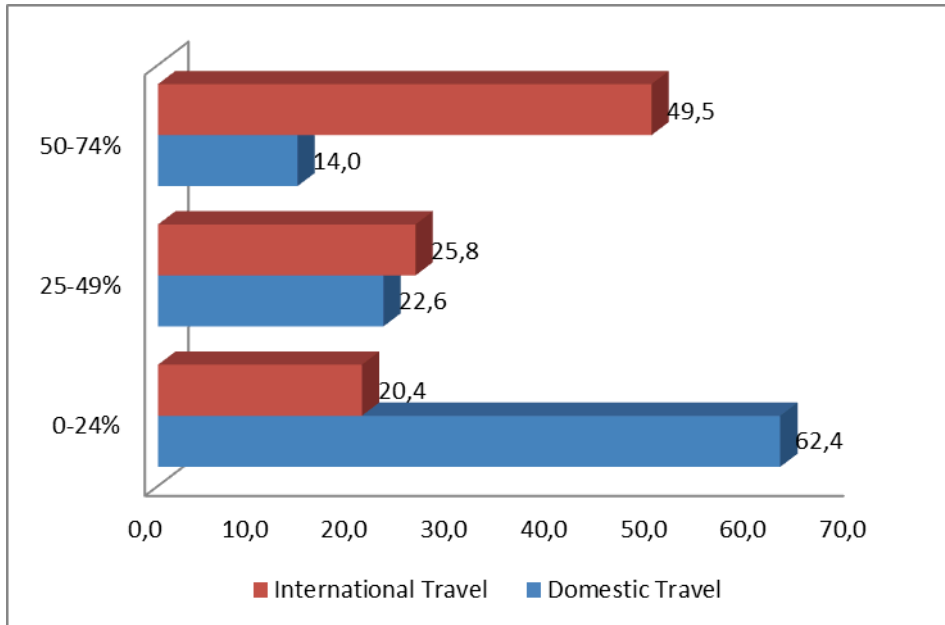
Figure 1: The use of the local airports for domestic and international destinations
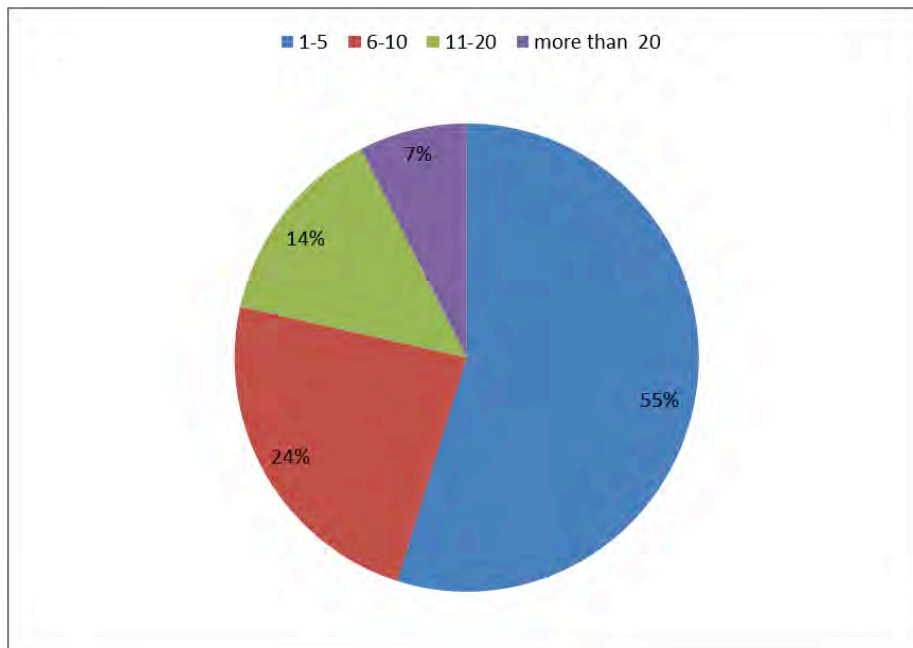
Figure 2: Quantity of weekly flights to preferred destinations

The local companies seem to believe that the airports in their area are important for their company and the local economy. Most companies agree that the airport is important for boosting international business contacts, production and Investment. The role of the prefecture airports is substantial for most industries but questionnaire respondents believe that the further development of the airports in their area could help attract hi-tech companies in the focal prefectures and increase touristic and agricultural industries growth. This is also supported by the interviews, since they recognize that the growth potential of both industries (agriculture and tourism) is high if the airports development is combined with local development projects. Such projects, in terms of tourism can be hotels and thematic tourism attractions, and combined transport services and usage of modern cultivating methods

for agriculture. Moreover the strategic position of the region can foster international collaboration of local agricultural producers and touristic agents to neighboring EU countries.

Most companies agree that the airport is important for boosting international business contacts, Production and Investment. There are not differences in the means based on the prefecture. There are differences between means of the companies only in domestic business contacts. Etolokarnania's companies seem to find statistically more important the airport for domestic business contacts compare to Achaia's and Ilia's corporation. A possible explanation is that the distance from the two major Greek cities (Athens and Thesaloniki) from this prefecture is relatively longer than from the other two prefectures. Therefore, the need for air transport is substantial bigger. This means that in Etolokarnania there is a need for domestic air transport as well as international air transport.
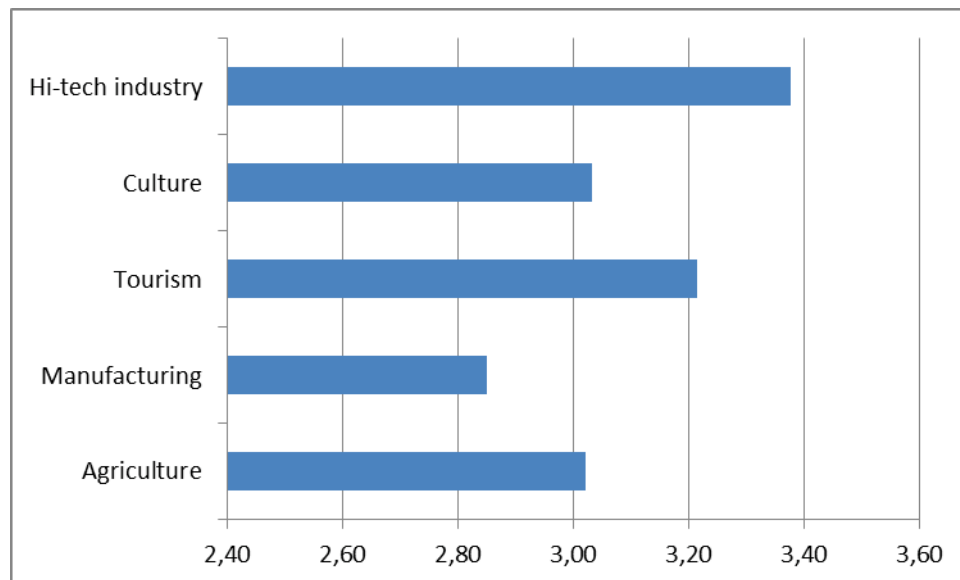
Figure 5: Which industries will gain from the further development of the airport?

The reliability/safety of the transport is the major key success factor, followed by the duration of the flight. This factor is connected with another success factor, direct flights for the international travel. On the other hand, companies find less important the services of the airport or the schedule of the flights or the prices of the tickets. However in order the airport to be adequately developed additional factors that will help its reach must be established. Such factors are the improvement of the public transportation from and to the airport, the increased quality of overall touristic and business services for visitors and the increase of accessibility, mainly in terms of national road axes.

d) Alternatives for air transportation in Western Greece
Concerning alternatives to transportation of passengers, the most important alternative to the usage of the regional airports is the usage of the Athens

International Airport of Eleftherios Venizelos, located approximately 200 km east of Patras. The Athens International airport, provides a wide variety of choices in flights to all national and most international destinations opposing to the choices presented by the regional airports. Moreover, the small size of Greece and the extensive road network makes the choice of either car or bus transportation attractive to almost 70% of the respondents. However this tendency is constantly reduced due to increasing gas and toll prices. Train and ship transportation are limited due to narrow choice of destinations and low frequency of itineraries. Finally the economic depression in Greece has limited business trips to an essential minimum.

e) Future of air transportation in Western Greece - SWOT analysis
Based on the findings described above, but not limited to them, a SWOT analysis regarding the usage of regional airports in the Region of Western Greece is presented in the following table.

Strengths	Weaknesses
• The region is currently supported by two airports and will be supported by another one in the future. • The touristic and cultural heritage of the region is strong and attracts tourism. • The agricultural production of the region can be easily absorbed by • The position of the region can attract visitors from both western and eastern Europe, as well as the Middle East countries. • The airport of Aktion is classified as statutory point of entry and exit and therefore receives direct flights from / to third countries outside the EU.	• The airports are not solely used for civil and transport purposed but also for military ones, thus restrictions apply to their usage and alterations. • All airports are controlled by HCAA which is very strict and inflexible to alternative usages. • The flights are neither frequent nor completely reliable. • The population of the area is limited and the continuous increase of unemployment reduces traveling for both business and touristic purposes. • Car is a comparative alternative since the overall territory of Greece is limited.
Opportunities	**Threats**
• The region has a significant potential for growth in both agricultural and touristic sectors. • Increase in gas and toll expenses limit the usage of car transportation, which is the dominant way of domestic traveling in Greece. • The usage of the new airport can potentially attract tourism in nearby areas.	•The increase in air traffic can be sufficiently supported by neither current touristic infrastructure and services, nor by current agricultural production •Economic depression has halted the international travel of most firms in the region and in EU level. Firms •Low frequency of flights, especially during winter time limit the intention of passengers to use air

	transportation.
• The increased need for globalization is promoting the cooperation between firms in the region and ones in neighboring countries and thus can increase the usage of flights.	

<div align="center">Table XXX SWOT – Future of air transportation in Western Greece</div>

f) Political implications of the results in Western Greece
Additionally to the results of the project, KiNNO Consultants has delivered to the vice governor of the Region of Western Greece a completed 120 pages report in Greek that can assist the region in planning actions and further developing commercial transport in the Region.

3.6 Context of Province of Savona: Savona

a) Geographical location
The Province of Savona is one of four provinces that constitute the Region Liguria. It is bordered to the east with the province of Genoa and west by that of Imperia. It has a total area of 1,545 sq km and it has about 300,000 inhabitants. The area is densely popolated with 194,76 inhabitants/kmq. It consists of 70 municipalities: the second most populous is Albenga, with about 24,000 inhabitants.

Distance of Savona to other cities in Italy	Distance of Savona to other European cities
To Rome (capital): 422 km	To Nice: 118 km
To Genoa: 38 km	To Paris: 689 km
To Milan: 140 km	To Brussels: 790 km
To Turin: 105 km	To London: 1024 km
To Ventimiglia: 90 km	To Berlin: 982 km

b) Landscape
The Province of Savona has a high number of places of natural interest, which represent the peculiarities of the region. The main nature reserves, adjacent to the zone of interest, the Regional Natural Park of Beigua, the largest protected area in the region, and the Regional Natural Reserve of Bergeggi Island, a few miles from Savona and Vado Ligure.
It's very interesting the stretch of coast that extends along the extreme eastern portion of the province of Savona, which preserves outstanding scenic and natural characteristics. This protected area of provincial interest has its fulcrum in the Coastal Park Plans Invrea.

Tourism_Natural park and reserve
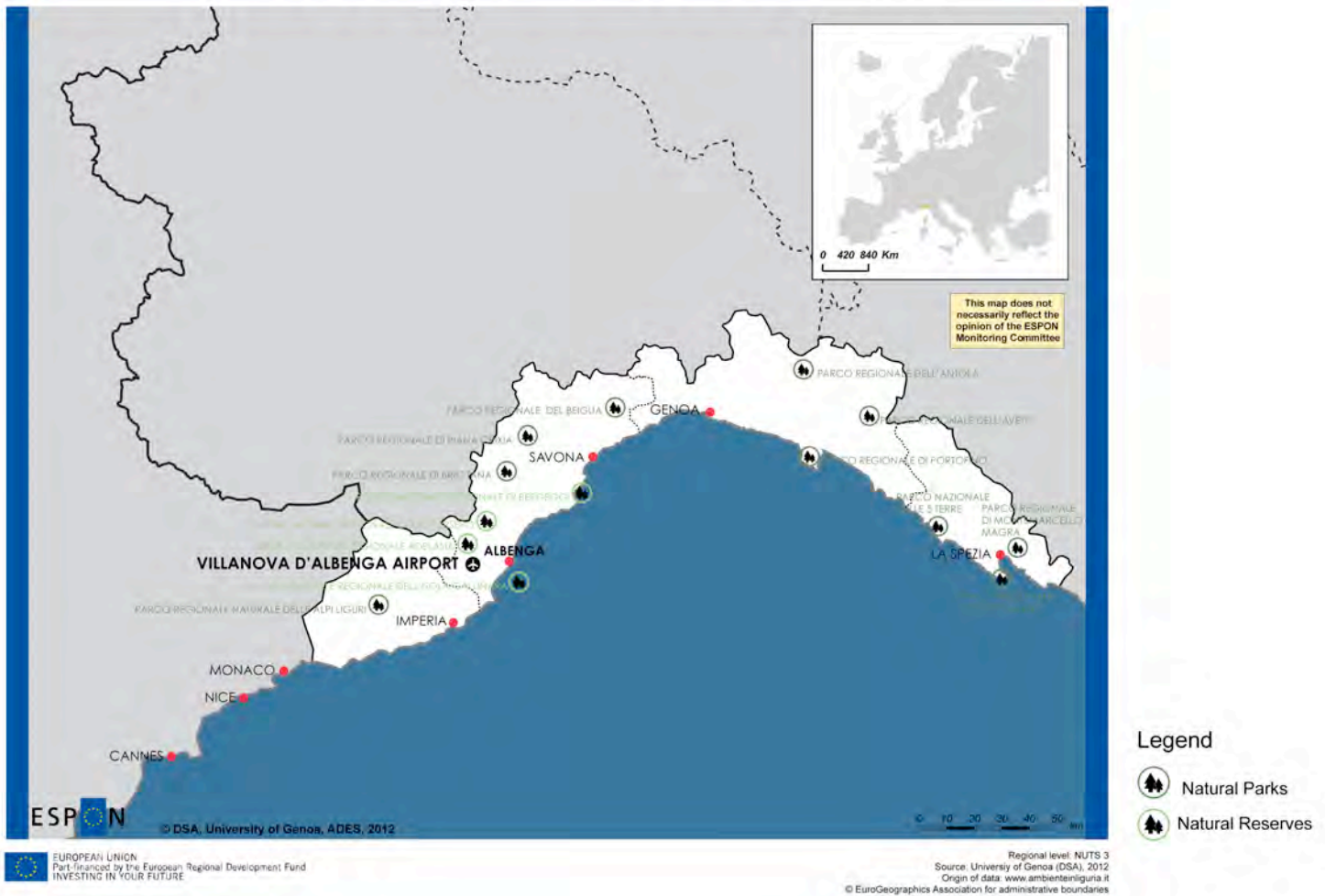
Map 13. Descriptive Maps_ Toourism_Natural parks and reserve

c) Infrastructures and accessibility

Three railway lines cross the province of Savona. These allow the connection to Genoa, Turin and Alessandria, the provincial capital of the neighbouring regions. The Ventimiglia railway line was recently renewed due to the displacement of the railway line upstream from the coast. In many cases the displacement of the railway led to the emergence of new walks to sea, near the sea, like suddenly walking and cycling Varazze - Cogoleto. The line Savona - Torino, important for the commercial traffic at the port of Savona, has many features single-track or alternate with steep slopes, due to crossing the Apennine section.

The province is crossed by two major highways, with heavy traffic, due to summer tourism in the West side of Liguria. The highway A10 called *Autostrada dei Fiori*, allows the connection between the Genoa, Savona and Ventimiglia. The last one is the gateway between Italy and France. The connection with Piemonte and the province of Cuneo, is allowed by the highway A6, which connects with the Savona to Turin Regional capital of Piemonte).

The airport (Map 14) is located on the northern edge of the plain of Albenga and unfortunately does not have a privileged access to the motorway but the closet barriers are Albenga and Alassio, reachable through highway A10 Genova - Ventimiglia or SS Aurelia 1 bis.


Map 14. Descriptive Maps_Aiports in Italy

The main interventions under the *Integrated Project 3b (Territorial Provincial Coordination Plan)* show: the displacment of *Aurelia* road between Finale Ligure and Albenga and between Alassio and Andora; the displacement upstream of the railway; the development of the Villanova d'Albenga airport; the construction of a center for logistics businesses in Savona territory, to be, link with the motorway Albenga-Millesimo-Predosa in a long-term project.

# Infrastructure Secondary roads
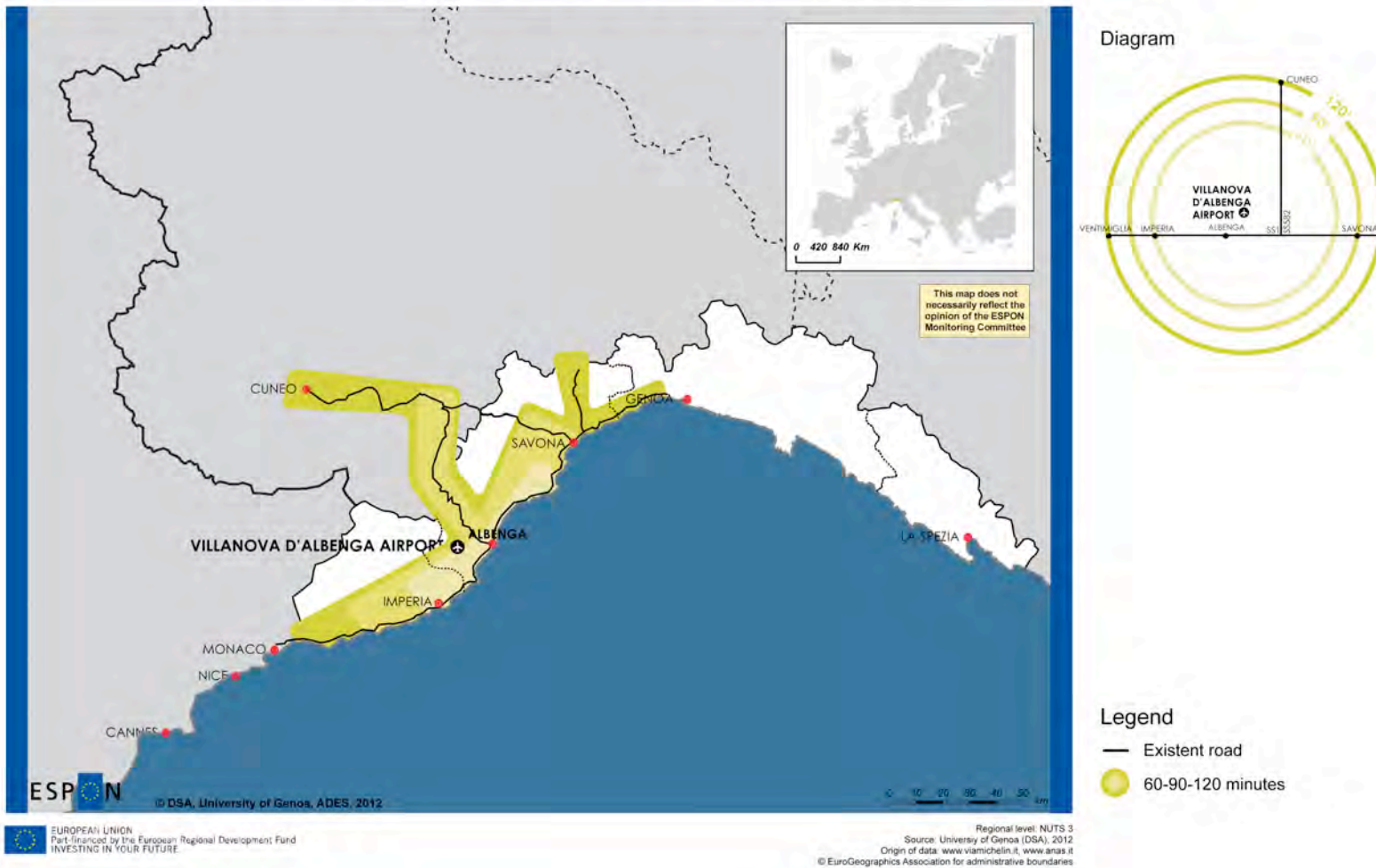
Map 15. Descriptive Maps_Infrastructure_Highways

d) Economic trends

The economy of the area is based mainly on agricultural trade and flowers, but with the presence of a strong service sector. There are many financial services firms and even some industries, also from a few years has been developing vigorously the tourism sector, both wine and food culture. The horticultural crops are, above all, aromatic plants and flowers. Around this is a real economic sector consists of the farms (mostly family), the structures and operators (technical advice, sale of products for cultivation, etc.) and traders, who often import products of the plain and the area towards the northern countries (especially Germany). It also activates the wine and olive cultivation and other agricultural products. Tourism is, of course, the largest source of income of the province of Savona.

Industry&Commerce_Industrial districts
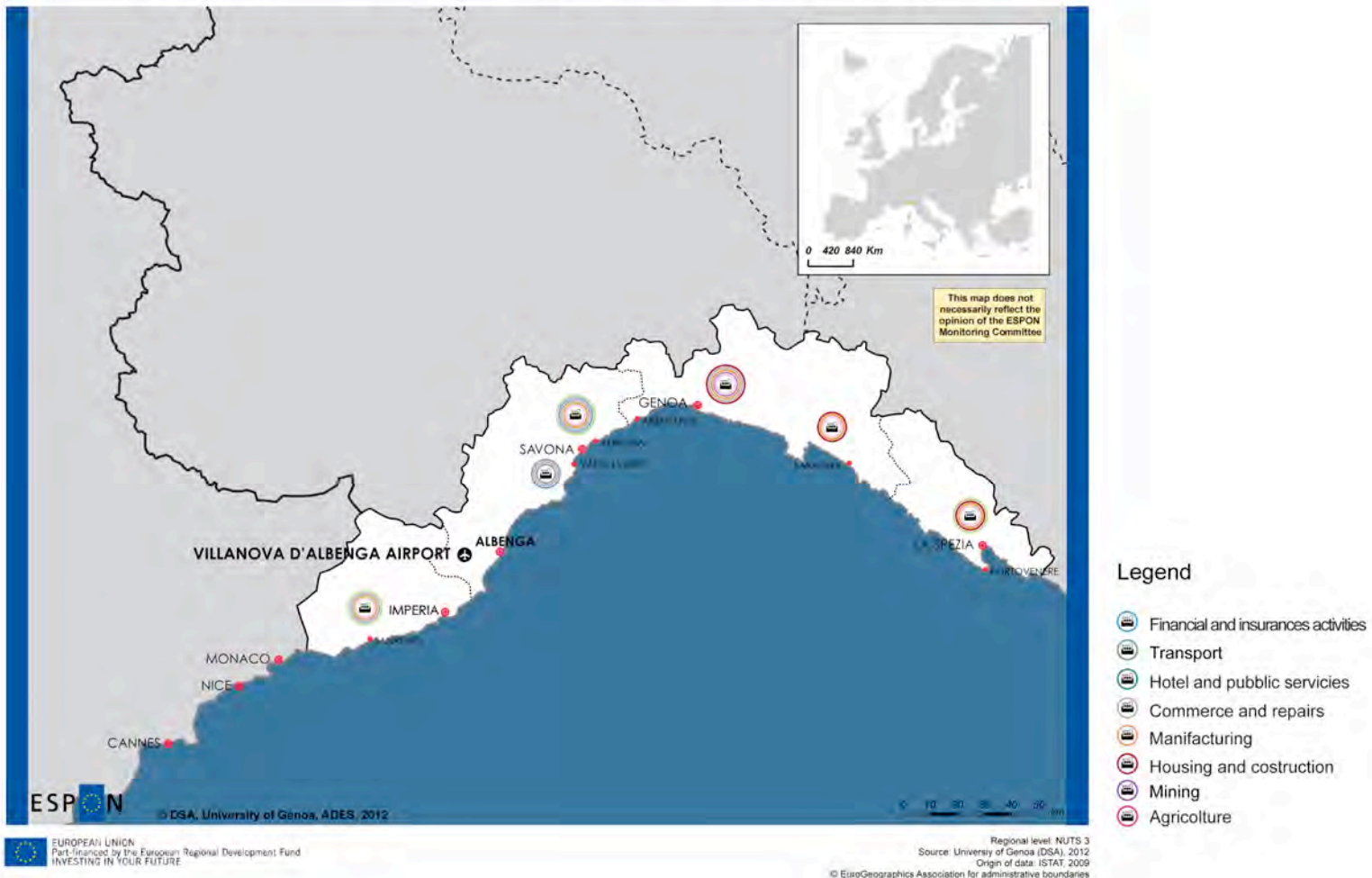
Map 16. Descriptive Maps_Industry‹&Commerce_Industrial districts

The most significant aspects of the success of this area's rich variety of landscapes, from hills - range at sea, the efficiency of hotel services, market and port facilities and supply of local food.

The beauties of the coast and the hinterland is enriched with artistic and architectural features, which can be discovered in churches, urban design, in craft shops. History and prehistory are revealed in the archaeological sites and caves that offer fascinating routes. The craftsmanship has its excellence in manufacturing glass and ceramics, both of ancient tradition.

The *Business Plan 2012-2012* signed by the Board of Directors of the Villanova d'Albenga Airport will provide a restructuring actions of the airport. In essence, the *Business Plan 2001-2012* will pursue three lines of action:

-   correction of the economic and financial adequacy and recurrence, with the organic investment;
-   development of a unique business strategy, enabling the identification of the factors necessary to support the action referred to above;
-   recovery of the business and the industrial structure to reach an effective monitoring process, and the elevation of the low efficiency of service delivery.

The redefinition of the economic and corporate identity and vocation is the act of correction of spending and easing the cost of the system due to the

industrialization of business processes, careful management of internal costs, but also to creation of a unified system of transportation of Western Liguria, which involved companies in the provinces of Imperia and Savona, currently represented on the board.

The intention is to unify the management of the center of various business activities, giving the activities previously managed by a consulting relationship, and thus creating a synergistic system of managing these service and support. The goal is to get the role of 'airport in the territory' in the service of the peculiarities of the area (western Liguria, Piemonte, French riviera) with collection of incoming traffic in the same territory with tourist and business, as well as the development of forms of horizontal integration (agreements with other airports in the country) and a vertical single logistics system (car-airplane-train).

The development model is based on the enhancement of the role of the airport to support the business aviation (such as the Cannes Mandelieu) and related services of premium aircraft hangars, and the attractiveness to carriers make available lines to major cities (Rome, Venice, Monaco Munich, Geneva), providing a streamlined and handling costs competitive. The project involves investments of around € 2,500,000, sustainable self-financing activities of the resulting revenues.

Furthmore, another objective of the *Integrated Project 3b (Territorial Provincial Coordination Plan)* is the integration of airport with new productive features advanced technology complementary to the Air Force, in particular you would like to associate the image of the airport of Villanova di Albenga to that of "Ecoaeroporto" by creating a buffer zone than in the airport where ecological connection between the protected areas in these provinces and the SIC and the inclusion of facilities for the production of energy from renewable sources (solar, wind).
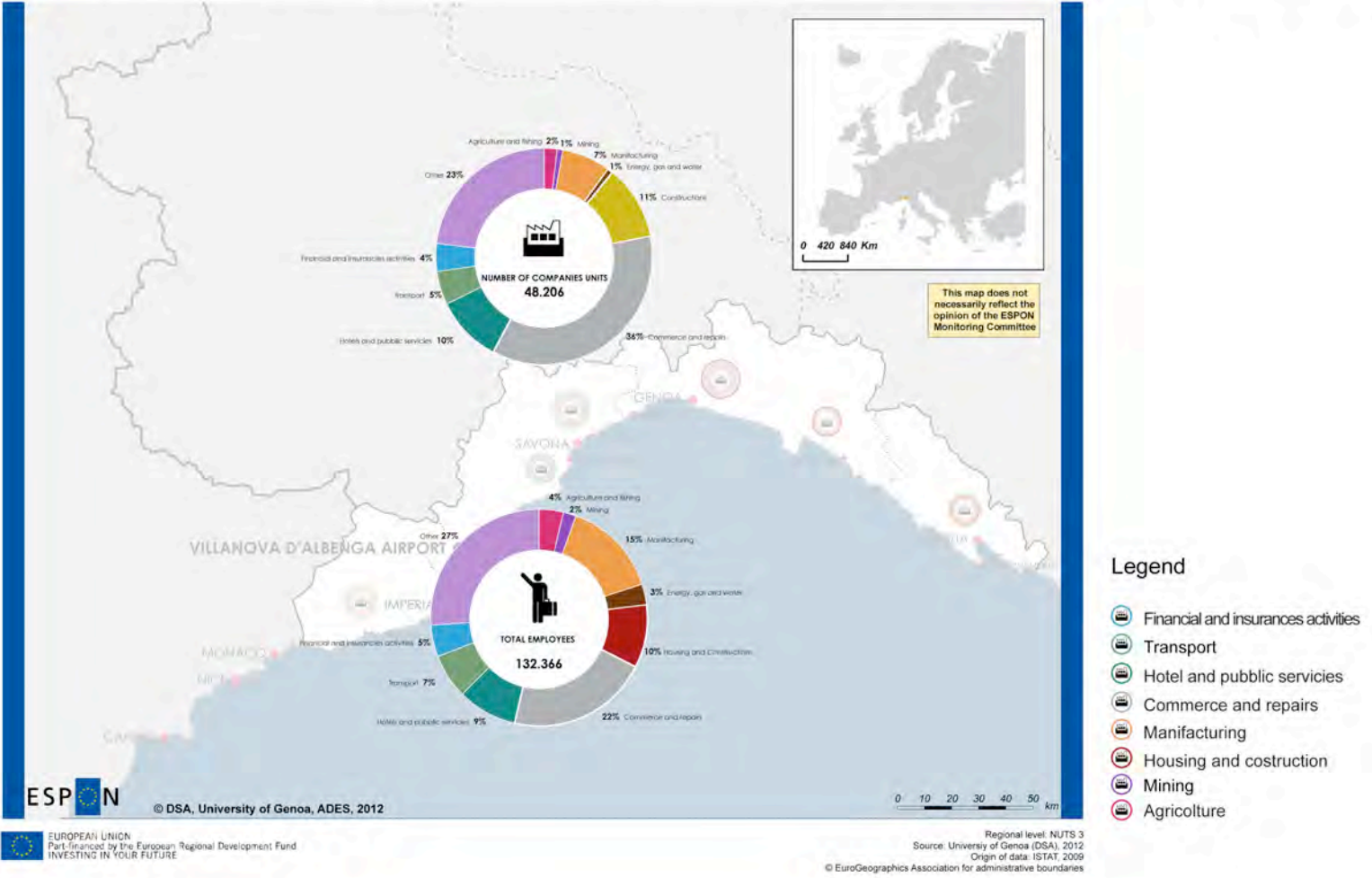
Map 17. Descriptive Maps_Industry‹&Commerce_Industrial districts (graphics)

e) Cultural and leisure services

The area economy is based mainly on agricultural trade and flowers, but with the presence of a strong service sector. There are many financial services firms and even some industries, also from a few years has been developing vigorously the tourism sector, both wine and food culture.

The horticultural crops are, above all, aromatic plants and flowers. Around this is a real economic sector consists of the farms (mostly family), the structures and operators (technical advice, sale of products for cultivation, etc..) and traders, who often import products of the plain and the area towards the northern countries (especially Germany). It also activates the wine and olive cultivation and other agricultural products.

There are some companies, import-export famous and leading national and European level in this sector as the Noberasco regarding dried fruit, Fruttital for import and export of fresh fruits and Fitimex renard vegetables.

Many products have won awards Denomination of Controlled Origin (DOC), Protected Designation of Origin (PDO), Tipical Geographical Indication (IGT), Protected Geographical Indication (PGI).

In the Province of Savona are also distinguished by the City of Albisola for the production of handmade ceramic crafts, excellence at national level.

The main industrial center of the province is Vado Ligure (2 km from Savona), where there are many factories and companies, including major railways are a large factory which produces electromotive opened in 1905 and the Thermoelectric Central Tirreno Power. Port activity is intense: in addition to the many ferries that connect to Corsica and Sardinia, dock cargo ships, container carriers and numerous tankers, making the port of Vado's first Italian port for petroleum and its derivatives. Shopping malls are numerous and widespread in this region. The main sports complexes are located between Savona and Loano. Very Important and specialized are the two hospitals of Pietra Ligure and Savona (in particular the field of Hand Surgery).
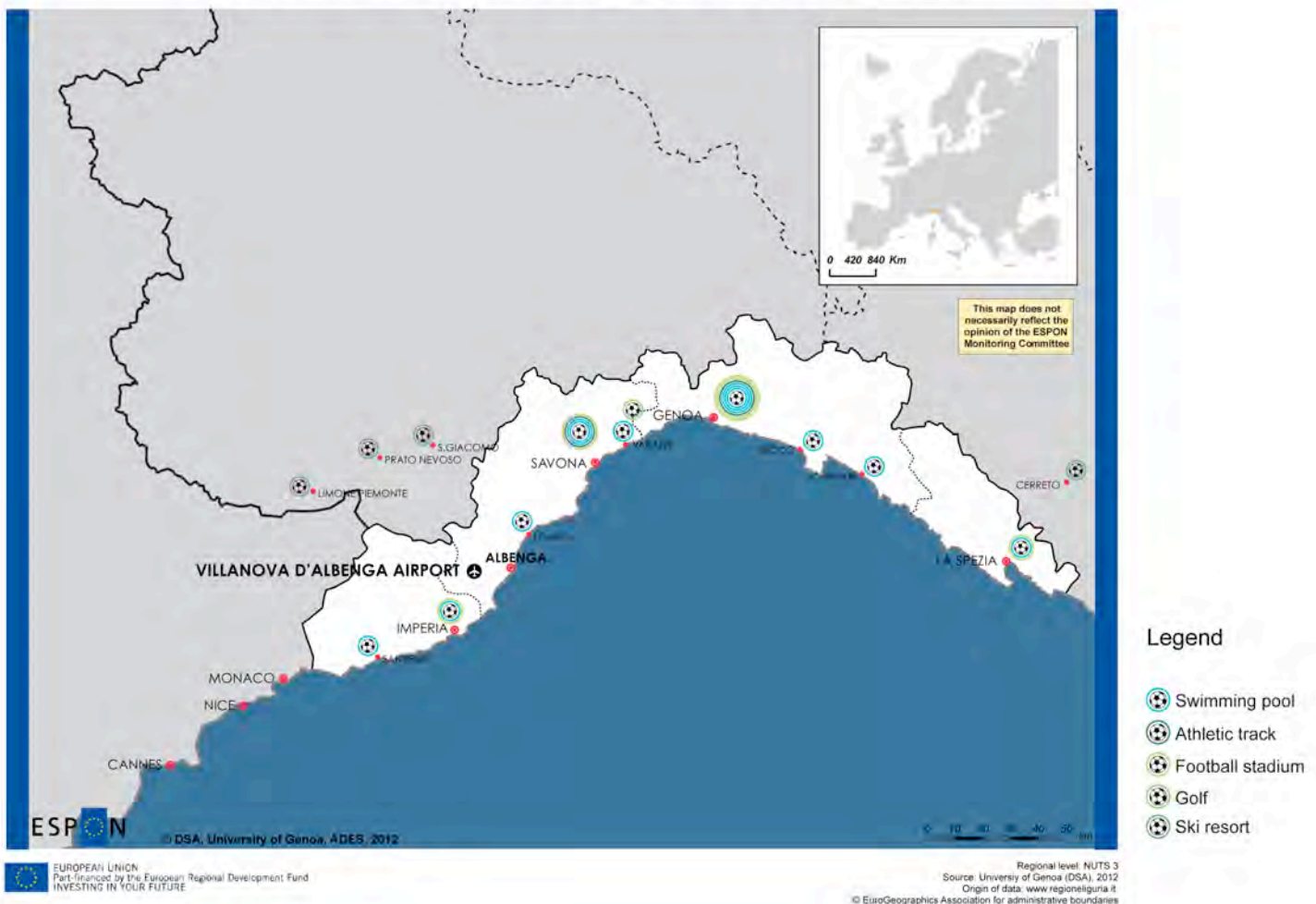
Map 18. Descriptive Maps_Public Services_Sport Comples

f) Tourism
Tourism is, of course, the largest source of income of the province of Savona.The most significant aspects of the success of this area's rich variety of landscapes, from hills - range at sea, the efficiency of hotel services, market and port facilities and supply of local food.

The attractiveness of the coast and the hinterland is enriched with artistic and architectural features, which can be discovered in churches, urban design and craft shops.

History and prehistory are revealed in the archaeological sites and caves that offer fascinating routes. The craftsmanship has its excellence in manufacturing glass and ceramics, both of ancient tradition. The Museum System of the Province of Savona preserves and makes available to the public a great historical, artistic and naturalistic. Events and festivals throughout the year offering moments of culture, relaxation and fun, to enrich the reception that the various resorts give to their guests.

There are numerous places to visit between the cities of art, the various coastal hills and picturesque villages, eight of whom are enrolled in the club of the most beautiful villages in Italy for their architectural heritage and natural beauty. Three locations also boast of Orange Flag, marking the Italian Touring Club for the small inland villages that stand out for their quality tourism and environment.

In 2011, for the second consecutive year, the Riviera has been awarded 17 blue flags for beaches of its coast (national record): 10 are in the Province of Savona (Map 17).

g) History of the airport and passenger structure

The airport "Clemente Panero" was opened in 1922 as a military airport, its runway was the first to be built in traditional macadam pavement in 1937, and was then completely civilized in 1983.
The main movements of the system are:
- private national and international aviation;
- aviation school;
- local activities.

Today, the airport seems oriented towards investing in the business aviation (private planes or air taxi) and influx Charter (flights to the Western Riviera and Albenga flights with origin and destination as other resorts). At the base, there are three feasibility studies, commissioned by the company manager of the airport itself, on three different scenarios: scheduled commercial, business aviation, charter.

The airport is strategically positioned in surrounding relation of the main departure port, the Port of Savona, one of the 15 largest commercial airports and cruise lines in Italy and the second of Liguria.
The area of Albenga is also connectedd by the railway line to Ventimiglia in the West side, and to La Spezia in the East. To the north the line connects with paths that reach Turin and Milan.
As a whole, occupies an area of approximately 97 hectares and has a runway long 1448 + 140 meters grassy strip at the arrest, has a width between 45 m and 60 + 7.5 + 7.5 meters and with a pavement, in asphalt bitumen, with a

resistance of 25.000 kg/SIWL (Single Isolated Wheel Load).

The airport of Villanova d'Albenga is one of the 101 airports on the Italian territory, accused of being a "cost" more than a benefit: no more than one million passengers a year, the threshold below which, according to experts, it would be in economic loss.
Overall, we note that:
- the costs are about double the revenue, with the dominant voice in increasing purchases and services;
- labour costs are less stable and equal to a fifth of output in 2006;
- grow revenues not directly related to aircraft movements, which, however, determine revenue substantially fixed;
- economic losses as significant, negative trend after peaking in 2004, should be slightly smaller.

Today the aerodrome could count on only the help of the Regional Law n. 26 of 1995 "Interventions for the expansion for tourism and sport airport of Villanova d'Albenga and Luni Sarzana "which provides funding" based on a three-year program of investment within the limits of
availability of budget "for the following interventions:
- functional improvement of buildings and structures for the 'user guide and sports;
- purchase of equipment and means to improve safety conditions for users and aircraft.

This funding is for additional work, not targeted at flights or airlines. In particular, it lent support to initiatives related to aviation flight schools and sports, at the moment flexure of members compared to previous years. Do not forget that the aerodrome is a logistic base for the air rescue facilities, primarily for Civil Protection and the Fire Department.

Interviews and questionnaires resume

a) Data collection
Data for the case study was collected through interviews and questionnaire in March 2012. Six persons were interviewed. They include regional airport manager, mayors of nearby cities, rappresentative of agricolture confederation and local industries.
The interviews were conducted by telephone and recorded on tape. The results obtained from these comparisons will be used as input to structure SWOT analysis.

List of interviews:
- Maurizio Maricone, Management Committee President of the Villanova d'Albenga Airport
- Umberto Vallino, Management Committee President of the Nice Airport
- Santiago Vacca, Councillor of Infrastructure + Mayor of Borghetto Santo

Spirito
- Claudio Linoli, Project Designer, Piaggio Aerop Industres S.P.A., Finale Ligure, Savona
- Aldo Alberto, Italian Agriculture Confederation (CIA) + Floricola Society
- Giacomo Mamberto, Local tour operator

b) Air and other transportation in Province of Savona
The railway lines passing through the province are essentially three, which allow the connection of the provincial capital with Genoa, Turin and Alessandria. The line to Ventimiglia was recently renewed due to the displacement of the railway line upstream from the coast. In many cases the shift rail led to the emergence of new walks to sea, near the sea, like suddenly walking and cycling Varazze - Cogoleto. The line Savona – Torino is important for the commercial traffic at the port of Savona. I has many features single-track or alternate with steep slopes, due to crossing the Apennine section.

The province is crossed by two major highways with heavy traffic, due to summer tourism in the West *Riviera*. The A10 motorway, called Flower, allows the connection road between the cities of Genoa - Savona and Ventimiglia, this is the gateway between Italy and France. The connection with Piemonte, specifically the province of Cuneo, is allowed by the A6 motorway, which connects with the Savona regional capital of Piemonte (Turin).

c) Importance and development of Province of Savona air transportation
According to the regional policy for the development and the strengthening of the infrastructure system, Villanova d'Albenga airport has a fundamental role in terms of quality. In the recent year, it was identified an appropriate role for the airport to its small size and to the economic characteristics of the area: this airport could be the strategical place in which localize technology and industrial companies. The manufacturing and technological activities characterize the surrounding area. The local companies involved in the agrarian and food sectors are growing. They cover the 20% export of the Province. The tourism is another relevant aspect of local economic trend.

It is unrealistic the development of a big hub for travelled because the catchment area is modest and the physical dimensions of the airport doesn't allowed a huge traffic of passengers. The transport is a consequence of the creation of a question. In the future it could be possible that new tourists will arrive with new flights carriers. However, tourists are not bringing by the creation of new flights. The creation of a touristic offer, the offer of hospitality, the promotion in Europe and in the world will attract tourists. The goal is to give to Villanova d'Albenga airport the role of **airport in the territory**.

Also the relationship with the nearest Nice and Cannes airport is crucial because they will organize a network in which an high specialization of

functions will decrease the competitively in favour of a synergy between airports. This will be the firs Italian example (maybe also European) of **cross-border network** and it will create a relationship that strengthens and generates growth in a shared *European region*.

The development model is based on the enhancement of the role of the airport to support the business aviation (such as the Cannes Mandelieu airport) and related services of premium aircraft hangars, and the attractiveness to carriers make available lines to major cities (Rome, Venice, Monaco Munich, Geneva), providing a streamlined and handling costs competitive.

d) Alternatives for air transportation in Province of Savona
According to the results, Villanova d'Albenga airport future activities have to focus more on local productive and industrial performances than to air traffic. With this regard, the airport has technical problems (length of the runway, no direct access to the highway) and it doesn't have any schedule flights so that people and local companies use car or trains. In fact, a car and a train are the most important competitors of this airport.

A train to Genoa or Ventimiglia (the borderline city to France) is relatively fast, ticket prices are moderate and there are several daily connections. In addition, a train provides good conditions for working. Even if the main road next to the river is a bottleneck of traffic, a car is the principal means of transportation used by firms. Also two highways that cross the Province of Savona have heavy traffic, due to summer tourism in the Riviera di Ponente. The highway A10 connects Genoa, Savona and Ventimiglia: this is the gateway between Italy and France. In is possible to reach the French border in only two hours and an half from Savona.

The railway lines connect the Province to Savona to the main neighbouring regional capital (Genoa, Turin and Alessandria) in two about hours. The Ventimiglia railway line was recently restructured and upgraded by the displacement of the railway upstream from the coast. The line Savona - Torino, important for the commercial traffic at the port of Savona, has many features single-track or alternate with steep slopes, due to crossing the Apennine section.

e) Future of air transportation in Province of Savona - SWOT analysis
Based on the findings described above, but not limited to them, a SWOT analysis regarding the usage of regional airports in the Province of Savona is presented in the following table.

Strengths	Weaknesses
• Strategic location of the airport • Good accessibility: good connection with infrastructure • Well developed economic context • High quality of the surrounding territories (sea, landscape, parks, beaches) • Export sectors: Agriculture + Tourism (2° sector in the Ligurian GDP) • State authorization for 20 years (recent renewed) • Nearest to touristic places in the West Liguria and to touristic harbors • Activities of aviation school and private flights • Presence of Management Society with an operative Industrial plan[26] for the airport development	• Technical problems: runway too short (now 1430 mt. max 1700 mt.) • No further tourist flights (Charter) caused by the runway length • No future for a cargo destination • Catchment area is modest • No direct connection with railway networks • Infrastructure system (highway and local road) saturated with bottlenecks • No services by local transport (bus) • No coordinate governance process for the airport development • No carriers flights on V.A. Airport • No time schedule during the week • No specialization and lost of competition with nearest airport
Opportunities	Threats
• Developing industrial pole: *Piaggio* Industries • Business aviation • Executive jet • Multi disciplinary economy on the territory • Tourism for local event • Land use to cultivate flowers and agricultural products by the society • Synergy between agricultural and touristic sectors • Synergy with the nearest French airports • New flight connections with Italian and European cities for commercial and touristic business • Better development of interconnection with other infrastructure network (highway, railway and local transport) • Increase of aviation school activities	• No possibilities to accept all typologies of airplanes • Recession of touristic and agricultural sectors • Lost of interest ton the Airport • High specialization and competition with the nearest French airports • High fees for carriers

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[26] Source: Business Plan 2001-2012, Province of Savona

Table SWOT – Future of air transportation in Province of Savona

f) Political implications of the results in Province of Savona
Villanova d'Albenga is already on its way to a new future trough 3 strategic target obtained[27]:
  1. Administrative regularization
  2. Partnership with other airports
  3. Inclusion of productive activities in the airport

1. The administrative regularization was completed on the 30th November by signing the State authorization for 20 years of management. This was required in order to plan strategies with long-term investments.

2. By the 30th November, officially Villanova d'Albenga Airport is involved in a network system. It was signed an agreement with the nearest airports of Nice and Cannes. It's the first example, probably in Europe, at least in Italy of cooperation in a international airport network.
A governance of systems drives this cooperation. Representatives of each airports are involved in the Management Committee of the others airports.
All representatives of the 3 airports approve a shared commercial policy: an overspecialization of airports to overcome the competition. Nice Airport an international big hub. Cannes Airport is specialized in business aviation. Villanova d'Albenga is the development area for hangar, maintenance and aircrafts research activities of the three airports.

3. A strategy of integration of the airport in the territory, by including services connected with the local production. In that sense, a priority is to improve the airport as a logistic hub. Currently, Villanova d'Albenga Airport has a good connection with the high way but it has a worst connection with the railway system. That means the primary requirement of an improvement of the railway connection with the project of a new railway station in Albenga.
Then, it's already in progress the collaboration with the Piaggio Aero Industries. Piaggio has located one of its industries in the land owned by the airport. This industry is specialized in designing, producing and testing mechanical part for aircrafts. It has now 700 employees and it supposed to be the main plant of this industry in Liguria

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[27] Source: Maurizio Maricone, *Management Committee President of the Villanova d'Albenga Airport*

3.7 Synthesis of the case studies

The analysis of the three Stakeholder regions reveals the difference and the similarities between ADES case studies: the contexts – geographical, economical, social – are extremely heterogeneous that didn't allowed to define an airport model to adopt indistinctly in all regions.

In fact, the geographical situation of the three stakeholder regions is very different. Jyväskylä in Central Finland is very central to Finland but very peripheral relative to Central Europe. As the economic centre of Finland is south of Jyväskylä, Central Finland is even more remote and Helsinki becomes a natural gateway to "Europe" for the whole of Finland. Patras in Western Greece is also rather central to Greece, but Greece as a whole is at the southern periphery of Europe. Despite the fact that Patras is even closer to Central Europe than the capital Athens, almost all air traffic goes through Athens. The situation of Savona differs considerably. It is rather central in Europe, but very peripheral in an Italian context. The airports of Genoa, Nice, Turin and Milan are relatively close. Thus, the air link situation of the three stakeholder regions also differs substantially.

The main economic indicators, the industry structure and regional contexts characteristics have compared in the three stakeholders regions. This provided important topics for reflection on the cognitive framework for socio-economic and territorial aspects that define the potential economic impacts of airports. More detailed and fundamental information have been provided by in-depth interviews and structured questionnaires (see *Annex 2*) carried out in local languages with key relevant stakeholders (at least five interviews per Region covering policy advisors, experts in different fields and policy makers).

One conclusion is that the peripheral context of ADES airports generates interest but also a limit. In many cases, politicians don't find a real convenience only to strengthen schedule flights or improve technical and physical characteristics of these infrastructures. When it happens, the airport dramatically graves on the regional economy. And this is what happens in the majority of ADES cases studies.

However, questionnaires and interview reveals belief in the airport future potentialities considering the **airport as a resource for regions**. The airport is considered not only in its functional role but it is also consider as image of a territory, whose development has to be taken in account in the regional planning. Therefore, two are the main guidelines recommended:

- The first, according to the guidelines of the European infrastructure development plan for 2014-2020, is to increase the airport connections with smaller networks of the surrounding territory, in order to bring the airport in better condition in the aviation economy (more schedule flight, etc..).

- The second is for the local Stakeholder. The recommendation is to increase the functions in the airport. This is refers not only to the flight operations (for example: storage for planes, production of planes,

business aviation, school of aviation), but also to include productive functions in the airport that allow to use the airport as a new territorial centrally of local production (as explained through examples in *Chapter 1.3c*). This will gain the opportunity to have benefits from the airport also when it is not use for flight operation. Villanova d'Albenga airport is an concrete example of an international cooperation.

This guideline are valid for all the ADES cases studies that we examined and the main recommendations is that the airport must to become a new centrality in a territorial and economic system

According to that, the recycling of airports could become an operative strategy for other urban transformations. The reconversion of airport infrastructure will increase quality and development of the surrounding urban and social condition: from airports on hold to airports catalytic of processes. The re-significance of this infrastructure could activate processes of growth of mobility, to develop transport and communication networks, to lost a physical precise cities' connotation, to increase the need of landscape and places in which to live in and recognize themselves. This could be the operative strategy for these airports to recalibrate their fundamental function in their physical contexts: the integration of air traffic transportation facilities with activities that regenerate their life and the surrounding business.

It wasn't possible to draw one general model to adopt in all Stakeholders regions. We propose three **strategies for development and renewal of infrastructure** and the peripheral region in which each airport is located. According to the heterogeneity of the three contexts, the logic for intervention in various areas is obviously different, depending on contextual analyzes conducted and results obtained.

The guidelines for the vision are based on three different strategies:

- Expansion of the existing airport, increasing the number of flights, adding new functions to neighbouring industrial and commercial (**incREase**);
- Maintenance of airport operation, hybridization with insertion of the functions of existing activities and related to the local context surrounding integration of urban functions (**REuse**);
- Abandon the airport function in favour of a comprehensive recycling action, a reclaiming land from the old infrastructure, creation of a park and public facilities for the city's new urban development (**REcycle**).

The relation and the individual application of these strategies to each ADES airports were previously explain in *DFR_Chapter 2.1.*

Concluding, as displayed above, Villanova d'Albenga is already on its way to a new future. On 30th November 2012 it was officially signed the contract for the management society with Cannes and Nice airport and with Piaggio Aero Industries S.p.A. This small airport can be a **model** for the other ADES case studies but also for other second and third tier airports in Italy and in Europe: it could be an example of territorial integration with the industrial and agro-food sectors. It and also be an example of cross-border integration with neighbouring airports.

4. MAPS

4.1 Introduction and methodology

The maps are intended to verify the opportunities and the limits of new "visual devices", as effective method to define sustainable rules for the territory, as question inside the discipline: on the "external" side, the vision maps will give the opportunity to develop a participated process, reaching solutions shared by the local stakeholders able to produce new "conscience of place" and of sustainable master plan.

From cartographic representations of data, maps have become an operational tool in outlining operative strategies with actors (politicians) concerned and at the same time are a significant means of communication possible future scenarios. This could permit to ensure data, territorial indicators and tools that are usable for policy makers and practitioners at all administrative levels. It could also ensure availability of comparable regional data at as detailed geographical scale as possible as well as statistical quality control and data validation.

In that sense, maps are a powerful tool to visualise spatial data but they can be also a useful instrument to help decision makers to choose and define the best strategies for local development. They are essential implements of communication with the local context, and were developed to be instructions for use, in service of political actors and institutions in general.

The project strategy focuses on three methodological moves. They correspond to as many analyses-interpretations-visions, trying to give quality to the future. Any move has within itself a strong project content and at the same time a descriptive element. In other words, this methodological approach encourages to use signs for interpreting and describing a new point of view on the city, territories and its changes. The proposal foresees 3 principal moves used like urban design tools:

Context_*sense + spaces + transformation demand + project + objectives*;
Concept_*project meaning and manifesto*;
Vision_*project forms and quality targets + timing + strategies*.

This interpretation of territory is shown by three groups of maps:

- **Descriptive Maps**: to show the current situation
- **Concept Maps**: to represent the project essence and the *manifesto*
- **Vision Maps**: as a support for further development process

Descriptive maps create appropriate images of Europe and of the Stakeholders regions involved in the project, according to the research project aim to represent their character, their potentialities to change through airport development, their specificity (infrastructures, urban centres, land uses, landscapes, and environment).

Concept maps show the heart of the project strategy. Concept maps are abstract images describing the inner nature of the project and at the same time represent the essence and manifesto. Concretely they summarize the main content of the work, what describes its shape with a remarkable independence from form.

Vision maps are the right tools to analyse the capacity of a specific context to produce local development and to analyse how this development meets the representations of the stakeholders according to general rules of sustainability

4.2 Descriptive Maps
Context has always been a cardinal point to understand and interpret the space. The idea of contextualization has rendered the Italian urban design method recognizable all over the world.
Virtual realities affect our life, job economy through the development of instantaneous adjacency and virtual networks connecting distant places in immediate communication. Territories and cities tend to lose their physical connotation and become more and more interrelated.
All this changes our way to conceive the future and its forms, as it should change the way we carry out projects. So the city has exploded. No direct connection exists between activities and places. Distances from a mere spatial point of view is useless, so what may happen to architecture?
We live in a context where everybody can choose their styles and living spaces, where time and poliarchy prevail over space.

Behind the rapid changes of contemporary society, the meaning of context has changed. We no longer speak solely of material space, but also of the figures of society, politics and economics with which the transformation projects of physical space must establish continuous relations. Context is space, meaning and statute. Knowing how to interpret different contexts that define contemporary nature of the city once again represents the essential condition for holding together the forms of space and society in a specific place, without damaging its cultural heritage. The context is space, sense and rules.

At the same time, it is important to study the transformation demand expressed by local society (the City or other public actors) through the city

code or through official projects. This graphic board also wants to show the student's idea of what and where change is needed. Programme defines transformation demand and conditions according with the nature of area following the urban code rules.

For each region, *Descriptive Maps* show the current situation and outline a series of representations that visualise statistical information. They show both the present situation and the changes over the last years in the three regions. The maps focus (among others) on the spatial profile and accessibility as well as regional transformations, new centralities, environmental mitigation and compensation.

The set of maps has been envisioned according to a precise structure, through which is possible understand the logical path of construction of each context and every consequential vision. In particular:

- **Europe**

  It is an overall image of Europe in which are juxtaposed ESPON maps of accessibility and GDP per capita. The comparison between these two maps is used to introduce two fundamental issues around the research work: economy and accessibility of each area. From these maps is possible to understand how seemingly inaccessible areas, can have, instead, a high level of production and economic. In contrast, regions well connected and equipped with infrastructure networks, reach rather low values of GDP. This situation leads to reflect on the importance of local contexts and the need to make insights at the regional scale.

- **Nation**

  In these three maps, one for each nation, are represented at national level the position of the main national airports. Airports are catalogued by the flow of passengers per annum (in reference to 2010 in particular). In this way there is an immediate image of the main airports hubs for each region. In particular, flows of passengers range from a maximum of 35 million in a year (e.g. Roma Fiumicino, Italy) and minimum of 100.000 in a year (e.g. Araxos, Western Greece).

- **Region**

  The first regional-scale map shows the three main statistical data on the peripheral regions in the studio: surface, population and density. The comparison of these data provides an interesting insight into the sheer diversity of the three territories: Central Finland has a surface of 19950 kmq and a population of only 274.000 inhabitants, Western Greece has a surface of 11350 kmq and a population of 741.282 inhabitants, Liguria, finally, has a surface of only 5420 kmq, but also a population of 1.616.788 inhabitants. The most significant is the density: 13,65 inhabitants/kmq for Central Finland, 66,37 inhabitants/kmq for Western Greece and even 298,3 inhabitants/kmq for Liguria.

  Below, was prepared a series of maps on a regional scale, for each region, represents the current environment through their specificity. In particular: infrastructures (highways, secondary roads, train, harbours,

airports), industry and commerce (industrial districts and shopping malls), landscape heritage (parks and natural reserve, beaches, blue flags, orange flags, monuments), public services (sport complex, hospitals), education and research (universities, research institutions). Each system is rational and is interpreted through conceptual and synthetic diagrams.

- **Airports**
  In this structure the connection between Descriptive Maps and Vision Maps is realized through the introduction of three maps on the airports, themes of the research. They are like ID cards and contain all the basic information on the airports of Jyväskylä, Andravida, Araxos, Aktion and Villanova d'Albenga. In particular, surface, number of employees, flows of passengers, length and characteristics of the track, etc.

4.3 Concept Maps

The concept is an abstract image describing the inner nature of the project and at the same time represents its essence and manifesto. It is the representation of elaborated thought. Concept interprets context, rendering the programme explicit, and anticipating techniques, alluding to forms of actions. It is the representation of an elaborated thought. The concept, in the end, establishes the relationship with a context and its transformation. It holds together interpretation and design in a synthetic icon that communicates change. In its abstraction the concept links the design hypothesis to others developed before by other designers, in other places. It renders the theoretical nature of the project and it's belonging to a cultural debate explicit.

Concretely the concept summarizes the main content of the work, what describes its shape with a remarkable independence from form. The concept clearly defines the ways to describe the transformation of physical space. In other words, a project which focuses on the plurality of players and the simultaneity of events as an aesthetic resource, and that gives cultural value to changing attitudes cannot but be based on a synthetic conception capable of communicating the level in the quality of space desired. This is the heart of the project and once you have reached a convincing state of definition, it tends to stay the same along all the stages of realization of the project.

The concept that drives ADES research strategies is the *osmosis* applied in the field of infrastructures, in particular airport infrastructures.

The concept of *osmotic airport* introduces this group of maps. The concept is an abstract image describing the inner nature of the project and at the same time represents its essence and manifesto. Through one icon-image, the *osmotic concept* clearly defines the ways to describe the transformation of physical space: it establishes a stronger relation between the infrastructure and their surrounding territories. At the same time the territories gain an economic improvement and new uses for the airports.

4.4 Vision Maps

So the traditional urban project finds it difficult to emerge as an instrument for controlling transformations. It may pursue a spatial order or became a form of process or the meeting point between strategy and opportunity, but successful results of these actions raise doubts. It is just the territory which cannot express quality and it seems to be expressing the traditional urban project crisis, unable to manage connections with the urban landscapes. It often rejects to interpret new parts of the contemporary city (infrastructure, malls, car parks, disused land, empty spaces, the places of integration and social conflict).

The only way left for describing the space where we live is to think about it as a landscape, made of relationships, stories, interior worlds. Its aesthetics cannot depend upon superimposed measurement. It becomes a complex project. The aesthetics of a landscape lies in images. In the way each place is lived, mythicized, or told. Above all it is the apparent form of a cultural, economic and social context, rather than a physical one.

The vision represents a solid alternative to common practices. It tends to work on the merit of the quality of urban spaces, seeking to conceive a definition of different spaces based on the interactions between dwelling, lifestyles and methods of production. Through this vision we try to give a form to processes of local development, by exploring change. The images of the future focus on strategic questions, direction settlement choices, move beyond the deaf form of the traditional plan that almost never manages to control the change, and always suffers its effects. Visions represent the objectives of quality. Through the process, it is possible to represent the way in which it is possible to realize the project, its ideas, figures and targets displayed by vision. Process is the active master plan device that the City uses to guarantee the quality of change for its citizens.

It is fundamental to find the consensus and the link with institutions. The conflict may be solved thanks to the quality of the future proposed. I think institutions should do the same, that is build up vision plans on which to discuss, find consensus and debate the quality of the projects.

Through vision we could mould processes of local development by exploring change. The images of the future help to focus on strategic issues, in order to define settlement choices and get rid of the traditional planning method.

Visions represent quality targets. They are points of no return as regards urban change management and generally they interpret a strategy of development which is not scared by process accelerations, because in these images the future has already started. You only have to see it.

The objective of *Vision Maps* is drawing a set of images that visualise potential futures and possible further development, specifically of the transportation system. Vision maps explore potential new assets; they use design as analysis and methodological support for strategic processes.

Airport infrastructure for its dimension and relations with the territory is a potential catalytic agent and an activator of contexts: airports as generators of

development in peripheral regions but also as generators of a new image for the area and of themselves. As introduced above, the logic for intervention in various areas is obviously different, depending on contextual analyzes conducted and results obtained.

5. DISSEMINATION

To ensure optimal effectiveness and efficiency of the ADES project, effective and timely communication is crucial during the whole project. Interaction and coordination with the stakeholders involved will permanently challenge both the research process and the outcomes of the research. Furthermore, discussion and dissemination to the ESPON community will further enhance the research process.

5.1 COMMUNICATION PLAN
Parallel Dissemination Strategy – TPG:
A parallel dissemination strategy during and after the project lifetime is adopted intended to promote the project scope and results to the academic community and regional policy stakeholders. To maximise impact in the scientific community and relate the targeted analysis to both theoretical debates in the academic community, the project results are presented at appropriate meetings and conferences, to be agreed by the TPG and communicated to the Steering Committee and ESPON. The project results are also presented for publication in relevant scientific conference, journals and local newspapers.

The Lead Partner and others members of the TPG carry out the dissemination activities and ensure that information and the outputs of the other activities are made available for dissemination purposes in appropriate formats. All dissemination documents are presented in appropriate formats and using non-technical language to reach the target audience and non-specialist planners who are final end-users of the project results. The TPG participated in some ESPON events and Seminars. It also presented the project and its results, as invited by the ESPON CU, public conference, international congress and seminars to present and discuss the first results between experts and regional representatives. The TPG will also presented during 3 stakeholder Seminars the state of ADES project to present and discuss the results. These coordinate meetings will take place in the case study regions and will produce a coordinate Report.

The TPG will also ensure that the summary materials for local, regional and national dissemination are available in an appropriate format that will be left at the disposal of the stakeholders also after the end of the project (presentations, summary conclusions of final report in a downloadable form).

Target Groups

The dissemination activities are targeted on a regional level through the direct communication in local meeting to local actors: firms, companies, politicians, and airport users. At the same time, the dissemination is carried out by the divulgation of the on-going activities through international congress and events. The purpose is to disseminate the research results not only at end of the project but during all the lifetime of the research, to maintained active and productive the interest and the participation of local actors on the research issues. Furthermore, the dissemination strategy planned the attendance not only in events related to the academic world, but especially in regional meetings with the direct participation of local actors, in particular politicians.

Dissemination tools

Efficient dissemination requires making use of a variety of dissemination tools.

The results of the ADES project will be made available through papers to be published in scientific and technical journals worldwide. Popular media (press, magazines, etc.) addressed to the users and the general public will also be targeted.

- Press releases (e.g. local newspapers)
- Media (e.g. a link on the official municipality website)
- Maps as tool of communication
- Questionnaires and interviews

The goal will be to have a number of ADES-related publications and presentations accepted for publication in proceedings and conferences. This will allow to reach a larger number of users and people interested in this topic.

Dissemination activities

The ADES research findings (also in a preliminary phase) are disseminated in national and international events and activities. The list of ADES events include:

a) ESPON Seminars
b) National and International Congresses and Conferences related to transportation systems, air infrastructure and regional development.
c) Umbrella organizations
d) Regional meetings (seminars, focus group or workshops) to present and discuss results to policy-makers and practitioners in the Stakeholder regions (including provision of material in English and local languages)
e) Academic events (with the participation of professionals from both research and practice)
f) European Workshops
g) Reports

a) ESPON Seminars

The TPG will participate in Seminars organized by ESPON CU and the stakeholder regions, (at least 3 ESPON seminars), and the public conference organized by ESPON. The TPG guarantee the presence of its partners at these events to share and discuss the results with the ESPON community.

b) National and International Congresses and Conferences

The TPG will participate at International Congress and Conferences during the project. Each Conference will include scientific presentations and papers, all peer reviewed by a Scientific Committee. The goal is to share experience with other experts on the same issues and to promote the ESPON research findings.

c) Umbrella organizations

The TPG will attend a dedicated meeting of at least one of these umbrella organizations and assist in providing appropriate materials for dissemination through these organizations to other regions. This approach facilitates the dialogue between local and regional authorities and other actors of the sector, such as industry, research centres and universities.

d) Regional meetings

At least one local event is planned to take place at each Stakeholder Regions. They will be coordinated by the TPG and could be structured as seminars, focus groups or workshops. During these meetings, the ADES results will be present and discuss to get feedback from the different local actors (user groups) and local Stakeholders. The goal is to promote project findings and results among representatives from local and regional authorities. The meetings will be opened to the public.

e) Academic events

According to the TPG dissemination strategy, the research findings are presented first to the academic community to get the scientific acceptance. Then, the results can be presented and disseminated to regional policy makers and other wider audience. Due the fact that part of the research activities are developed in academic contexts, it is extremely relevant to share the research findings to experts in the same fields of interest. The add value of these events is that at these meetings always participate professionals from both research and practice.

f) European Workshops

The Workshops are organized in different European cities and airports. These events are conceived as an in situ intensive studio to address some of the themes at the level of the airports and their surrounding territories. The goal is to know the actual condition of underused airports, to upgrade the knowledge by sharing findings with other experts.

e) Reports

The meetings in the Stakeholder Regions will be produced a Report of each events. This report will have a common template in order to make heterogeneous the contents in the documents. They will be in local language

(for local authorities) and in English (to divulge at an European level).
The project will be concluded by a Final Report, consisting of several parts suitable for academics and regional policy-makers, with an Executive Summary that shall be translated into local languages by the TPG for most effective dissemination purposes.

5.2 Schedule of ADES dissemination activities
The following Table gives a schedule of ADES dissemination activities:

Date	Location	Event	Typology of Activity
19 - 20 September 2011	IUAV Venice, Italy	International VDH3 Seminar	Academic events
16 - 21 October 2011	Lleida-Alguaire, Cataluña	International Workshop Emerging Infrastructural Landscapes	European Workshops
1 - 2 December 2011	MAXXI, Rome, Italy	International VDH3 Seminar	Academic events
8 - 10 March 2012	TU Delft, The Netherlands	International VDH3 Seminar	Academic events
14 - 15 March 2012	Oslo, Norway	Joint NS-RSA and ESPON Norba Scientific Seminar	ESPON Seminar
19 - 20 April 2012	Lisbon, Portugal	AIRDEV 2012 Conference	International Conference
13 - 16 May 2012	Delft, The Nederlands	Regional Studies Association European Conference	Umbrella Organization
28 - 29 June 2012	Genoa, Italy	MED.NET.EU.12 International Congress	International Congress
March 2012	City of Jyväskylä, Finland	Summary about the results of the case study of Jyväskylä (in Finnish)	Report
April 2012	Region of Western Greece	Introduction letter of questionnaire	Questionnaire
21 - 25 August 2012	Bratislava, Slovakia	52nd European Congress of the RSAI (ERSA)	International Congress
September 2012	City of Jyväskylä, Finland	Press release	Press and publication

16 - 19 October 2012	TU Delft, The Nederlands	EAAE/ISUF "New Urban Configuration" Conference	International Conference
5 - 6 December 2012	Paphos, Cyprus	Internal ESPON Seminar	ESPON Seminar
30 November 2012	Province of Savona (Villanova d'Albenga), Italy	Regional meeting	Regional meeting and Report
December 2012	City of Jyväskylä, Finland	Article in ESPON publication (in Finnish)	Press and publication
December 2012	Helsinki, Finland	ESPON Seminar	ESPON Seminar
10-11 January 2013	City of Jyväskylä, Finland	Regional meeting	Regional meeting and Report

For a more detailed list of dissemination activities and publications see *Annex 4.*

This Dissemination Plan presented a comprehensive dissemination strategy with a common graphic identity, specific tools and activities adapted to the respective target groups, a clear communication policy and an internal assessment procedure.

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