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National Factors of Cluster Development and Management

The changing environment puts pressure on performance of business. In order to stay competitive firms create clusters, which require a more collaborative management; collaborative in the sense of creating relationships and trust, working on mutual investment and innovation projects and looking for ways to finance this change. The factors, which influence cluster development and also management, may come from the micro as well as the macro level. The aim of the article is to study the impact of national factors on cluster development and management in the EU countries. The results of analysis suggest that social capital dimensions have a differing influence on the proportion of clusters in an economy, while the level of innovation performance has a positive influence.

Introduction

The occurrence of clusters is considered a key feature of a region's or a country's competitive position. Clustering of businesses stimulates growth, cooperation, competition and opportunities for investment. Silicon Valley (USA), Dommel Valley (Netherlands) and the industrial districts of Central and North Italy are some examples of practical inter-firm networking and institutional support. Even the literature on clusters (for example, *Porter* 1998) stresses their importance as "an engine for economic value, added over and above simple collections of firms" (*DETR* 2000, p. 25).

Cluster success is dependent on successful management at the cluster level, but also at the environment level, that is, the macro level. Success at the macro level assumes skilled management at the local level, and vice versa (*Routamaa and Saatsi* 2011). Cluster management is required throughout the whole lifecycle of a cluster. Therefore, given the clusters importance for an economy, the article tries to identify the national factors that foster cluster development and management in the European Union countries.

Theoretical background

Clusters are „geographic concentrations of interconnected companies and institutions in a particular field" (*Porter* 1998, p. 78). They comprise a number of connected industries and other organizations important to competition, such as suppliers of specialized inputs, manufacturers, governmental institutions, universities, think tanks, trade associations and other. Clusters are a new form of spatial organization that enable both cooperation and competition to occur (*Porter* 1998).

The factors affecting cluster development can be divided into external and internal. The external factors result from the macroeconomic conditions. Clusters emerge in certain locations for several reasons. On one hand they can emerge and develop either naturally, as a result of a natural factor advantage or 'historical accident', or they can be formed with the support of cluster initiatives (*Sölvell* 2008, *Bresnahan et al.* 2007). National and regional strategies may significantly facilitate the creation and development of clusters (*Pavelková et al.,* 2009). It is advantageous for firms to cluster, because closeness and resource and information sharing increase their competitive position.

For this reasons, cluster development is usually initiated by industry leaders, the government and other institutions (*Miller et al.* 2002, *Bresnahan et al.* 2007). The other group of factors, the internal factors, result from the conditions of particular cluster functioning and thus influence the nature of cluster, its structure, way of management, goal setting, etc. (*Pavelková et al.,* 2009).

The management faces several challenges during the lifecycle of the cluster, especially in the early phases of its development. These challenges encompass creating social capital, trust, and strategic relations between members (*Andersson et al.* 2004, *Feldman* 2007). Other important issues that cluster management needs to resolve include cluster financing (*Feldman* 2007) and adequate human capital (*Bresnahan et al.* 2007).

Creating social capital, trust and strategic relations

This approach emphasizes the creation of social relations between different actors, from the public as well as the private sector (*Andersson et al.* 2004). Social capital is "the process by which social actors create and mobilize their network connections within and between organizations to gain access to other social actors' resources" (*Knoke* 1999, p. 18). Social capital elements like norms, codes, trust and solidarity are created and strengthened when a common goal is shared among individuals, firms or other hierarchical economic structures (*Maskell* 2000). Unlike physical and human capital, social capital is rooted in a country's culture and institutions (*Sölvell et al.* 2003).

Building trust between members of a cluster is crucial because it facilitates achievement of common goals (*Andersson et al.* 2004) and it is a fundamental factor in the success of alliances between firms (*Child* 2001). Trust belongs to the basic values of social exchange and communication; therefore, mutual trust should exist between individuals, firms and organizations if they want to build up their performance by lowering monitoring time and costs (*Doh et al.,* 2010). Building trust is enabled through common information and communication channels. Individual members of a cluster need to communicate and meet up; relations need to be created between businessmen, service providers and representatives of public administration (*Andersson et al.* 2004). Frequent contacts with partners support the process of learning in a cluster. Interaction is also enabled through shared cultural traditions and habits (*Clar et al.* 2008).

Human resources

Highly skilled labour is an important factor of cluster growth. Skilled human capital is the result of availability of local universities, but also large firms, which provide trainings that foster technical competencies. Besides universities and large firms, also government contracts spur development of skills in contractor firms (for example, after the contract research for the defence department in the USA ended, the skills and competencies of the labour force were used in the ICT and communication technologies). Another source of skilled human capital may be the outside regions (*Bresnahan et al.* 2007).

Availability of finance

Another key to cluster formation is the availability of finance. Cluster financing may be either from the private sector, the public sector or a combination of both. When it comes to finance from the private sector, the funds usually come from the firms involved in the cluster, often from the leading companies. Other forms of private sector funds include bank products, sponsorship or other partnerships, venture capital, foreign direct investments, investor networks and business angels (*Feldman* 2007, *Pavelková et al.* 2009).

The public sector provides funds in such cases, when the cluster may contribute to the development of regional industry dynamics. Public finance usually comes from the state and re-

gional budget, from the universities and in case of the EU, from the structural funds. Cluster financing based only on public funds is, however, rather uncommon (*Pavelková et al.* 2009). In some countries the role of government support is an important factor influencing business collaborative and innovative activities (*Burger* 2012).

Methodology

The aim of the paper is to study the impact of national determinants on cluster development and management in the EU countries. As the national factors were identified: access to finance, education and social capital; and innovations will be also regarded as a factor, which may have impact on the cluster formation.

Existing research justifies setting the following research hypothesis:
1. A positive dependence exists between social capital and the proportion of clusters on number of enterprise.
2. A positive dependence exists between innovation and the proportion of clusters on number of enterprise.
3. A positive dependence exists between access to finance and the proportion of clusters on number of enterprise.
4. A positive dependence exists between education and the proportion of clusters on number of enterprise.

Data

The research is based on several representative sources. The data used for assessing the number of clusters come from the European Cluster Organisation Directory. The number of clusters was divided by the total number of enterprises[1] (in business economy except activities of holding companies) in each country (*Eurostat*).

In the area of innovation, total intramural R&D expenditures in all sectors (% of GDP) were used (*Eurostat*). In the area of access to finance was used the SMAF index, which measures the availability of credit and venture capital to small and medium-sized enterprises (*European Commission*). In the area of education, the percentage of population with first and second stage of tertiary education between the age 15 and 74 was used (*Eurostat*). Social capital was measured using the data from the last wave of the European Values Study (EVS) realized in 2008. It was measured using several dimensions (see *Table 1*) based on the previous research on social capital (*Van Oorschot et al.* 2006, *Knack and Keefer* 1997). The data used are summarized in *Appendix 1*.

The data on national determinants are from the year 2008, while the data on the number of clusters and number of firms are from the year 2010. There is an assumption of a two year lag in the influence of the national characteristics on the formation of clusters.

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[1] Data for Slovakia and Denmark come from their national statistical offices. Data for Greece and Malta are estimates for 2010 (*European Commission*).

Table 1: Social capital dimensions

Dimension			Question
TRUST	*General trust*		Q1. Generally speaking, would you say that most people can be trusted or that you cannot be too careful in dealing with people?
			Q2. Do you think that most people would try to take advantage of you if they got the chance, or would they try to be fair?
	Institutional trust		Q3.Please look at this card and tell me, for each item listed, how much confidence you have in them, is it a great deal, quite a lot, not very much or none at all?
NETWORKS	*Formal networks*		Q4. Please look carefully at the following list of voluntary organizations and activities and say which, if any, do you belong to?
			Q5. Please look carefully at the following list of voluntary organizations and activities and say which, if any, are you currently doing unpaid voluntary work for?
	Informal networks	*Socializing with friends*	Q6. How important are friends and acquaintances in your life?
		Socializing with family	Q7. To what extent do you feel concerned about the living conditions of your immediate family?
			Q8. How important is family in your life?
CIVISM	*Social norms*		Q9. Please tell me for each of the following whether you think it can always be justified, never be justified, or something in between.
	Political engagement		Q10. When you get together with your friends, would you say you discuss political matters frequently, occasionally or never?
			Q11. How often do you follow politics in the news on television or on the radio or in the daily papers?

Source: author's own work based on data (*EVS* 2011; *Van Oorschot et al.* 2006).

Linear regression

The relationship between R&D expenditures, SMAF index, education, the social capital dimensions and the proportion of clusters to the number of firms in a country is verified using the Pearson correlation coefficients and the general model of linear regression, which can be written in the following form (*Hatrak* 2007)0:

$$y_i = \beta_0 + \beta_1 \beta X_{i1} + \beta_2 X_{i2} + ... + \beta_k X_{ik} + u_i \tag{1}$$
$$i = 1,2,...,n$$

where y represents the dependent variable (the number of clusters relative to the number of firms in a country), $X_1, X_2, ...X_k$ are the independent variables (R&D expenditures, SMAF index, education and the individual dimensions of social capital), u is the unobservable error estimate and parameters $\beta_0, \beta_1, \beta_2, ..., \beta_k$ are the coefficients, which should be estimated.

The model of linear regression was tested for the presence of normality distribution (Jarque-Bera Normality test), heteroscedasticity (Breusch-Pagan test), autocorrelation (Durbin-Watson test) and multicollinearity and was expressed as follows:

$$\text{number of } \frac{\text{clusters}}{\text{number}} \text{ of firms} = \text{participation} + \text{voluntary work} + \text{friends important} + \text{family important} + \text{family (living coditions)} + \text{norms} + \text{polit}$$

(2)

In case of Pearson correlation as well as linear regression the program R was used due to its availability.

Results

Table 2 contains the results of correlation coefficients and the p-values for each dimension of social capital, R&D expenditures, SMAF index, education and the number of clusters relative to the number of firms in a country. The values of Pearson correlation coefficient point to a positive dependence between the number of clusters relative to the number of firms and social capital dimensions trust, fairness, participation and watching politics in media. This means that the proportion of clusters in a country is significantly related to strengthening of trust and fairness, participation and watching the politics in media. From the stated follows that the first hypothesis (a positive dependence exists between social capital and number of clusters) was confirmed. The same results of strong and positive dependence are detected also in case of R&D expenditures. Therefore, if the proportion of clusters in a country increases, this is significantly related to the level of R&D expenditures. The second hypothesis was confirmed as well. Regarding other dependencies, the statistical significance, which should be confirmed by the values of Pearson correlation coefficient, was not proven. Therefore, the third and the fourth hypothesis were not confirmed.

Table 2: Values of Pearson correlation coefficient and the corresponding p-values

			Proportion of clusters to number of firms
Proportion of clusters to number of firms			*****
R&D expenditures			0.679 (<0.001)
SMAF index			0.046 (0.818)
Education			0.226 (0.257)
Social capital	**Trust**	*Q1. Trust*	0.617 (0.001)
		Q2. Fairness	0.683 (<0.001)
		Q3. Institutional trust	-0.172 (0.390)
	Networks	*Q4. Participation*	0.441 (0.021)
		Q5. Voluntary work	0.266 (0.179)
		Q6. Friends important	0.297 (0.137)
		Q7. Family (living conditions)	-0.088 (0.662)
		Q8. Family important	0.121 (0.548)
	Civism	*Q9. Norms*	-0.205 (0.306)
		Q10. Politics (friends)	0.187 (0.354)
		Q11. Politics (media)	0.370 (0.057)

Source: author's own calculation

Table 3 shows the results of linear regression. At first, all variables were included into observation. Given the p-values, statistically significant were social capital dimensions (norms, discussing politics with friends, fairness and institutional trust) and R&D expenditures. The model of linear regression can be written in the following way:

Clusters to number of firms = - 6.147e-05 + 1.945e-04 norms - 2.346e-04 discussing politics with friends + 7.857e-04 fairness - 4.183e-04 institutional trust + 3.991e-05 R&D expenditures + u   *(3)*

The model can be accepted given the low p-value of 3.67e-06 and the coefficient of determination of 71.92%.

Table 3: The results of linear regression

	estimate	standard deviation	t-statistics	p-value
(Intercept)	-6.147e-05	4.785e-05	-1.285	0.212931
Norms	1.945e-04	9.538e-05	2.039	0.054247 .
Politics (friends)	-2.346e-04	1.281e-04	-1.831	0.081381 .
Fairness	7.857e-04	1.742e-04	4.511	0.000191 ***
Institutional trust	-4.183e-04	1.797e-04	-2.328	0.029991 *
R&D expenditures	3.991e-05	8.847e-06	4.511	0.000192 ***
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1				

Source: author's own calculation

The proportion of clusters relative to the number of firms in a country is positively influenced by social capital dimensions norms and fairness and R&D expenditures; and negatively influenced by the social capital dimensions discussing politics with friends and institutional trust. However, all the independent variables have a very small influence. If the strength of norms, fairness and R&D expenditures grow in a country, the proportion of clusters of that country grows as well. On the other hand, if people discuss politics with friends more often and their trust towards institution increases, the proportion of clusters in that country decreases.

Cluster management in the EU

Figure 1 depicts a map displaying the spatial distribution of the absolute number of clusters in countries of the European Union. The darker the colour, the more clusters there are in a country. From the map can be seen that the majority of clusters are located in Germany and Italy. On the contrary, the least number of clusters are located in Cyprus and Malta. If we were to compare the absolute number of clusters with the proportion of clusters to total number of firms in a country, the ranking would change for all countries, except Sweden (see *Appendix 2*). Then, the proportional majority of clusters would be located in Denmark and Hungary and the proportional minority of clusters would be located in Portugal and Greece.

Figure 1: Number of clusters in EU countries
Source: author's own work based on data (European Cluster Organisation Directory, Eurostat,
European Commission, statistical offices of Slovakia and Denmark)

Cluster management is being reviewed by the European Cluster Excellence Initiative (ECEI), which was set off by the European Commission DG Enterprise and Industry, based on quality indicators. Clusters are then evaluated based on a quality labelling system for professional cluster management. Two labels are attainable (*ESCA*):

- *Cluster Management Excellence Label BRONZE – Striving for cluster excellence*, which is based on a self-evaluation by the cluster manager and is awarded to clusters for being benchmarked following the ESCA (The European Secretariat for Cluster Analysis) benchmarking approach,

- *Cluster Management Excellence Label GOLD – Proven for cluster excellence* is based on a third party expert evaluation of the structure of the cluster, governance, financing, strategy and services and recognition by which certain 'levels of excellence' have to be met.

In 30 European countries (of which 19 are the EU member states) 420 clusters have already been benchmarked since 2010. Yet, only 15 clusters have been awarded the Cluster Management Excellence Label GOLD (six in Germany, two in Austria, Denmark and France, one in Spain, Sweden and Norway) (*ESCA*).
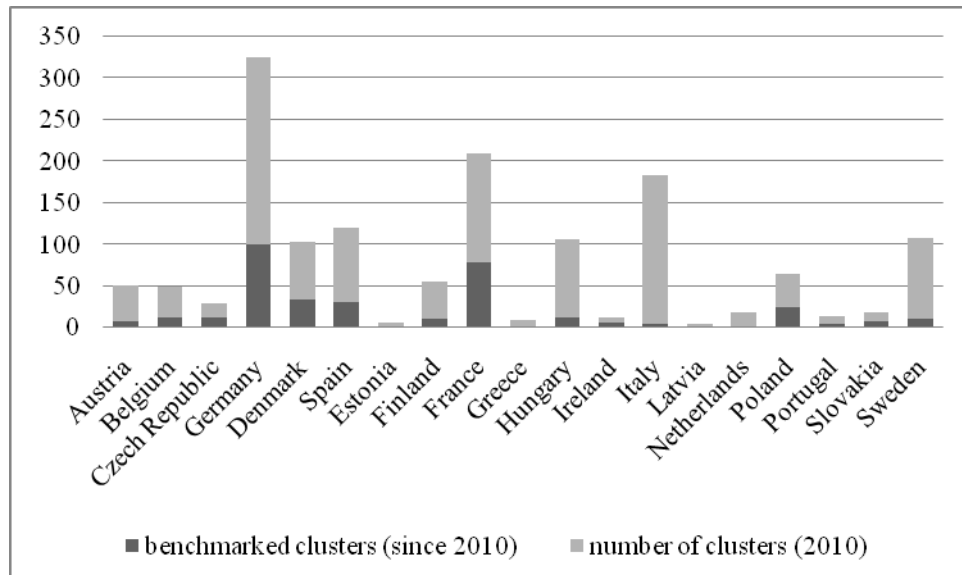
Figure 2: Proportion of benchmarked clusters to number of clusters in EU countries
Source: author's own work based on data (*ESCA, European Cluster Organisation Directory*)

The proportion of benchmarked clusters to total number of clusters in the countries of the EU is depicted in *Figure 2*. The highest share of benchmarked clusters is located in Ireland (85.71%), the Czech Republic (70.59%), Latvia (66.67%), Slovakia (63.64%) and Poland (60%). On the other hand, the lowest share of benchmarked clusters is situated in Italy (2.22%), Netherlands (5.88%), Sweden (11.34%), Greece (12.50%) and Hungary (13.83%).

Conclusion

Collaboration inside the cluster is a critical feature of cluster success. However, only facilitated collaboration can bring about the full potential of the cluster. Therefore, it is the role of management to facilitate collaboration and achieve positive results. The results of the article imply that there is a higher tendency of clusters located in smaller countries and the countries of the Central and Eastern Europe (except Hungary) to attempt to acquire a cluster management excellence label than there is in clusters of other countries of the EU. The reason behind this may presumably lie in that clusters in smaller countries or the countries of the Central and Eastern Europe want to increase their competitiveness by acquiring different certificates or labels, the need of which in the clusters of more developed countries is not so high. Similar results, although in different area were found in a study by *Burger* (2012) where countries with lower level of innovation performance accepted any offer of financial sources from the public funds, unlike the pro-cluster oriented countries.

The results of the linear regression show a strong and positive relationship between the proportion of clusters on total number of firms and social capital dimensions norms and fairness and R&D expenditures. On the other hand, social capital dimensions institutional trust and discussing politics with friends have a negative influence on the proportion of clusters to total number of firms. These results imply that the national factor social capital has both a positive and a negative influence, i.e. its different dimensions influence the development and management of clusters diversely. The level of innovation performance of a country also influences the number of clusters that emerge and develop in that country. The influence of other national fac-

tors, availability of finance and education, on the cluster development and management were not proven by the results of linear regression.

The results of the analysis are subject to certain limitations which should be taken into consideration. The article works with the number of clusters given in the European Cluster Organisation Directory. However, the real number of clusters is hard to determine, as such, it may be only a rough estimate of the number of clusters in an economy. Each cluster is highly individual and the circumstances under which it is developed and managed differ from country to country, even within a country. The analysed factors are thus non-exhaustive. Furthermore, the fact that the number of clusters (with or without a management certificate or label) is higher in some countries does not prove the level of good or bad management in countries with lower number of clusters. To conclude, there does not exist a manual for successful development and management of clusters, because each cluster has its own history, members, relations, goals, activities, etc.

Acknowledgement

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Appendix 1: Overview of the results in individual areas

COUNTRY	PROPORTION OF CLUSTERS RELATIVE TO NUMBER OF FIRMS	R&D EXPENDITURES	SMAF INDEX	EDUCATION	SOCIAL CAPITAL										
					TRUST			NETWORKS					CIVISM		
					General trust		Trust in institutions*	Formal networks*		Informal networks			Social norms*	Political engagement	
					Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11
Austria	0.000131	2.67	101.62	14.8	0.368	0.098	0.074	0.063	0.032	0.568	0.319	0.790	0.459	0.172	0.521
Belgium	6.92E-05	1.97	96.88	27.0	0.346	0.038	0.092	0.087	0.036	0.463	0.762	0.871	0.371	0.092	0.483
Bulgaria	3.09E-05	0.47	107.82	18.3	0.179	0.056	0.052	0.022	0.016	0.382	0.810	0.864	0.594	0.157	0.510
Cyprus	1.94E-05	0.43	117.42	29.2	0.092	0.019	0.126	0.036	0.019	0.491	0.945	0.937	0.670	0.136	0.426
Czech Republic	1.75E-05	1.41	94.06	12.1	0.301	0.043	0.059	0.057	0.036	0.379	0.155	0.785	0.362	0.099	0.267
Denmark	0.000235	2.85	111.62	25.4	0.76	0.233	0.104	0.183	0.326	0.606	0.716	0.879	0.454	0.274	0.684
Estonia	7.11E-05	1.28	109.44	28.1	0.326	0.044	0.073	0.054	0.028	0.289	0.618	0.750	0.506	0.115	0.485
Finland	0.000157	3.7	101.42	29.1	0.647	0.027	0.091	0.106	0.043	0.458	0.100	0.844	0.371	0.116	0.395
France	4.44E-05	2.12	103.92	23.3	0.272	0.046	0.083	0.049	0.024	0.521	0.640	0.891	0.375	0.180	0.589
Germany	7.64E-05	2.69	92.99	21.0	0.388	0.049	0.052	0.048	0.021	0.426	0.829	0.779	0.422	0.235	0.575
Greece	1.07E-05	0.6	104.46	18.3	0.213	0.018	0.085	0.026	0.016	0.459	0.843	0.864	0.515	0.226	0.525
Hungary	0.000167	1	86.93	15.8	0.212	0.053	0.053	0.019	0.011	0.424	0.853	0.910	0.554	0.073	0.375
Ireland	3.58E-05	1.46	90.10	28.5	0.389	0.06	0.107	0.108	0.083	0.742	0.332	0.905	0.488	0.122	0.294
Italy	4.52E-05	1.21	102.09	11.6	0.308	0.038	0.097	0.048	0.534	0.388	0.527	0.912	0.570	0.191	0.537
Latvia	3.63E-05	0.62	124.21	20.5	0.255	0.027	0.084	0.033	0.027	0.274	0.539	0.684	0.481	0.147	0.524
Lithuania	3.31E-05	0.8	121.28	24.1	0.299	0.023	0.027	0.028	0.016	0.183	0.725	0.619	0.438	0.094	0.580

COUNTRY	PROPORTION OF CLUSTERS RELATIVE TO NUMBER OF FIRMS	R&D EXPENDITURES	SMAF INDEX	EDUCATION			SOCIAL CAPITAL									
					TRUST			NETWORKS					CIVISM			
					General trust		Trust in institutions*	Formal networks*		Informal networks			Social norms*	Political engagement		
					Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11
Luxembourg	7.24E-05	1.66	128.09	22.7	0.311	0.056	0.151	0.100	0.058	0.535	0.534	0.902	0.451	0.168	0.516
Malta	2.84E-05	0.56	107.90	11.3	0.217	0.055	0.241	0.020	0.014	0.412	0.867	0.934	0.768	0.098	0.352
Netherlands	2.16E-05	1.77	105.54	27.0	0.617	0.034	0.051	0.209	0.070	0.613	0.767	0.859	0.396	0.168	0.530
Poland	2.04E-05	0.6	88.11	16.0	0.276	0.051	0.077	0.016	0.007	0.384	0.693	0.865	0.463	0.140	0.347
Portugal	1.03E-05	1.5	98.95	11.6	0.172	0.019	0.097	0.031	0.026	0.342	0.746	0.760	0.500	0.134	0.464
Romania	2.44E-05	0.58	111.68	10.0	0.176	0.084	0.150	0.029	0.019	0.286	0.655	0.866	0.588	0.067	0.365
Slovakia	2.73E-05	0.47	87.67	12.0	0.126	0.026	0.071	0.032	0.016	0.439	0.491	0.897	0.367	0.091	0.467
Slovenia	0.000121	1.66	108.82	18.2	0.242	0.062	0.039	0.072	0.041	0.486	0.461	0.835	0.485	0.067	0.429
Spain	2.87E-05	1.35	92.12	24.9	0.343	0.018	0.096	0.023	0.011	0.422	0.655	0.839	0.430	0.092	0.439
Sweden	0.000145	3.7	111.69	26.2	0.707	0.072	0.058	0.091	0.040	0.552	0.882	0.925	0.373	0.112	0.657
United Kingdom	2.88E-05	1.78	100.11	28.1	0.403	0.044	0.111	0.064	0.023	0.632	0.364	0.897	0.466	0.129	0.347
*average per question category															

Source: EVS, Eurostat, European Commission, European Cluster Organisation Directory

Appendix 2: Ranking of the countries based on absolute and relative number of clusters

Rank	Country	Number of clusters (2010)	Rank	Country	Number of clusters relative to number of firms (2010)
1	Cyprus	1	*1*	Portugal	1.03E-05
2	Malta	1	*2*	Greece	1.07E-05
3	Luxembourg	2	*3*	Czech Republic	1.75E-05
4	Latvia	3	*4*	Cyprus	1.94E-05
5	Lithuania	4	*5*	Poland	2.04E-05
6	Estonia	5	*6*	Netherlands	2.16E-05
7	Ireland	7	*7*	Romania	2.44E-05
8	Greece	8	*8*	Slovakia	2.73E-05
9	Portugal	9	*9*	Malta	2.84E-05
10	Bulgaria	10	*10*	Spain	2.87E-05
11	Romania	11	*11*	United Kingdom	2.88E-05
12	Slovakia	11	*12*	Bulgaria	3.09E-05
13	Slovenia	15	*13*	Lithuania	3.31E-05
14	Czech Republic	17	*14*	Ireland	3.58E-05
15	Netherlands	17	*15*	Latvia	3.63E-05
16	Belgium	37	*16*	France	4.44E-05
17	Poland	40	*17*	Italy	4.52E-05
18	Austria	44	*18*	Belgium	6.92E-05
19	Finland	45	*19*	Estonia	7.11E-05
20	United Kingdom	58	*20*	Luxembourg	7.24E-05
21	Denmark	70	*21*	Germany	7.64E-05
22	Spain	89	*22*	Slovenia	0.000121
23	Hungary	94	*23*	Austria	0.000131
24	Sweden	97	*24*	Sweden	0.000145
25	France	131	*25*	Finland	0.000157
26	Italy	180	*26*	Hungary	0.000167
27	Germany	226	*27*	Denmark	0.000235

Source: European Cluster Organisation Directory, Eurostat, European Commission, statistical offices of Slovakia and Denmark