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## Conference Paper

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50th Congress of the European Regional Science Association: "Sustainable Regional Growth and Development in the Creative Knowledge Economy", 19-23 August 2010, Jönköping, Sweden

### Provided in Cooperation with:

European Regional Science Association (ERSA)

*Suggested Citation:* Dimaki, Katerina; Angelis, Vasilis; Mavri, Maria (2010) : Identifying Clusters of European Regions Based on Their Economic and Social Characteristics., 50th Congress of the European Regional Science Association: "Sustainable Regional Growth and Development in the Creative Knowledge Economy", 19-23 August 2010, Jönköping, Sweden, European Regional Science Association (ERSA), Louvain-la-Neuve

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# Identifying Clusters of European Regions Based on Their Economic and Social Characteristics.

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## ABSTRACT

Nowadays, globalization, technological innovation, migration and population ageing, make it increasingly difficult to predict the future of regions. Identifying the key problems that regions face and considering how these findings could be effectively used as a basis for planning region's improvement, are essential in order to improve the conditions in the European Union regions. Measuring the development of a region means going beyond a purely economic description of human activities and integrate economic, social and environmental concerns.

Working in this context, we have so far defined a variable which is called the Image of a region and expresses its power to attract both economic activities and the right blend of people to run them. The regions' Image is a function of a multitude of factors physical, economic, social and environmental, some common for all potential movers and some specific for particular groups of them.

In some earlier works in this area, we have classified the 27 EU countries according to their economic, social and environmental characteristics in 3, 2 and 3 clusters respectively. By estimating the Image of every cluster member we have defined the country which could be characterized as the leader of the cluster and serve as a benchmark for the others.

As the "region" is in the center of interest of the seventh European Framework Program (FP7), in this study we are going one step further and we focus on the regions of the 27 EU countries. More specifically, our objective is to estimate the Basic Image values for selected EU regions and then group them into clusters on the basis of the same characteristics

used in country level, namely their Economic and Social Indicators. Preliminary results show that the regions of a given country may be allocated to different clusters. The final results will be presented and critically discussed.

**Keywords:** Region's Image, Cluster Analysis, European Regions

## **1. Introduction**

Nowadays, there is wide economic disparity between countries within European Union, with some leading national economies and others falling behind. As governments work to improve their economies, they should consider the results provided by measuring countries' sustainable development.

Sustainable development refers to the ability of societies to meet the needs of the present without sacrificing the ability of future generations to meet their own needs (World Commission on Environment and Development, 1987). Measuring sustainable development means going beyond a purely economic description of human activities; requires integration of economic, social and environmental concerns. New techniques are required in order to benchmark performance, highlight leaders and laggards on various aspects of regional development, and facilitate efforts to identify best practices. New tools have to be designed so as to make sustainability decision-making more objective, systematic and rigorous.

Working in this context, we have so far defined a variable which is called the Image of a region and expresses its power to attract both economic activities and the right blend of people to run them. The regions' Image is a function of a multitude of factors physical, economic, social and environmental, some common for all potential movers and some specific for particular groups of them. Our objective in this paper is to consider the regions of selected EU countries, measure the Image of those regions, and then classify them in various groups on the basis of their images. These clusters will give an indication of a region's present state of development and future prospects and may be used as initial basis for designing measures aiming at the region's improvement.

After this brief introduction, section 2 presents the concepts of sustainability and sustainable development, while section 3 describes measurements and indicators expressing sustainable development. Section 4 briefly describes European Regional Cohesion policies. Section 5 introduces the concept of Basic Image, a measure of an area's overall progress

towards sustainable development which encompasses the two concerns economic and social and suggests ways of measuring it. Section 6 applies this concept to the 147 regions of selected European countries, estimates the Basic Image values and classifies them according to those values. The results are presented and discussed. Finally, Section 7 summarizes the conclusions and suggests further work.

## **2. Sustainable development**

The concept of development is used to express the achievements or the positive changes in the basic elements of human socio-economic behaviour.

Sustainable development is a strategy by which communities seek economic development approaches that also benefit the local environment and quality of life. It has become an important guide to many communities that have discovered that traditional approaches to planning and development are creating, rather than solving, societal and environmental problems. Where traditional approaches can lead to congestion, sprawl, pollution, and resource overconsumption, sustainable development offers real, lasting solutions that will strengthen our future. Sustainable development provides a framework under which communities can use resources efficiently, create efficient infrastructures, protect and enhance quality of life, and create new businesses to strengthen their economies. It can help us create healthy communities that can sustain our generation, as well as those that follow us.

Sustainable development is not a new concept. Discussions about the limits and implications of economic growth and the need for a social dimension of growth have been recurrent in economic history. Recently, a new environmental dimension of development has been added to the economic and social and the blending of all three dimensions in defining sustainable development has been examined.

In the 1950's and 1960's the focus of economic progress was on growth and increase in output based mainly on the concept of economic efficiency. Environment was not yet taken into account since it didn't seem to affect the economic results.

Protection of the environment is the emerging strong new concern in the next decade. By the early 1970's the large and growing numbers of poor in the developing world made people aware of the social dimension of growth and led to greater efforts of directly improving income distribution. The end of this decade also marks the appearance of environment as a new factor affecting economic activity but with limited importance.

Environmental threats are conceived of as local in time and space and hence easy to overcome. Furthermore, at that time, economic growth and environmental quality were largely perceived as opposing each other.

By the early 1980's protection of the environment has become the third objective of development showing that environmental degradation was a major barrier to progress. The concept of sustainable development has therefore evolved to encompass three major points of view: economic, social and environmental. Furthermore by the end of the decade environmental concern is for the first time integrated into the business decision making process.

In the 1990's environmental matters are considered to be the major component of the wider economic activity. Furthermore environmental threats are now perceived as emerging on a very large scale, often related to socio-economic turbulent factors and requiring immediate corrective action. This trend continues and becomes even stronger in the current decade.

The emergence of a borderless economy we are facing today does not imply that cities and regions are the same everywhere but that their distinctive characteristics can become comparative advantages economically, socially and environmentally. Sustainable development emphasises the links among the economic, the social and the environmental dimensions of human well-being, their long-term compatibility and the need for balancing them when conflicts arise in the short-term.

### **3. Indicators and measurements of Sustainable Development**

Measuring sustainable development means going beyond a purely economic description of human activities and integrates economic, social and environmental concerns. In other words, sustainable development means ensuring economic efficiency while respecting social equity and safeguarding ecological integrity.

Many tools and methodologies have been used over the past years to measure the progress towards sustainability. According to Munda (2006), the majority of them make use of a single: (1) measurable indicator such as GDP per capita, (2) dimension i.e. one of the economic, environmental or social dimensions, (3) scale of analysis, (4) objective, e.g. maximization of economic efficiency; (5) time horizon.

Many approaches for measuring sustainable development have led to very detailed frameworks, from which long lists of indicators have been derived. The criteria, according to

which indicators are selected for measuring sustainable developments, are exhausting in literature. Key requirements include (i) the rigorous connection to the definitions of sustainability (Pezzey, 1992), (ii) the selection of meaningful indicators representing holistic fields (Custance and Hillier, 1998), (iii) reliability and availability (measurability) of data for quantification over longer time horizons (Barrios and Komoto, 2006).

A number of researchers include to their measurement frameworks aspects such as social capital (Putnam, 2000), personal capital (Tomer, 2003), freedom rights (Sen, 1999) well-being (Helliwell, 2006) which are seen as important inputs leading to significant socioeconomic outcomes, in order to explain differential sustainable development

On the basis of all the above it can be said that measuring sustainable development means going beyond a purely economic description of human activities - at a minimum, requires integration of economic, social and environmental concerns. This is not an easy task and requires the design of a specific tool. Hence, in this paper we introduce the concept of Basic Image, a measure of an area's overall progress towards sustainable development which encompasses all the three concerns economic, social and environmental and suggests ways of measuring it.

#### **4. European Regional Policy**

The Regional policy of the European Union is a policy with the stated aim of improving the economic well-being of certain regions in the EU. Since 1995, four Cohesion policies have been developed.

According to the *European Regional Cohesion Policy Report*, there are a range of factors which influence the effectiveness and the impact of European cohesion policy. An economic context characterized by price stability and sound budget balances will benefit from lower interest rates. The efficiency and effectiveness of public administrations on national, regional and local level is another critical factor. Finally it is often external factors, notably globalisation, that are the main driving factors of structural changes at all levels and which have a large impact on economic development and job creation.

The importance of regional policy has grown with the progressive enlargement of the EU. The States that have acceded in the past five years had lower GDP per head than the Union they were joining and their accession has by itself had the statistical effect of considerably widening disparities between Member States and between regions.

Three Funds are used for regional policy:

- The *European Regional Development Fund* (ERDF) finances direct aid for investment in companies (particularly small and medium-sized enterprises), infrastructure, financial instruments (such as capital risk funds and local development funds) and technical assistance measures. It is allocated on a regional basis.
- The *European Social Fund* (ESF) finances projects in the labour market that improve skills (human capital) and access to employment opportunities and social integration. It is again allocated on a regional basis.
- The *Cohesion Fund* finances developments in transport networks which have been identified as priority projects by the EU; projects related to the environment; and energy and transport projects with clear environmental benefits. It is allocated at the Member State level, with finance from the Fund conditional on compliance with the Stability and Growth Pact requirement of not running an excessive public deficit.

Regional policy's share of the budget has also increased over time: by 1988 the share was 17% and since then it has slowly risen and is budgeted to be 38% by 2013. This growth has been at the expense of payments to agriculture, for which the share of the budget has gradually decreased over time. For the 2007–2013 Financial Framework, the total funding available is €308 billion at 2004 prices<sup>26</sup> which constitutes approximately 0.38% of the EU's GNI. However, the proportion of the budget allocated to regional policy has not risen significantly in recent years despite the increased disparity in wealth in the enlarged EU

Sustainable convergence can only be achieved if we take into account the broader framework in which the EU economy operates. In the role of cohesion policy is to help regional economies find their place in world markets, in critical global networks and clusters; to allow them to measure their strengths and weaknesses against global challenges and opportunities and to foster their internationalisation.

According to the last regional policy, two statements for economic and social cohesion are obvious:

- Convergence is occurring both at national and at regional level but disparities remain important. Increases in employment and productivity are raising growth in the regions (*Economic Cohesion*)
- Employment rates converged at the EU level and the national level and disparities in unemployment rates have decreased. Poverty remains a challenge. Education levels are increasing but remain low in lagging regions (*Social Cohesion*)

## 5. The concept of Basic Image

The growth or decline of a region depends on its power to "pull" and retain both business activities and the right blend of people to run them; this pulling power depends on what we call the Image of the region. At each point in time the region "sends out" its Image and depending on its impact on the people (both employers and employees) the region may be considered attractive or non attractive. In other words, the growth of a region depends on the nature of the net flows of investment and migrants between the region and the rest of the world which are frequently influenced by something as insubstantial as the kind of image the region puts forth (Perloff, H. S. and Wingo, L., 1971).

One may argue that since people "receiving" the image of the region belong to various distinct groups (i.e. employers, unskilled workers, skilled workers etc.) and are sensitive to different factors; the impact of the Image of the region on the members of each particular group will be different. Whilst this is plausible, the evidence presented in section 2 suggests that all groups of potential movers react similarly to a basic set of factors; more precisely a set of minimum standards largely common to all groups must be satisfied if the region is to be considered as a potential choice by any of them. To reconcile these two views we refine the concept of a region's Image by introducing the following two concepts: the Basic Image and the Specific Image.

**Basic Image** of a given region measures the degree to which the region satisfies a set of basic criteria common for all movers. A region satisfying those criteria is considered by all potential movers as worth a closer examination and as a potential final choice.

**Specific Image** of a given region, as perceived by a particular group of potential movers, measures the degree to which movers belonging to that particular group consider the region as their best final choice. This Specific Image however, although a function of specific factors appealing mainly to members of that group, is primarily a function of the Basic Image.

The concepts of Basic and Specific Image has been discussed in full details in some earlier papers (Angelis, 1980, 1990, 2009, Angelis & Dimoloulou, 1991, Angelis & Dimaki, 2010). Summarizing the findings for the Basic Image which is our main interest in this paper, we can say the following:

The factors affecting the Basic Image that have been presented so far, include land availability for business expansion, access to markets and materials, housing conditions, sanitary and environmental conditions, regional influence etc. Furthermore, they have been divided into two sets according to whether they express the economic or the social function of



the region. The factors of the first set (*Accessibility to Centers of Influence, Land Availability, Financial Conditions*) provide a measure of the region's economic development prospects. This measure is referred to as Economic Indicator. Similarly, the factors of the second set (*Housing Conditions, Environmental Conditions, Social Conditions*) provide a measure of a region's social profile. This measure is referred to as Social Indicator. Hence,

$$\text{Basic Image} = \varphi(\text{Economic Indicator}, \text{Social Indicator})$$

The expression of the Basic Image as a function of those two Indicators is not accidental; on the contrary, it is consistent with the concept of a region as a socio-economic unit. The main advantage of such an expression is that it may be used to underline and eventually describe, the basic conflict that characterises the development of a region (Perloff, H. S. and Wingo, L., 1971 and Zolotas, X., 1981).

At this point it should be mentioned that the growth of a region may be expressed both in absolute or relative terms. In the latter and most interesting case the development pattern of a given region is compared to that of a hypothetical region, which is referred to as the "typical" region and expresses, as far as possible, an average of the main regions of a similar type to that of the study. In this paper we shall be looking at the relative development patterns of a region. Hence, all the factors affecting its images (Basic and Specific) should be expressed in relative terms as compared to the corresponding values of the "typical" region

Furthermore, it has been shown that the process of shaping a region's Basic Image has all the properties characterizing phenomena which may be modeled in terms of Catastrophe Theory (Thom, 1975; Zeeman, 1973, 1977). Hence we may now use Catastrophe Theory to estimate a region's Basic Image. It is reminded that the Basic Image of a region has been defined as a function of two conflicting indicators. Therefore, the appropriate elementary catastrophe is the cusp. Consequently, the value  $x$ , of a region's Basic Image, at each point in time, is given as a solution of the equation:

$$x^3 - bx - a = 0 \tag{1}$$

with,

$$\begin{cases} a = m(\alpha - \alpha_0) + (\beta - \beta_0) \\ b = (\alpha - \alpha_0) - m(\beta - \beta_0) \end{cases} \text{ if } m \leq 1 \left( \text{i.e. } \theta \leq \frac{\pi}{2} \right)$$

and

$$\begin{cases} a = (\alpha - \alpha_0) + (1/m)(\beta - \beta_0) \\ b = (1/m)(\alpha - \alpha_0) - (\beta - \beta_0) \end{cases} \text{ if } m > 1 \left( \text{i.e. } \theta > \frac{\pi}{2} \right)$$

since,

$$\begin{pmatrix} \alpha - \alpha_0 \\ \beta - \beta_0 \end{pmatrix} = \cos \theta \begin{pmatrix} \cos\left(\frac{\pi}{2} - \theta\right) & -\sin\left(\frac{\pi}{2} - \theta\right) \\ \sin\left(\frac{\pi}{2} - \theta\right) & \cos\left(\frac{\pi}{2} - \theta\right) \end{pmatrix} \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix} \begin{pmatrix} a \\ b \end{pmatrix} \text{ if } \theta \leq \frac{\pi}{2}$$

and

$$\begin{pmatrix} \alpha - \alpha_0 \\ \beta - \beta_0 \end{pmatrix} = \sin \theta \begin{pmatrix} \cos\left(\frac{\pi}{2} - \theta\right) & -\sin\left(\frac{\pi}{2} - \theta\right) \\ \sin\left(\frac{\pi}{2} - \theta\right) & \cos\left(\frac{\pi}{2} - \theta\right) \end{pmatrix} \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix} \begin{pmatrix} a \\ b \end{pmatrix} \text{ if } \theta > \frac{\pi}{2}.$$

Equation (1) is referred to as the **Basic Image Equation** and its graph is qualitatively equivalent to the Cusp Catastrophe Graph (Figure 1).

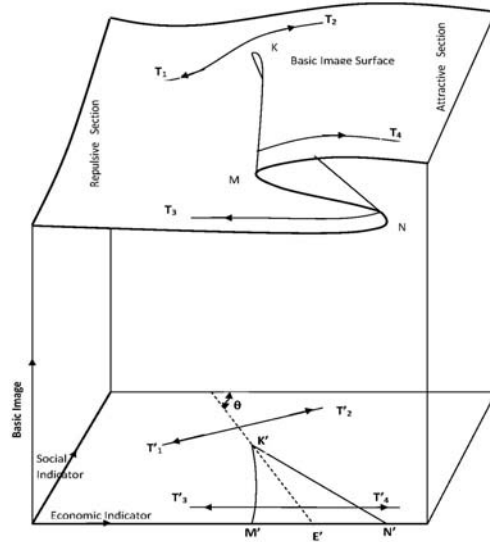


Figure 1 The Cusp Catastrophe graph in the case of Basic Image

The variables  $\alpha$ ,  $\beta$  express the values of the two Indicators, while  $\alpha_0$ ,  $\beta_0$ , express the values of those two Indicators for the “typical” region. The point  $(\alpha_0, \beta_0)$  corresponds to the vertex of the cusp, while  $m = \tan \theta$  represents the slope of the cusp axis and expresses the relative weights attached to each one of the two indicators in defining the Basic Image.

For the purposes of this work, the values of all Indicators lie in the interval  $[0,1]$ , whereas the value of its Basic Image lies in the interval  $[-1,1]$ . The value of the “typical” region's Basic Image is 0. Hence, positive Basic Image indicates an attractive region that may be considered as a potential final choice by the various groups of prospective movers

The position of the cusp in Figure 1 is indicative. The trajectory of a region's Basic Image lies on the Basic Image surface. As long as the trajectory remains on the upper section of this surface the area is attractive while if the trajectory moves on the lower part, the region becomes repulsive.  $T_1T_2$  and  $T_3T_4$  are typical trajectories of an area's Basic Image and  $T_1'T_2'$ ,  $T_3'T_4'$  are their projections on the two dimensional Control Space  $C$ . The line  $KM$  is the locus of breaking points for areas undergoing sudden loss of attractiveness while the line  $KN$  is the locus of turning points for regions going through a phase of sudden increase of attractiveness.  $K'M'$ ,  $K'N'$  are the projections of  $KM$ ,  $KN$  on the Control Space and  $K'E'$  is the projection on  $C$  of the cusp axis.

Returning to the present case it is reminded that the factors affecting a region's Basic Image may be divided into two sets according to whether they express the economic or the social aspect of the region. The factors of the first set provide a measure of the region's economic development prospects. This measure is referred to as the **Economic Indicator**. Similarly, the factors of the second set provide a measure of a region's social profile. This measure is referred to as the **Social Indicator**.

A list of all variables affecting a region's Basic Image and a detailed outline of their conversion into the two Indicators and finally into the region's Basic Image is given in the next section 6 (*Table 7*).

## 6. Application

In some earlier work, using the concept of Basic Image and the methodology presented in the previous section, we have calculated the Basic Image values of the twenty seven EU countries for the year 2008. Furthermore, based on the components of the Basic Image Indicators, which express the economic, social and environmental characteristics of the countries under consideration and using cluster analysis, we have classified the twenty seven EU countries in three, two and three clusters respectively. Summarizing the findings, we can say that:

1. A cluster containing all the ex- socialist European countries was formed irrespective of the classification criteria used. Slovenia was the only exception to that rule, as it shows a completely different behavior.
2. All the other EU-countries were classified in one or two clusters depending on the criteria used each time.

After classifying the countries, we ranked them, according to their Basic Image, as shown in Table 1

*Table1 Basic Image values for the 27 European countries*

#	Countries	BI	#	Countries	BI
1	Austria	1.133	15	Latvia	0.475
2	Sweden	1.126	16	Portugal	0.366
3	Finland	1.111	17	Cyprus	0.361
4	Luxembourg	1.103	18	Greece	0.271
5	Germany	1.100	19	Czech Republic	-0.134
6	France	1.084	20	Estonia	-0.209
7	Ireland	1.083	21	Malta	-0.265
8	Denmark	1.073	22	Hungary	-0.279
9	Italy	1.071	23	Lithuania	-0.318
10	Belgium	1.069	24	Slovakia	-0.327
11	Slovenia	1.027	25	Poland	-0.374
12	Spain	1.027	26	Bulgaria	-0.379
13	Netherlands	1.019	27	Romania	-0.397
14	United Kingdom	0.996			

Based on Table 1 the following conclusions may be drawn:

- Austria has the higher Basic Image value
- The first thirteen countries have positive Basic Image values greater than 1
- United Kingdom has Basic Image value approximately equal to 1
- Latvia, Portugal, Greece and Cyprus have positive Basic image values but lower than 0.5
- All ex-social countries have negative Basic Image values lying in the interval [-0.4, 0]

The work concluded by identifying the country with the highest Basic Image value in each cluster. This region is referred to as the cluster leader and may be used as a benchmark for all other countries. Summarizing the findings, we can say that Luxemburg, Romania and Austria were leader countries in the three economic clusters, Austria and Latvia leaders in the two social clusters and finally Austria, Latvia and Germany leaders in the three environmental clusters respectively.

In this paper we go a step further and focus on the regions of a selected cluster from the previous application, in order to determine the different groups emerging at regional level. The scope of this application is to identify:

- the regions of different countries belonging to the same cluster
- the leader region in each cluster

The countries of the chosen cluster are: Belgium, Germany, Netherlands, Italy, Austria, Slovenia, Finland, Sweden, and United Kingdom. Those countries have in total 147 regions distributed among them as shown in Table 2 below:

*Table 2: Number of examined regions per country*

<b>Countries</b>	<b># of regions</b>
Belgium	11
Germany	39
Netherlands	11
Italy	21
Austria	9
Slovenia	6
Finland	5
Sweden	8
United Kingdom	37
<b>TOTAL</b>	<b>147</b>

We start by classifying these regions twice, based on their economic and social characteristics respectively. Towards this end a cluster analysis has been used consisting of the following steps:

*Step 1:* The Hierarchical Clustering method was used in order to determine, through a dendrogram, the number of emerging clusters.

*Step 2:* After defining the number of clusters the K-means method was used, in order to determine the regions belonging to each cluster.

*Step 3:* The means of selected regional characteristics were compared in order to identify differences between clusters.

On the basis of their economic and social characteristics, the regions have been classified into 6 clusters each time, as shown in Tables 3 and 4.

In order to identify the differences between the economic clusters, the following hypotheses is tested

**H<sub>0</sub>:** There is no difference in the means of economic characteristics of clusters 1, 2, 3, 4, 5, and 6

**H<sub>1</sub>:** There is difference in the means of at least one economic characteristic of clusters 1, 2, 3, 4, 5, and 6.

The results are shown in Table 5

*Table 5: Report of means comparison between Clusters*

<b>Report</b>					
<b>Cluster</b>		<i>GDP per habitant</i>	<i>Employment Rate</i>	<i>% of GDP in Research &amp; Development</i>	<i>Braodband Access</i>
<b>1</b>	<b>Mean</b>	<b>3.0740</b>	<b>1.0883</b>	<b>2.8250</b>	<b>.9877</b>
	N	2	2	2	2
	Std. Deviation	.48078	.00509	.60104	.00000
<b>2</b>	<b>Mean</b>	<b>.5534</b>	<b>.9801</b>	<b>.5519</b>	<b>1.0029</b>
	N	80	80	80	80
	Std. Deviation	.32735	.10739	.24439	.04526
<b>3</b>	<b>Mean</b>	<b>2.2264</b>	<b>.9536</b>	<b>.8182</b>	<b>.9844</b>
	N	18	18	18	18
	Std. Deviation	.57240	.13659	.35426	.02931
<b>4</b>	<b>Mean</b>	<b>1.0488</b>	<b>1.0529</b>	<b>1.4411</b>	<b>.9951</b>
	N	30	30	30	30
	Std. Deviation	.45003	.05760	.31825	.04574
<b>5</b>	<b>Mean</b>	<b>5.8048</b>	<b>.9723</b>	<b>.6333</b>	<b>.9877</b>
	N	2	2	2	2
	Std. Deviation	.49834	.01019	.02357	.04988
<b>6</b>	<b>Mean</b>	<b>.8954</b>	<b>1.0477</b>	<b>2.5115</b>	<b>1.0167</b>
	N	15	15	15	15
	Std. Deviation	.35267	.04354	.48218	.04742
<b>Total</b>	<b>Mean</b>	<b>1.0000</b>	<b>1.0000</b>	<b>.9980</b>	<b>1.0001</b>
	N	147	147	147	147
	Std. Deviation	.90724	10326	.72668	.04392

- Cluster 2 contains 50% of the regions under consideration. These are regions with very good social infrastructure, as the means of all variables are either higher or slightly lower than the respective population
- Clusters 3 and 4 contain economically strong regions as the means of all variables are higher than the respective population means.
- Cluster 5 contains slightly less strong regions than those of Clusters 3 and 4. The means of all variables are higher than the respective population means, with the exception of one variable (% of GDP to Research & Development), whose means is lower than the respective population mean
- Clusters 1 and 6 contain only two regions each. Hence, although the means of all variables are higher than the respective population means, no statistically significant conclusion may be drawn.

In order to identify the differences between the social clusters, the following hypotheses is tested

$H_0$ : There is no difference in the means of social characteristics of clusters 1, 2, 3, 4, 5, and 6

**H<sub>1</sub>:** There is difference in the means of at least one social characteristic of clusters 1, 2, 3, 4, 5, and 6.

The results are shown in Table 6

*Table 6: Report of means comparison between Clusters*

<i>Cluster</i>		<i>Hospital Beds</i>	<i>Expenditure in Social Protection</i>	<i>Young Educated People</i>	<i>Expenditure on Education</i>	<i>Energy</i>
<b>1</b>	<b>Mean</b>	<b>7.8643</b>	<b>1.0574</b>	<b>1.9788</b>	<b>2.8625</b>	<b>.6329</b>
	N	1	1	1	1	1
<b>2</b>	<b>Mean</b>	<b>.5200</b>	<b>1.0878</b>	<b>1.4255</b>	<b>2.2452</b>	<b>1.0972</b>
	N	21	21	21	21	21
	Std. Deviation	.46006	.13612	.43820	.65733	.29835
<b>3</b>	<b>Mean</b>	<b>2.4949</b>	<b>1.0574</b>	<b>.6452</b>	<b>.9081</b>	<b>.6329</b>
	N	18	18	18	18	18
	Std. Deviation	.47032	.00000	.12284	.17119	.00000
<b>4</b>	<b>Mean</b>	<b>4.0862</b>	<b>1.0574</b>	<b>1.0858</b>	<b>1.4874</b>	<b>.6329</b>
	N	11	11	11	11	11
	Std. Deviation	.52147	.00000	.31046	.18981	.00000
<b>5</b>	<b>Mean</b>	<b>.4597</b>	<b>1.1106</b>	<b>.4995</b>	<b>.6553</b>	<b>.9747</b>
	N	61	61	61	61	61
	Std. Deviation	.27452	.13984	.26901	.36148	.34995
<b>6</b>	<b>Mean</b>	<b>.2593</b>	<b>1.1178</b>	<b>1.7752</b>	<b>.6640</b>	<b>1.2724</b>
	N	35	35	35	35	35
	Std. Deviation	.10444	.17288	.38058	.38824	.39803
<b>Total</b>	<b>Mean</b>	<b>.9915</b>	<b>1.0982</b>	<b>1.0073</b>	<b>.9927</b>	<b>.9934</b>
	N	147	147	147	147	147
	Std. Deviation	1.30742	.13434	.62886	.70445	.38272

- Cluster 2, 3 and 4 contain regions with very good social infrastructure, as the means of all variables are either higher or slightly lower than the respective population means.
- Cluster 5 and 6 contain regions with developed social infrastructure, as three out of five means of variable are consider higher than the respective population means. Variables with lower than average value refers to the level of hospital beds and expenditure on education.
- Cluster 1 and 6 contain only two regions each, so no conclusion may be drawn.

After classifying regions, we proceed to the calculation of their Basic Image. It has already been mentioned that the Basic Image is a measure of a region's attractiveness and a function of a multitude of variables economic and social. All these variables and an indicative plan of their conversion into the two indicators is shown in Table 7.

*Table 7: Conversion of the variables affecting a region's Image into Basic Image*

<b>Basic Image</b>			
<b>Indicator</b>	<b>Multiplier</b>	<b>Index</b>	<b>Variable</b>
<b>Economic</b>	GDPC	GDP per Capita in Purchasing Power Standards (PPS) (EU-27 = 100)	Population Density
			Gross Domestic Product
	RDGM	Research & Development percentage of GDP	Percentage of Gross Expenditure on R&D financed by industry
			Percentage of Gross Expenditure on R&D financed from abroad
			Gross Domestic Product
	ERM	Employment Rate	Number of persons aged group 15-64 employed
BEM	Percentage of enterprises with Broadband connection	Number of enterprises with more than 9 employees	
		Number of enterprises with Broadband connection to the Internet	
<b>Social</b>	ESPM	Expenditure on social protection per head (in PPS million)	Social benefits (amount transferred, in cash or in kind, to households or individuals to relieve them of a set of risks)
			Administration costs
			Other expenditure (i.e. payment of property income)
	EEM	Expenditure on Education (in PPS million)	Population Density
			Total expenditure for educational institutions
	HBM	Hospital beds (in 100.000 habitants)	Total expenditure transferred to private households and firms
			Number of Hospital Beds
	EYPM	Educated Young People	Number of young people aged 20-24 years having attained at least upper secondary education attainment level
Number of young people aged 20-24 years old			
EIEM	Energy Intensity of the Economy	Gross inland consumption of energy the gross domestic product (GDP)	
		Index of greenhouse gas emissions and targets - In CO <sub>2</sub> equivalents (Actual base year = 100)	
		Extraction of energy products from natural sources to a usable form	
		Primary production of biomass, hydropower, geothermal energy, wind and solar energy	



Table 8 summarizes the Basic Image values of all regions. Looking at this table the following conclusions may be drawn remarks:

- The region with the highest basic image is Etelä-Suomi in Finland
- Positive Basic Image value have
  - Five out of the thirteen regions of Belgium
  - Seven out of the thirty-nine regions of Germany
  - Seven out of the eleven regions of Netherlands
  - Seventeen out of the twenty one regions of Italy
  - Seven out of the nine regions of Austria
  - None of the regions of Slovenia
  - Four out of the five regions of Finland
  - All the regions of Sweden
  - Nineteen out of the thirty nine regions of United Kingdom
- Among the regions with the higher Economic Indicator values [0.6,0.7], four regions belong to Germany (Stuttgart, Oberbayern, Darmstadt, Karlsruhe) one in Finland (Etelä-Suomi), one in Sweden (Stockholm) and two in United Kingdom (East Anglia, Bucks and Oxfordshire)
- Among the regions with the higher Social Indicator values [0.55,0.6], two regions belong to Sweden (Stockholm, Västsverige) five in Italy (Lazio, Lombardia, Emilia-Romagna, Campania, Toscana ), one in Austria (Wien), one in Finland (Etelä-Suomi).

The values of Basic Images gives an indication of the region which could be characterized as the leader of the cluster and each characteristics, will be the benchmarks for all the regions of the cluster.

*Table 9: Leader Regions*

	<i>Basic Image (BI)</i>
<i>Economic Cluster</i>	
Cluster 1	Oberbayern Germany
Cluster 2	Etelä-Suomi Finland
Cluster 3	Lazio Italy
Cluster 4	Wien Austria
Cluster 5	Lombardia Italy
Cluster 6	Västsverige Sweden
<i>Social Cluster</i>	
Cluster 1	Outer London United Kingdom
Cluster 2	Etelä-Suomi Finland
Cluster 3	Essex United Kingdom
Cluster 4	East Anglia United Kingdom
Cluster 5	Oberösterreich Austria
Cluster 6	Stockholm Sweden

Based on Table 9 the following remarks can be made:

- i. The leaders of the six economic clusters are six regions belonging to different countries (Italy, Austria, Finland, Sweden, Germany and United Kingdom).
- ii. Among the leaders of the six social clusters three belong to the United Kingdom (clusters 1, 3 and 4).

## **7. Conclusions**

Sustainable development refers to the ability of our societies to meet the needs of the present without sacrificing the ability of future generations to meet their own needs. Measuring sustainable development means going beyond a purely economic description of human activities; requires integration of economic, social and environmental concerns. New techniques are required in order to benchmark performance, highlight leaders and laggards on various aspects of regional development, and facilitate efforts to identify best practices. New tools have to be designed so as to make sustainability decision-making more objective, systematic and rigorous.

The first part of this paper discussed the concept of sustainable development and introduced Basic Image i.e. a variable expressing a region's attractiveness and overall progress towards sustainable development which encompasses all the three components economic, social and environmental of such a development. The second part gave an overview of the methodology used to quantify a region's Basic Image and applied it to a number of selected regions. More specifically, using the results of a previous work on the clustering of the 27 EU countries based on their economic, social and environmental characteristics we selected an economic cluster and listed all the regions belonging to the countries of that cluster. Then, using cluster analysis, we classified those regions on the basis of their economic and social characteristics into six clusters each time and commented on the results. Finally, we calculated the Basic Image values of all regions, identified the cluster leaders i.e. the regions with the highest Basic Image value in each cluster and also commented on the results.

The paper presents a number of very interesting findings. An area of further research would be to extend the procedure so as to include all regions of 27 EU countries.

*Table 3: Regional Clusters based on Economic Characteristics*

<b>Cluster 1</b>	<b>Cluster 2</b>		<b>Cluster 3</b>	<b>Cluster 4</b>	<b>Cluster 5</b>	<b>Cluster 6</b>
<i>Germany</i>	<i>Belgium</i>	Marche	<i>Germany</i>	<i>Germany</i>	<i>Italy</i>	<i>Germany</i>
Stuttgart	Region de bruxelles	Abruzzo	Hamburg	Karlsruhe	Lombardia	Tubingen
Oberbayern	Antwerpen	Molise	Darmstadt	Freiburg	<i>United kingdom</i>	Dresden
	Limburg	Puglia	Dusseldorf	Mittelfranken	OuterLondon	<i>Austria</i>
	Oost Vlaanderen	Basilicata	Koln	Unterfranken		Steiermark
	Vlaam Brabant	Calabria	Arnsberg	Berlin		<i>Finland</i>
	West Vlaanderen	Sardegna	<i>Netherlands</i>	Bremen		Pohjois Suomi
	BrabantWallon	<i>Austria</i>	NoordHolland	Detmold		Aland
	Hainaut	Burgenland	ZuidHolland	Rheinessen Pfalz		<i>Sweden</i>
	Liege	Niederosterreich	<i>Italy</i>	Thuringen		OstraMellansverige
	Luxembourg	Salzburg	Piemonte	<i>Netherlands</i>		Smalandmedoarna
	Namur	Vorarlberg	Veneto	Gelderland		Vastsverige
	<i>Germany</i>	<i>Slovenia</i>	EmiliaRomagna	Utrecht		NorraMellansverige
	Oberfranken	Vzhodna Slovenija	Toscana	Noord Brabant		<i>United kingdom</i>
	Schwaben	Zahodna Slovenija	LazioI	Limburg		GreaterManchester
	Brandenburg Nordost	Bratislavsk kraj	Campania	<i>Austria</i>		LeicestershireRutland
	Brandenburg Sudwest	Zapadne Slovensko	Sicilia	Wien		BedfordshireHertfords
	Darmstadt	Stredne Slovensko	<i>United Kingdom</i>	Karnten		InnerLondon
	Gieben	Vychodne Slovensko	Lancashire	Oberosterreich		
	Kassel	<i>Finland</i>	EasAnglia	Tirol		
	MecklenburgVorpommern	Ita Suomi	BerkshireOxfordshire	<i>Finland</i>		
	Hannover	Etela Suomi	Hampshire	LansuomiF		
	Luneburg	<i>Sweden</i>		<i>United Kingdom</i>		
	WeserEms	Stockholm		TeesValleyandDurham		
	Munster	Sydsverige		Merseyside		
	Koblenz	MellerstaNorrland		Shropshire Staffordshi		
	Trier	OvreNorrland		Essex		
	Saarland	<i>United Kingdom</i>		Surrey		
	Chemnitz	NorthumberlandTyne		Kent		
	Leipzig	Cumbria		Gloucestershire Bristol		
	Sachsen Anhalt	Cheshire		DorsetU		
	Schleswig Holstein	East Yorkshire Norther		NorthEasternScotland		
	<i>Netherlands</i>	North Yorkshire		HighlandsIsland		
	Friesland	South Yorkshire				
	Drenthe	WestYorkshire				
	Overijssel	DerbyshireNottingham				
	Flevoland	Lincolnshire				
	Zeeland	Herefordshire				
	<i>Italy</i>	WestMidlands				
	ValleAostaallee	Cornwall				
	Liguria	Devon				
	ProvinciaAutonomaBolz	West Wales				
	ProvinciaAutonomaTren	East Wales				
	FriuliVeneziaGiulia	Eastern Scotland				
	Umbria	South Western Scotland/ NorthernIreland				

Table 4: Regional Clusters based on Social Characteristics

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5		Cluster 6
<b>United Kingdom</b>	<b>Germany</b>	<b>United Kingdom</b>	<b>United Kingdom</b>	<b>Belgium</b>	<b>Italy</b>	<b>Belgium</b>
OuterLondon	Stuttgart	Tees Valley and Durham	GreaterManchester	Regiondebruxelles	ValleAostaallee	Limburg
	Oberbayern	Northumberl and Tyneand	West Yorkshire	Antwerpen	ProvinciaAutonomaBolz	OostVlaanderen
	Berlin	Cheshire	Derbyshire Nottinghams	VlaamsBrabant	<b>Austria</b>	WestVlaanderen
	Darmstadt	Lancashire	West Midlands	BrabantWallon	Burgenland	Hainaut
	Dusseldorf	Merseyside	East Anglia	Liege	Niederosterreich	Luxembourg
	Arnsberg	SouthYorkshire	InnerLondon	<b>Germany</b>	Karnten	Namur
	<b>Netherlands</b>	Leicestershire Rutland	BerkshireOxfordshire	Oberpfalz	Oberosterreich	<b>Netherlands</b>
	Gelderland	Herefordshire	Surrey	Oberfranken	<b>Slovenia</b>	Overijssel
	Noord Holland	Shropshire Staffordshi	Gloucestershire Bristol	Mittelfranken	VzhodnaSlovenija	Utrecht
	Zuid Holland	Bedfordshire Hertfords	EasternScotland	Unterfranken	ZapadneSlovensko	<b>Italy</b>
	<b>Italy</b>	Essex	South Western Scotland	Schwaben	StredneSlovensko	Liguria
	Piemonte	Hampshire		BrandenburgNordost	<b>United kingdom</b>	FriuliVeneziaGiulia
	Lombardia	Kent		BrandenburgSudwest	Cumbria	Umbria
	ProvinciaAutonomaTren	Dorset		Bremen	EastYorkshireNorther	Abruzzo
	Veneto	Devon		Hamburg	NorthYorkshire	Molise
	EmiliaRomagna	WestWales		Gieben	Lincolnshire	Calabria
	Toscana	EastWales		Kassel	Cornwall	Sardegna
	Lazio	NorthernIreland		MecklenburgVorpommern	NorthEasternScotland	<b>Austria</b>
	Campania			Braunschweig	HighlandsIsland	Wien
	Sicilia			Hannover		Steiermark
	<b>Finland</b>			Luneburg		Salzburg
	EtelaSuomi			WeserEms		Tirol
				Munster		<b>Slovenia</b>
				Koblenz		ZahodnaSlovenija
				Trier		Bratislavsk kraj
				RheinessenPfalz		<b>Finland</b>
				Saarland		ItaSuomi
				Chemnitz		LansSuomi
				Dresden		PohjoisSuomi
				Leipzig		Aland
				Sachsen Anhalt		<b>Sweden</b>
				SchleswigHolstein		Stockholm
				<b>Netherlands</b>		OstraMellansverige
				Friesland		Smalandmedoarna
				Drenthe		Sydsverige
				Flevoland		Vastsverige
				Zeeland		NorraMellansverige
						MellerstaNorrland
						OvreNorrland

Table 8: Basic Image values for the 147 European regions

	EI	SI	BI		EI	SI	BI		EI	SI	BI
<b>Belgium</b>				<b>Germany</b>							
Région de Bruxelles	0.485	0.468	0.2083	Hannover	0.525	0.420	-0.3856				
Prov. Antwerpen	0.489	0.471	0.2359	Lüneburg	0.438	0.402	-0.3510				
Prov. Limburg	0.436	0.469	0.1409	Weser-Ems	0.459	0.432	-0.2807				
Prov. Oost-Vlaanderen	0.468	0.494	0.3116	Düsseldorf	0.574	0.509	0.4503	<b>Austria</b>			
Prov. Vlaams Brabant	0.459	0.429	-0.2919	Köln	0.598	0.491	0.4350	Burgenland	0.384	0.413	-0.2744
Prov. West-Vlaanderen	0.456	0.498	0.3124	Münster	0.478	0.437	-0.2820	Niederösterreich	0.458	0.464	0.1142
Prov. Brabant Wallon	0.420	0.420	-0.2842	Detmold	0.502	0.416	-0.3738	Wien	0.568	0.583	0.5561
Prov. Hainaut	0.430	0.487	0.2452	Arnsberg	0.526	0.473	0.2991	Kärnten	0.466	0.468	0.1768
Prov. Liège	0.430	0.422	-0.2870	Koblenz	0.435	0.394	-0.3671	Steiermark	0.519	0.543	0.4660
Prov. Luxembourg	0.415	0.431	-0.2382	Trier	0.416	0.353	-0.4300	Oberösterreich	0.505	0.493	0.3467
Prov. Namur	0.422	0.444	-0.1782	Rheinhessen-Pfalz	0.539	0.415	-0.4106	Salzburg	0.422	0.501	0.2893
<b>Germany</b>				Saarland	0.437	0.375	-0.4071	Tirol	0.475	0.514	0.3736
Stuttgart	0.672	0.481	0.4851	Chemnitz	0.451	0.394	-0.3802	Vorarlberg	0.422	0.408	-0.3218
Karlsruhe	0.607	0.442	-0.4130	Dresden	0.537	0.400	-0.4398	Övre Norrland	0.478	0.501	0.3429
Freiburg	0.546	0.422	-0.4010	Leipzig	0.461	0.376	-0.4235	Schleswig-Holstein	0.497	0.445	-0.2695
Tübingen	0.570	0.406	-0.4564	Sachsen-Anhalt	0.468	0.430	-0.2979				
Oberbayern	0.666	0.488	0.4928	Thüringen	0.494	0.426	-0.3384	<b>Sweden</b>			
Niederbayern	0.537	0.381	-0.4732	<b>Netherlands</b>				Stockholm	0.626	0.560	0.5676
Oberpfalz	0.535	0.377	-0.4781	Friesland	0.417	0.438	-0.2075	Östra Mellansverige	0.555	0.548	0.5007
Oberfranken	0.447	0.377	-0.4110	Drenthe	0.422	0.379	-0.3882	Småland med öarna	0.446	0.503	0.3181
Mittelfranken	0.541	0.402	-0.4393	Overijssel	0.464	0.476	0.2309	Sydsverige	0.565	0.538	0.4931
Unterfranken	0.493	0.387	-0.4283	Gelderland	0.531	0.495	0.3787	Västsverige	0.594	0.550	0.5321
Schwaben	0.480	0.405	-0.3803	Flevoland	0.437	0.358	-0.4366	Norra Mellansverige	0.447	0.502	0.3161
Berlin	0.578	0.464	0.3317	Utrecht	0.505	0.492	0.3437	Mellersta Norrland	0.407	0.473	0.1403
Brandenburg - Nordost	0.398	0.379	-0.3700	Noord-Holland	0.550	0.518	0.4470	Umbria	0.408	0.480	0.1870
Marche	0.425	0.498	0.2822	Zuid-Holland	0.560	0.538	0.4893				
Brandenburg - Südwest	0.450	0.389	-0.3900	Zeeland	0.407	0.386	-0.3623	<b>Slovenia</b>			
Bremen	0.470	0.359	-0.4585	Noord-Brabant	0.581	0.513	0.4639	Vzhodna Slovenija	0.410	0.394	-0.3468
Hamburg	0.544	0.404	-0.4380	Limburg	0.488	0.463	0.1626	Zahodna Slovenija	0.453	0.431	-0.2780
Darmstadt	0.625	0.475	0.4246	<b>Finland</b>				Bratislavský kraj	0.409	0.437	-0.2041
Gießen	0.474	0.375	-0.4351	Itä-Suom	0.440	0.504	0.3154	Západné Slovensko	0.391	0.400	-0.3168
Kassel	0.448	0.383	-0.4004	Etelä-Suomi	0.616	0.572	0.5751	Stredné Slovensko	0.370	0.404	-0.2892
Mecklenburg-rpommern	0.452	0.401	-0.3654	Länsi-Suomi	0.542	0.531	0.4638	Východné Slovensko	0.371	0.395	-0.3135
Braunschweig	0.571	0.399	-0.4699	Pohjois-Suomi	0.523	0.494	0.3680				
				Åland	0.378	0.359	-0.3934				

*Table 8: Basic Image values for the 147 European regions (cont.)*

<b>Italy</b>				<b>United Kingdom</b>			
Piemonte	0.551	0.541	0.4871	Tees Valley and Durham	0.439	0.436	-0.2416
Valle d'Aosta/Vallée d'Aoste	0.370	0.389	-0.3271	Cumbria	0.395	0.373	-0.3797
Liguria	0.454	0.491	0.2866	Cheshire	0.546	0.423	-0.3985
Lombardia	0.552	0.574	0.5342	Greater Manchester	0.497	0.503	0.3665
Provincia Autonoma Bolzano-Bozen	0.389	0.384	-0.3528	Lancashire	0.523	0.455	-0.2509
Provincia Autonoma Trento	0.414	0.461	0.0151	Merseyside	0.465	0.449	-0.2000
Veneto	0.506	0.544	0.4577	East Yorkshire and Northern Lincolnshire	0.413	0.415	-0.2937
Friuli-Venezia Giulia	0.442	0.486	0.2538	North Yorkshire	0.460	0.404	-0.3652
Emilia-Romagna	0.536	0.567	0.5140	South Yorkshire	0.441	0.445	-0.1949
Toscana	0.510	0.554	0.4767	West Yorkshire	0.471	0.491	0.3046
Northumberland. Tyne and Wear	0.453	0.452	-0.1559	Derbyshire and Nottinghamshire	0.529	0.486	0.3509
Marche	0.425	0.498	0.2822	Leicestershire. Rutland and Northants	0.494	0.467	0.2156
Lazio	0.565	0.584	0.5553	Lincolnshire	0.399	0.395	-0.3356
Abruzzo	0.421	0.498	0.2784	Herefordshire. Worcestershire and Warks	0.497	0.443	-0.2791
Molise	0.368	0.450	-0.0840	Shropshire and Staffordshire	0.431	0.459	-0.0202
Campania	0.481	0.555	0.4570	West Midlands	0.502	0.504	0.3738
Puglia	0.443	0.530	0.3823	East Anglia	0.618	0.495	0.4623
Basilicata	0.372	0.414	-0.2611	Bedfordshire. Hertfordshire	0.547	0.468	0.3053
Calabria	0.388	0.486	0.1981	Essex	0.567	0.469	0.3372
Sicilia	0.459	0.548	0.4291	Inner London	0.562	0.514	0.4496
Sardegna	0.404	0.487	0.2183	Outer London	0.525	0.536	0.4589
				Berkshire. Bucks and Oxfordshire	0.610	0.491	0.4466
				Surrey. East and West Sussex	0.523	0.505	0.3958
				Hampshire and Isle of Wight	0.572	0.477	0.3712
				Kent	0.520	0.467	0.2589
				Gloucestershire. Wiltshire and Bristol/Batharea	0.578	0.494	0.4225
				Dorset and Somerset	0.433	0.441	-0.2093
				Cornwall and Isles of Scilly	0.381	0.377	-0.3614
				Devon	0.433	0.434	-0.2440
				West Wales and The Valleys	0.433	0.479	0.2093
				East Wales	0.469	0.430	-0.2989
				Eastern Scotland	0.467	0.482	0.2648
				South Western Scotland	0.534	0.494	0.3791
				North Eastern Scotland	0.500	0.368	-0.4662
				Highlands and Islands	0.405	0.367	-0.3982
				Northern Ireland	0.460	0.473	0.2069

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