APPRAISAL OF THE REGIONAL COMPETITIVENESS OF THE RESEARCH-DEVELOPMENT SECTOR IN ROMANIA BY HIGHLIGHTING THE CORRELATIONS AMONG CLUSTERS, WORKFORCE AND EXPENSES IN CD

Narcisa-Melania TĂNASE[1], Mihaela Caramihai (GUDA) [2], Alexandru MARIN[3]
Laura BOANȚĂ[4], Anca Alexandra PURCĂREA[5]

Starting from the essential role of clusters in the increase of the research-development competitiveness' sector, this study suggests the survey of the interdependence relation among the cluster type research units, the employed workforce within the research-development sector and the expenses allotted to the said sector. Within this context, the correlations have been approached at regional level, through a comparative analysis of the clusters' situation in the eight development regions of Romania, concurrently with the workforce employed within CD sector, but also with the expenses allotted to this sector.

Keywords: cluster, competitiveness, research-development, development regions

1. Introduction

This study analyzes the clusters at the level of the eight development regions of Romania in relation to the employed workforce within the research-development field, but also with the expenses adherent to this sector in order to determinate the existence of some interdependence relations, but also for setting up the regional competitiveness starting from these correlations.

The key concept governing the whole analysis is represented by *clusters*, the specialized publications defining them as being *geographical concentrations of interconnected institutions and companies belonging to a certain field; they include related industries, and other important entities from the competing point of view, such as: specialized input providers (components, machinery and services), specialized infrastructure providers. Clusters can also extend downstream (towards different distribution channels, towards clients) or, laterally, towards the*

[1] Ph.D Student, the Faculty of Entrepreneurship, Engineering and Business Management, University POLITEHNICA of Bucharest, Romania, e-mail: narcisa.tanase@research.gov.ro
[2] Ph.D Student, the Faculty of Entrepreneurship, Engineering and Business Management, , University POLITEHNICA of Bucharest, Romania, e-mail: mihaela.guda@research.gov.ro
[3] Prof., PhD, University POLITEHNICA of Bucharest, email: alexandru.marin@upb.ro
[4] PhD Student, University POLITEHNICA of Bucharest, email: laura.boanta@upb.ro
[5] Prof, PhD, Faculty of Entrepreneurship, Engineering and Business Management, University POLITEHNICA of Bucharest, Romania, e-mail: apurcarea@gmail.com

complementary products manufacturers or towards industries related by common technologies, qualifications or inputs. However, governmental institutions, but also universities, professional training providers, standards agencies, think tanks, employers' associations etc. can be also found integrated in the clusters, having the role of providing specialized training, education, informing, research, technical support. [1]

The relationship between clusters and the workforce was addressed within the paper European Cluster Observatory – Clusters and Workforce Development (Discussion paper) elaborated by the European Commission in the year 2016, the main conclusions referring to the role of clusters in the personnel's competences development, and to the capacity of clusters in providing the education and professional training of the workforce according to the specifics of the industry. Within this context, there are clusters that can provide their own professional training programs and that are financially sustained by governmental institutions. At the same time, the clusters contribute to the increase of the recruitment competitiveness, especially in the regions where there is a shortage of qualified personnel, through conferences and events organized within the clusters, these providing, for many times, recruitment opportunities and the development of a job oriented networking etc. [2] From the same point of view, a survey of the European Secretariat for Cluster Analysis (ESCA) puts Romania under the EU average in the ranking of the countries whose clusters implement professional training services, with a number of almost 5 such projects per year, in the classification top being Italy, Germany, France and Spain (with a number of over 10 services implemented per year), the European average being of 10 services per year. [3]

In Romania, in order to provide network, but also to create a specific frame for the development of new clusters, Clustero – the Clusters Association from Romania was created in the year 2011, containing 42 of the most active clusters in Romania. The objectives of this association were represented by: ensuring and providing information in connection with clusters' activity, sources and financing possibilities; support and consultancy for the establishment, development and cooperation within, but also among clusters by communication; analysis of the clusters' competitiveness, organizing specific professional training courses and programs etc. The main challenges aim: the development of innovation and internationalization specialized training, development of information exchange at international level. [4]

2. Theoretical regards

It is necessary to set up even from the very beginning the differences among the concepts used within this paper, the specialty literature by making the following conceptual determinations: [5]

a) *competitiveness pole* – according to Porter's approach, it represents a complete triple helix structure or a four leaves clover with the following characteristics: action on one or more markets, export oriented, accent on innovative projects and on the production activity, national and international impact;
b) *cluster* – conform to Marshall's theory, it represents an industrial agglomeration that emphasizes the relationship among enterprises, with a structure situated on different maturity stages;
c) *excellence pole* – conform to the theory of the specialists Lundvall, Nelson, Guth, it represents a competitiveness pole strongly oriented to research-innovation, the accent being put on CDI activities;
d) *urban development pole* - conform to Jane Jacobs' theory, it is oriented towards the geographical dimension and on the role of cities in crystallizing the competitiveness poles.

In order to identify the correlations among the suggested concepts it is also necessary to understand the motivations that are the basis of the initiatives for forming clusters, respectively: [6]

a) *research and networking* – the information exchange within the organizations, informing etc. are aimed.
b) *political action* – the creation of dialogue among industry, the scientific community and the local authorities is aimed;
c) *commercial cooperation* – refers to assistance in business, consultancy in marketing, promoting exports, achievement of common acquisitions etc.;
d) *education and training* – the training of the workforce, of managers etc.; these activities are very important, directly influencing the competitiveness of a cluster by: specialized human resources, the access to a specialized know-how, cooperation and collaboration among the members etc.;
e) *innovation and technology* – the facilitation of the technologic transfer among the organization within the clusters, and the improvement of the innovation process are aimed;
f) cluster's extension – aims the promoting of a certain region, objective that is desired to be reached by promoting a specific brand or by diverting the direct foreign investments in the said region.

At the same time, quoting the same bibliographic source above, the competitiveness of a cluster is influenced by the following factors: the access to human resources and to a specialized know-how, entrepreneurship based on the capitalization of the researches' results and of the market's opportunities, collaboration among organizations, legislation specific for clusters, specialized technologies. In the same time, a key factor providing the competitive advantage of a cluster is represented by the development of the human resource by: recruitment and quality of the candidates, training, experienced employees, but also with a specific

stock of knowledge in certain fields, the cluster's culture and the satisfaction degree of the clients.

At the same time, *the main advantages* of establishing a cluster reside in: increasing competitiveness, increasing productivity, facilitating market access, innovation, common allotment of resources, coming close to the clients and providers, reducing the transactions' costs, human resource center, reputation and image, improvement of communication, strategic information for business [7].

At the level of Romania, the surveys performed in the year 2017 highlight a very developed CD infrastructure, being considered more than competitive by the highest western standards, thus being able to sustain complex CDI projects. [8]

The performance of a cluster is analyzed by the appraisal Audit for excellence in the cluster management performed by the European Secretariat for Cluster Analysis (ESCA) starting with November 2010.

The results of the audit are fulfilled in three types of certifications granted to clusters, as follows:

a) bronze label – does not actually represent a certification of quality, but it expresses the intention and wish of the management of a cluster for the improvement of the managerial performances; this audit is based on the analysis of 36 indicators regarding the: cluster's structure, cluster's management, financing of the cluster's management, services provided by the cluster's organizations, interaction and cooperation with relevant actors, the results and recognition of the cluster's organization. [9]
b) silver label – represents a certification of quality, confirming the successful implementation of the improvement processes suggested following the audit for obtaining the bronze label;
c) gold label – represents the highest quality qualification being based on high standards with regard to the practices of a cluster's management; in this regard, clusters should fulfill a series of criteria referring to: structure, typology, management and cooperation, financing, strategy, objectives, services, results. [10].

Also in this case, one of the analyzed criterion is the one referring to human resources, the audit analyzing the availability of human resource for the cluster's management, respectively the stability and continuity of human resource within the management team of the cluster, but also the workforce competences and the development within the cluster, highlighting once again the impact of human resource over the clusters' performances and excellence.

At the moment, in Romania there are 2 Gold certified clusters, 2 Silver certified clusters, respectively 24 Bronze certified clusters. The analysis considered only the clusters that have valid certifications, more information being presented in the section referring to the results of the research [11].

Also, in order to develop a cluster, two aspects are essential: the financial support for the cluster's functioning, on one side and, on the other side, the personnel existing within the cluster. Within this context, the local/regional/national authorities implement different financing schemes for the development of clusters, and professional training programs for the existent personnel, this being an additional argument sustaining the role of the workforce in a cluster's competitiveness increase. [12]

3. Methodology and results of the research

Taking into consideration the fact that the specialty literature sustains the correlation of the workforce with the clusters' development, this research starts just from this assumption, trying to demonstrate the existence of an interdependence relationship between the two concepts at the level of Romania's development regions.

3.1. Methodology of research

The aim of the research is to identify the relationship among the number of clusters and the workforce in the eight development regions of Romania, the objectives deriving from this wish referring to the:

a) analysis of clusters on development regions;
b) analysis of the dynamics of CD units number during 2016-2017;
c) analysis of the workforce dynamics belonging to the research-development activity during 2016-2017 (on development regions);
d) analysis of the dynamics of expenses with research-development activity during 2016-2017 (on development regions);
e) analysis of GDP evolution on regions during 2016-2017;
f) analysis of the regional competitiveness.

The hypotheses that are to be confirmed or rejected following the research are:

a) the existence of a correlative relationship between the number of clusters in a region and the workforce (weight, specialization degree and qualification) existent at the level of the said region;
b) the existence of a correlative relationship between the number of clusters in a region and the CD volume of expenses in the said region;
c) the existence of a correlative relationship between the number of clusters in a region and the regional competitiveness (GDP level);

For this purpose, by using as instruments the research of the bibliographic sources and the analysis of the statistic data (taken from specialty websites), the research is based on a qualitative type analysis.

3.2. Results of the research

The results of the research aim to present the way the set up objectives were reached within the research Methodology, being further presented [13].

a) clusters' analysis of development regions

In this paper have been analyzed 86 clusters from Romania, their distribution being presented in the figure below (Fig.1.)

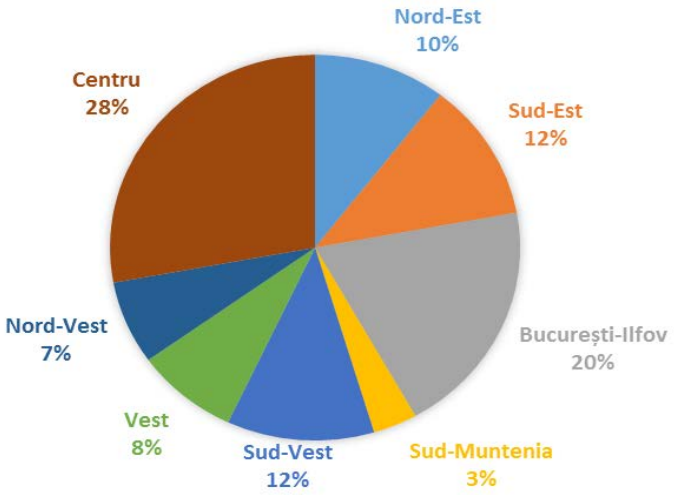

Fig. 1. Analysis of the number of clusters on development regions

Thus, it can be seen that most clusters are at the Center region level (28%), followed by Bucharest-Ilfov region (20%), the less clusters being found at South-Muntenia region level (3%).

From the *specialization field* point of view there can be distinguished the following industries on development regions:

- the North-West region – is dominated by clusters from the IT industry, renewable energy, mobile;
- the Center region – is dominated by clusters from the wood processing industry, renewable energy, Aerospatiale, print and design, textiles, agro alimentary, tourism;
- the North-East region – the predominant fields are: textiles, tourism, IT, media, creative industries, biotechnologies;
- the South-East region – dominated by shipbuilding industry, textiles, renewable energy;
- the South-Muntenia region – dominated by automotive industry;
- Bucharest-Ilfov region – dominated by textiles industry, automotive industry, electronics, electrical engineering, automation, aerospatiale etc.
- the South-West Oltenia region – dominated by automotive industry, tourism, IT.

From *ESCA certifications point of view*, the following development regions whose clusters are certified may be distinguished: the North-West region – has two Gold certifications in the IT fields and furniture; the region Center, respectively North-West – have one Silver certification; the other development regions contain Bronze certified clusters.

b) *the analysis of the dynamic regarding the number of CD units during 2016-2017, at national level* is presented in the table below (Table 1).

Table 1

Crt. no.	Performance sectors	Year 2016 (number)	Year 2017 (number)	Quantitative evolution (number)	Percentage evolution (%)
1	Total out of which:	792	713	-79	-9.97
2	Public sector	293	276	-17	-5.80
3	- governmental sector	200	190	-10	-5.00
4	- high education sector	93	86	-7	-7.53
5	Private sector	499	437	-62	-12.42
6	- business sector	476	414	-62	-13.03
7	- non-profit private sector	23	23	0	0.00

Conform to the information presented in the table above, it can be noticed a decrease in absolute size of 79 units in the year 2017 given the year 2016, most of them being recorded in the private sector (62 units). The decrease of the research-development unit's number has a negative impact over CDI sector's competitiveness and of Romania's competitive position at European level.

c) *the analysis of the workforce dynamics belonging to the research-development activity during 2016-2017 (on development regions)* is presented in the following table (Table 2).

Table 2

Crt. no.	Development region	Year 2016 (no. of persons)	Year 2017 (no. of persons)	Quantitative evolution (no. of persons)	Percentage evolution (%)
1	North-West	3,175	3,280	105	3.31
2	Centre	4,072	4,000	-72	-1.77
3	North-East	4,129	3,947	-182	-4.41
4	South-East	2,150	2,290	140	6.51
5	South-Muntenia	2,836	2,344	-492	-17.35
6	Bucharest - Ilfov	21,968	22,709	741	3.37
7	South-West Oltenia	2,025	2,132	107	5.28
8	Total	44,386	44,801	415	0.93

Analyzing the dynamics presented in the table above, we can notice an increase of the persons' number that activate in the field of research-development in an absolute size of 415 persons at the level of the whole country, aspect deemed to be positive. The region that recorded the highest increase is represented by Bucharest-Ilfov, on the opposite pole being the South-Muntenia region, with a decrease of 492 employees,

among which 227 are researchers, a strongly descending trend being remarked at the level of this region (information corroborated with the ones in Table 3).

The workforce structure within the research-development activity is the following:

Table 3

Crt. no.	Personnel type	Development region	Year 2016 (pers. no.)	Year 2017 (pers. no)	Quantitative evolution (pers. no.)	Percentage evolution (%)
1	Researchers	North-West	2,223	2,210	-13	-1
2		Center	1,783	1,565	-218	-12
3		North-East	3,223	3,056	-167	-5
4		South-East	1,426	1,566	140	10
5		South-Muntenia	1,642	1,415	-227	-14
6		Bucharest - Ilfov	13,384	13,411	27	0
7		South-West Oltenia	1,622	1,651	29	2
8		Total	27,801	27,367	-434	-2
1	Technicians and assimilated	North-West	422	511	89	21
2		Center	723	785	62	9
3		North-East	276	215	-61	-22
4		South-East	255	253	-2	-1
5		South-Muntenia	335	478	143	43
6		Bucharest - Ilfov	3,865	3,573	-292	-8
7		South-West Oltenia	176	184	8	5
8		Total	6,332	6,221	-111	-2
1	Other categories	North-West	530	559	29	5
2		Center	1,566	1,650	84	5
3		North-East	630	676	46	7
4		South-East	469	471	2	0
5		South-Muntenia	859	451	-408	-47
6		Bucharest - Ilfov	4,719	5,725	1,006	21
7		South-West Oltenia	227	297	70	31
8		Total	10,253	11,213	960	9

It is also alarming the fact that from the personnel's structure, the sector of researchers is the one that recorded the most dramatic decrease (434 persons), having a negative impact over the competitiveness of CD activity, an increase being recorded only at the level of other categories of employees, but these having a more reduced added value. Also, with regard to the dynamic of the employees number within the

research-development activity at 10,000 civil occupied persons, this is presented in Fig 2.

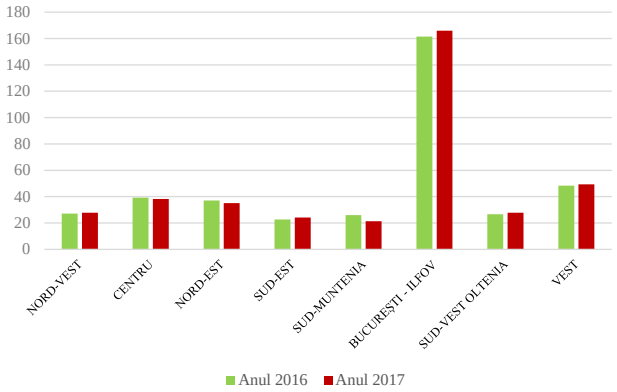

Fig.2. The dynamic of the number of employees within the research-development activity at 10,000 civil occupied persons during 2016-2017

Corroborating the information presented above with the information regarding the dynamic of employees' number within the CD activity at 10,000 civil occupied persons, it can be noticed that Bucharest-Ilfov region overcame the other regions not only as number of employees within CD activity at 10,000 occupied persons, but also as increase in absolute size in relation to the year 2016. The region that records the most reduced weight of the number of employees within CD at 10,000 occupied persons in the year 2017 is South-Muntenia region.

At the same time, with regard to the weight of the employees within the research-development activity from the total of the occupied population on development regions, maximum 2% activate within the research-development field (in Bucharest-Ilfov region). The lowest percentage is recorded in South-Muntenia region.

d) the analysis of the expenses dynamic with research-development during 2016-2017 (on development regions) is presented in Table 4.

Table 4

Crt. no.	Development region	Year 2016 (thousands lei)	Year 2017 (thousands lei)	Quantitative evolution (thousands lei)	Percentage evolution (%)
1	North-West	229,229	247,611	18,382	8.02
2	Center	272,635	256,017	-16,618	-6.10
3	North-East	170,650	153,981	-16,669	-9.77
4	South-East	67,234	61,799	-5,435	-8.08
5	South-Muntenia	356,332	342,976	-13,356	-3.75
6	Bucharest - Ilfov	2,167,252	2,807,480	640,228	29.54
7	South-West Oltenia	80,555	128,247	47,692	59.20
8	Total	3,675,142	4,317,086	641,944	65

Therefore, the region that distinguishes itself from the weight of expenses dynamic for research-development point of view is Bucharest-Ilfov, this recording an increase of almost 640 mil. lei, opposite to it being the North-East and Center regions with a reduction of almost 16 mil. lei. At national level there can be noticed an increase in absolute size of the research-development expenses, but the said increase is visibly marked by Bucharest-Ilfov region, the discrepancies compared to the other regions being quite significant.

e) *the analysis of GDP on regions during 2016-2017* is highlighted in Table 5.

Table 5

Crt. no.	Development region	Year 2016 (thousands lei)	Year 2017 (thousands lei)	Quantitative evolution (thousands lei)	Percentage evolution (%)
1	North-West	81,651.90	90,116.70	8,464.80	10.37
2	Center	78,804.80	86,592.90	7,788.10	9.88
3	North-East	71,454.40	77,167.70	5,713.30	8.00
4	South-East	76,189.70	79,909.80	3,720.10	4.88
5	South-Muntenia	86,633.20	93,684.90	7,051.70	8.14
6	Bucharest - Ilfov	197,799.40	207,571.60	9,772.20	4.94
7	South-West Oltenia	52,054.70	55,335.10	3,280.40	6.30
8	Total	712,587.80	765,135.40	52,547.60	7.37

Conform to the information in the table above, we can notice an increase of the GDP in absolute size of almost 52 milliards lei at national level, the regions that distinguish themselves from this increase point of view being: Bucharest-Ilfov, North-West, Center, South-Muntenia. At the level of the year 2017, the regions that recorded the highest GDP were: Bucharest-Ilfov, South-Muntenia, North-West, Center.

f) the analysis of the regional competitiveness

Starting from the information presented above, the most competitive region is Bucharest-Ilfov region, recording the highest level of GDP, the highest level of CD expenses, the most number of researchers and the highest weight of employees within CD, but not the greatest number of clusters, being situated on the second place in this classification. On the last position is situated, considering the GDP level, the South-West region, but without the level of GDP to be recorded based on the analyzed indicators within the research-development activities.

4. Conclusions

Following this study, we can draw the following conclusions with regard to the initially set up hypotheses, as follows:

a) *the existence of a correlative relationship between the number of clusters in a region and the workforce (weight, specialization degree and qualification) existent at the level of the said region* – partially confirmed.

- the ranking of the first three development regions from the number of clusters point of view are: Center (28%), Bucharest-Ilfov (20%), South-West and South-East (12%); the least clusters being found at the level of South-Muntenia region (3%);
- the ranking of regions from the existent workforce point of view:
  * workforce within CD activity: Bucharest-Ilfov (22.709 persons), Center (4000 persons), North-East (3.947 persons) regions; the most reduced level being recorded in South-West, South-East and South-Muntenia regions;
  * the most researchers are recorded at the level of Bucharest-Ilfov region, and the least in South-Muntenia region; the most technicians and assimilated are recorded at the level of Bucharest-Ilfov, Center, North-West regions; other personnel categories within the CD activity are recorded at the level of Bucharest-Ilfov, Center, North-East regions;
  * the number of employees within the research-development activity at 10,000 civil occupied persons, respectively the weight of the employees within the research-development activity from the total of the occupied population: Bucharest-Ilfov region significantly detaches from the other regions, and South-Muntenia region records the most reduced level;

b) *the existence of a correlative relationship between the number of clusters in a region and the volume of CD expenses in the said region* – rejected.
   - the ranking of the regions that record the highest volume of CD expenses are: Bucharest-Ilfov, South-Muntenia, Center and North-West; it has been noticed that Bucharest-Ilfov region, even does not have the most clusters, allots the highest volume of expenses with CD; a high volume of expenses can be also noticed in the case of South-Muntenia region, this having the least number of clusters; the Center region, even holds the most clusters, is outclassed by South-Muntenia region from CD expenses point of view; at the same time, the South-East region that holds 12% from the total of clusters (top 3), holds the least volume of expenses with CD;

c) *the existence of a correlative relationship between the number of clusters in a region and the regional competitiveness (GDP level)* – rejected.
   - the ranking of regions from the GDP level point of view is: Bucharest-Ilfov, South-Muntenia, North-West, Center, while the regions Center, Bucharest-Ilfov, South-West, South-East lead the ranking with regard to the number of clusters; the best example in this case is represented by South-Muntenia region, this recording the least number of clusters, but the highest level of GDP after Bucharest-Ilfov region.

Inferring, Bucharest-Ilfov region significantly detaches from the other development regions with regard both to the competitiveness as recorded GDP level, and as the impact of the research-development activity. However, by observing

Pareto rule, South-Muntenia region that holds the least number of clusters records the next GDP level at the level of the year 2017 in relation to the other regions. Therefore, the regional competitiveness is not determined by the number of clusters, but, by the competitiveness of each cluster in part, the expenses for research-development and the workforce sensitively influencing the results of a cluster, and not their number.

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