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To cite this article: Alka Obadić & Lela Tijanić (2014) Multivariate analysis of the Croatian clusters, *Economic Research-Ekonomiska Istraživanja*, 27:1, 120-133, DOI: [10.1080/1331677X.2014.947134](https://doi.org/10.1080/1331677X.2014.947134)

To link to this article: <http://dx.doi.org/10.1080/1331677X.2014.947134>



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Published online: 11 Sep 2014.



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Multivariate analysis of the Croatian clusters

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(Received 19 March 2013; accepted 2 October 2013)

Clusters have an important role in fostering regional and national economic development. Clustering can help the members to take advantages of the benefits discussed in this article. The aim of the article is to identify the reasons why some of the cluster members in Croatia do not recognise the benefits of clustering? In this article the authors use a multivariate analysis to obtain results to confirm if there are significant differences among firms that: (1) think that clustering helps them; (2) believe that the idea is good but does not function in practice; and (3) consider that clusters are not necessary. Our analysis suggests that different attitudes toward satisfaction with exchange of information, joint promotion, education and market research are the main reasons why these observed cluster members differ. The result of our study can be useful in formulating policies for the future cluster development programmes in Croatia.

Keywords: cluster; benefits of clustering; satisfaction with cluster; multivariate analysis; Croatia

JEL classification: L10; L25; R11; R12

1. Introduction

In the last few decades, academics and policymakers alike have become interested in studying the clusters. The concept of cluster is one way of describing a more than century long observed phenomenon. Geographical concentration of economic activities is widely considered to be an important factor in national and regional economic development; in innovation and competitiveness (Hernandez Gascón, Pezzi, and Soy Casals, 2010, p. 30). The benefits of clustering can be seen in firms all over the world. During the 1990s, most European countries were interested in creating industrial districts, clusters and local production systems to become an integral part of their regional development and industrial policies. Cluster organisations have invariably connected businesses with academia, education with industry, large firms with small firms by providing activities and meeting places where common issues could be discussed and acted upon jointly (Lindqvist, Ketels, and Sölvell, 2013, p. 4).

Benefits of clustering have been studied by many (e.g. Ketels and Protsiv, 2013; International Trade Department, 2009; Sölvell, 2009; Sölvell and Williams, 2013 and others). Until recently, most of the conducted studies on clusters have been limited to seek qualitative justification of their performance by observing successful clusters

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(European Commission – Enterprise Directorate – General, 2007). Clusters grow and decline. Some scholars believe that cluster policies face more problems than are often assumed and may do more harm than good if not carefully adopted (Brakman and Van Marrewijk, 2013, p. 217).

The European Commission (2008, p. 43) has observed that in advanced economies cluster organisations tend to focus more on innovation services and knowledge creation, while in countries still in transition place more emphasis upon supply chain development, export promotion or simple networking and training. The most prioritised objectives of cluster organisations in Europe include building a cluster identity and branding the cluster; initiating innovation projects and research and development investment (which is in accordance with low research and development efficiency measures explained in Aristovnik, 2012); building a strategy and vision for the cluster. In Croatia initiatives for cluster creation started only lately. According to BIOS data (2010) the country had 70 clusters. In most cases they did not create a fertile ground for their own development and thus slowly disappeared (Dragičević and Obadić, 2013, p. 141). It is therefore important to study the advantages and eventual disadvantages of clustering and hurdles in their development. Considering the fact that clusters in Croatia still do not function well, it will be worth investigating different attitudes among them. Multivariate analysis could be a useful tool with which to do so.

Along with the Introduction and Concluding Remarks, this article has two sections. Section 2 reflects upon the theoretical background of the study. Section 3 covers the methodology, the multivariate analysis (based on BIOS [2010] data the principal component factor analysis, hierarchical and non-hierarchical cluster analysis) and empirical results.

2. Theoretical background of cluster benefits

From several perspectives that have been advanced in relevant literature, there are a wide variety of concepts and definitions available¹. Basically, the concept of clusters is built upon the traditional location and agglomeration theory and integrates some other concepts, such as the concept of ‘industrial districts, growth poles, new industrial spaces, system of production, innovative milieu, national or regional innovation systems, learning or creative regions, etc.’ (European Commission, 2008, pp. 10–11). Clusters are an international phenomenon and do exist in a multitude of shapes, sizes, and can contain a small or large number of enterprises, as well as small and large firms in differing ratios (Möhring, 2005a, p. 22). Potter and Miranda (2009, p. 219) find that collaborations between cluster members range from simple participation in supply chains to an intensive co-operation on innovation projects where networking provides opportunities for identifying customers and sharing information, thus helping build the supply chains.

Michel E. Porter explains that once a cluster is formed, the whole group of industries becomes mutually supportive and the benefits flow forward, backward, and horizontally; entry from other industries within the cluster spurs upgrading by stimulating diversity in research and development approaches and providing means for introducing new strategies and skills. Information flows freely and innovation diffuses rapidly through the conduits of suppliers or customers who have contacts with multiple competitors (Porter, 1998, p. 151). By clustering together the firms seem to be able to pull from a common and accessible pool of resources, information, and demand for innovation to enhance competences and create competitive advantages to compete globally (Niu, 2010, p. 142). Clusters have been widely recognised as one of the ways of overcoming the size limitations of small and medium-sized enterprises (SME’s) and as an

important instrument in improving their productivity, knowledge, innovativeness and overall competitiveness (Ferreira, Garrido Azevedo, and Raposo, 2012, p. 148; Karaev, Koh, and Szamosi, 2007, p. 820). Kovárník believes that clusters bring positive effects that could spread in planning, organisation and project management, production and human resources management, finance, logistics, marketing and sale, research and development (Kovárník 2007, p. 763). UNIDO too (2010, p. 4) observes that with respect to pro-poor growth strategy, cluster approach can be a valuable tool to tackle poverty and lay the ground for a process of broad-based growth².

Although clusters enjoy popularity, they are criticised too (Ketels, 2013). Brakman and Van Marrewijk (2013) argue that criticism of the cluster concept in academic literature explains why cluster policies hardly work in practice. Möhring (2005a, p. 25), notes that clusters stand accused of being underpinned by a hazy underlying theoretical concept lacking geographical or industrial boundaries, agency, and clear evidence of associated benefits, or methodologies used to identify them. Lorenzen (2005) sees the problem of clusters decline in relative neglect of research. Moreover, failures of clusters can be attributed to the fact that one or more critical success factors for cluster development were either not existing or not addressed correctly (Tambunan, 2005, p. 149). Despite their great potential for dynamic interaction between actors, clusters exploit a small share of this potential and can suffer from knowledge failures, network failures and cooperation failures, leading to innovation failures (Sölvell and Williams, 2013, p. 22)³. We feel that though there is an abundant literature on cluster related issues, there is lack of empirical introspection in the existing differences among the members in their attitudes on clustering.

The role of clusters in the Croatian economy has been thoroughly investigated by Kersan-Škabić and Afrić Rakitovac (2011). While Dragičević and Obadić (2013) elaborate Croatian cluster policies and analyse successful examples of clusters, Obadić and Kurnoga Živadinović (2013) analyse main characteristics of regional clusters in EU-27 and Croatia and show the differences among them.

The significance of clusters has also been well recognised by the Croatian government and it has become a part of the regional policy (Ministry of Regional Development, Forestry and Water Management, 2010). It has also been accepted by the Ministry of Entrepreneurship and Crafts (2013) in its documents: *Development Strategy for Entrepreneurship 2013–2020* and *Cluster Development Strategy in Republic of Croatia 2011–2020*.

3. Multivariate analysis of characteristics of Croatian clusters

3.1. Methodology of investigation

In order to examine the differences between the attitudes of the cluster members about their satisfactions with clusters, it is necessary to extract main factors and create homogeneous groups. Multivariate analysis is widely recognised as a suitable tool for such an empirical analysis (Bahovec, Dumičić, and Palić, 2011; Kurnoga Živadinović, Dumičić, and Čeh Časni, 2009; Mihić, 2006; Metaxas, 2010; Rašić Bakarić, 2012)⁴. Such an analysis could identify smaller sets of uncorrelated factors that are associated with sets of highly correlated original variables (Del Campo et al., 2008, p. 605). Thus, we use principal component factor analysis for factor extraction. This procedure enables us to observe if few first principal components account for a major proportion of total variance. Cluster analysis (hierarchical and non-hierarchical) can also be applied to group observation units into groups with similar characteristic.

Empirical research in this article is based upon information from entrepreneur incubator BIOS and agency for market research and public opinion Audeo. Primary research on members of Croatian clusters has been conducted in 2010 (BIOS, 2010), which is the last available research of this type on the cluster members in Croatia. The aim of this study was to define the characteristics of cluster members, their perception of clusters, perception and benefits of cluster membership, activities of clusters and their future plans, satisfaction with previous activities, the possibilities of becoming more successful, the attitude towards the state support of clusters, etc. The data was collected using an online survey sent via e-mail to cluster members (gathered from the Membership Register). A total of 57 responses (i.e. 16%⁵) were received. Learning that in Croatia the number of active clusters is low, it was expected that the response rate too will be low. Accordingly, we created a sample that could be considered reliable under the given circumstances. For us it was interesting to study why the cluster members are not satisfied with clustering that usually end in future *passive clusters* or (even worst) cluster failures. Cluster members included in our study are used as units of analysis and coded from 1 to 57.

Initially we identified 32 variables. But, for further empirical analysis we stick only to 10 metric variables because we could use these as variables in multivariate factor and cluster analysis. The selected variables refer to the attitudes of the respondents about their satisfaction with the clusters in different activities. Posed questions were responded to using the scale from 1 (very dis-satisfied) to 5 (very satisfied). Even though the scale is ordinal, it can be observed as interval if it relies on the assumption that the intervals on the scale applied in this analysis are the same as in Kurnoga Živadinović (2004).

The following variables were included in principal component factor analysis:

- VAR 1: Satisfaction with cluster – exchange of information
- VAR 2: Satisfaction with cluster – joint promotion
- VAR 3: Satisfaction with cluster – joint education
- VAR 4: Satisfaction with cluster – joint appearance at fairs
- VAR 5: Satisfaction with cluster – joint approach to customers
- VAR 6: Satisfaction with cluster – joint investment in research and development
- VAR 7: Satisfaction with cluster – joint purchase
- VAR 8: Satisfaction with cluster – joint market research
- VAR 9: Satisfaction with cluster – lobbying
- VAR 10: Satisfaction with cluster – joint distribution.

In drawing more complete conclusions from our study it is possible to use some additional variables from BIOS (2010) that do not satisfy the preconditions of the said multivariate analysis. Variables that describe members' attitudes toward clustering can be looked upon in three groups: (1) firms that think clustering helps cluster members; (2) firms that think the idea is good but does not function in practice; and (3) firms that think clusters are not necessary. In our analysis we also include: (1) variables that refer to the possible activities that have to be strengthened in the future where the respondents have to choose between more joint activities, more active cluster management, better defining of aims and goals of clusters, stronger financing of common work, stronger state support (and no answer); (2) variables that signify attitudes toward state support for clusters (has/has not done enough in financial and/or counselling sense); and (3) as a variable – the number of employees – so as to differentiate small and large firms.

3.2. Analysis and results

Principal component factor analysis is performed in order to get factor scores that are used in further cluster analysis. Before carrying-out such an analysis we have examined the preconditions, i.e. the variables are metric; every independent variable has at least one correlation coefficient that is $> |0,3|$ (minimal value to include any variable in further analysis as is suggested by Kinnear and Gray, 1994⁶); and the magnitudes of the observed correlation coefficients compared to the magnitudes of the partial correlation coefficients (as is suggested by the Kaiser-Meyer-Olkin measure, the measure being > 0.5 which signifies that the correlation matrix is appropriate to be applied to principal component factor analysis⁷). Note that in practice most scholars rarely use a single criterion in determining the usable number of factors. If, on the one hand, the number is too small then it is likely that the correct structure is not revealed and some important dimensions are omitted. Similarly, on the other hand, if too many factors are extracted and observed then the interpretation becomes difficult when the results are rotated (Hair, Tatham, and Anderson, 1998). Accordingly, for extraction of the factor number in our analysis we use three criteria: the latent root, percentage of variance and the scree test.

Table 1 shows eigenvalues, percentage of variance and cumulative percentage of variance that has helped us in defining the number of factors.

In deciding upon the number of factors to be extracted, we apply the eigenvalue criterion. The rationale for the eigenvalue criterion is that any factor should account for at least the variance of a single variable (as suggested by Soares, Lourenço Marquês, and Ferreira Monteiro, 2003, p. 128). In our case, as is apparent from Table 1, two factors have eigenvalues > 1 . Thus, these two can be extracted. Two factors meet also the percentage of variance criterion. Soares et al. (2003, p. 128) argue that the percentage of variance criterion suggests that one should extract all the factors that account for at least 60% of the variance of the original variables⁸.

Finally, as suggested by Cattell (1966), scree test can be used as another criterion to check the number of these identified factors. Figure 1 presents scree plot for the eigenvalues where the shape of the curve confirms that two factors should be extracted because the curve begins to straighten out at that point convincing the authors to select the mentioned factors for analysis.

After selecting the number of factors, it is necessary to interpret the factors. In Table 2, is the rotated factor matrix (after varimax rotation of factors to simplify the columns in a factor matrix) and together with is the percentage of explained variance for

Table 1. Eigenvalues, percentage of variance and cumulative percentage of variance.

Factors	Eigenvalues	Percentage of variance	Cumulative percentage of variance
1	4,713633	47,13633	47,1363
2	1,338807	13,38807	60,5244
3	0,918624	9,18624	69,7106
4	0,821892	8,21892	77,9296
5	0,622322	6,22322	84,1528
6	0,419532	4,19532	88,3481
7	0,398832	3,98832	92,3364
8	0,324080	3,24080	95,5772
9	0,236883	2,36883	97,9461
10	0,205395	2,05395	100,0000

Source: Calculated by the authors.

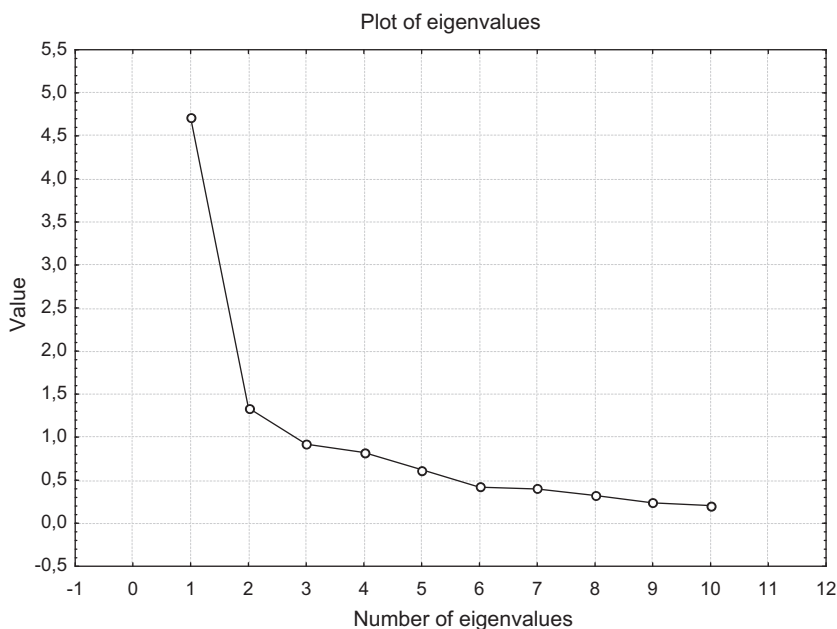


Figure 1. Scree plot for the eigenvalues.
Source: Calculated and plotted by the authors.

two factors. Metaxas (2010, p. 14), referring to Kaiser (1958) and Abdi (2003), explains that after a varimax rotation, each original variable tends to be associated with one (or a small number) of factors, and each factor represents only a small number of variables. Further, the factor loadings indicate the importance of each variable for each factor (Kurnoga Živadinović, 2004, p. 960).

The first factor has significant loadings (factor loadings $> \pm 0.50$ represent values that are generally considered necessary for practical significance [Hair et al., 2010]) on variables VAR 5, VAR 1, VAR 2, VAR 8, VAR 4, VAR 9 and VAR 7. It can be seen that this factor is described with variables that refer to satisfaction with different

Table 2. Rotated factor matrix after varimax rotation of factors.

Variable	Factor 1	Factor 2
VAR 1	0,794803	0,058552
VAR 2	0,745870	0,168610
VAR 3	0,264158	0,549340
VAR 4	0,728892	0,025718
VAR 5	0,824369	-0,037739
VAR 6	0,424377	0,729021
VAR 7	0,628183	0,448810
VAR 8	0,736706	0,362378
VAR 9	0,715159	0,359851
VAR 10	0,413462	-0,674151
Expl. Var	4,268529	1,783911
Prp. Totl	0,426853	0,178391

Marked loadings are > 0.50 ; Source: Calculated by the authors.

marketing complementarities and lobbying, while the second factor is assigned to the variables that refers to satisfaction with joint investment in research and development (VAR 6) and joint education (VAR 3). The first and second factor together account for 60.52% of the total variance. The factor scores were calculated for two factors and were used in (hierarchical and non-hierarchical) cluster analysis as input variables.

We have carried-out the cluster analysis with the purpose of grouping (clustering) members of clusters into several groups that have similar characteristics (homogeneous within the group and maximum possible heterogeneous to other groups). Through hierarchical cluster analysis using the Ward's method with squared Euclidean distances we have obtained the best possible solution. The dendrogram in Figure 2 shows the cluster groupings scored by the chosen method.

Based on successive increases in the distances at which clusters are joined, as can be seen from Figure 2, three clusters can be identified. Note that the dendrogram depicts each stage of the clustering and as we move from single member cluster heterogeneity increases (so the clusters are less homogeneous). Firms that think clusters are not necessary (firms 13, 42) are grouped in the same cluster, as well as most of the firms that think clustering helps cluster members (firms 16, 20, 33, 38, 39, 44, 54, 56 are in the same cluster, while firms 25 and 27 are the only ones that think clustering helps cluster members but are not in the group with the other firms that have the same opinion). Non-hierarchical cluster analysis by using K-means method with Euclidean distances was performed to check the results from the hierarchical cluster analysis.

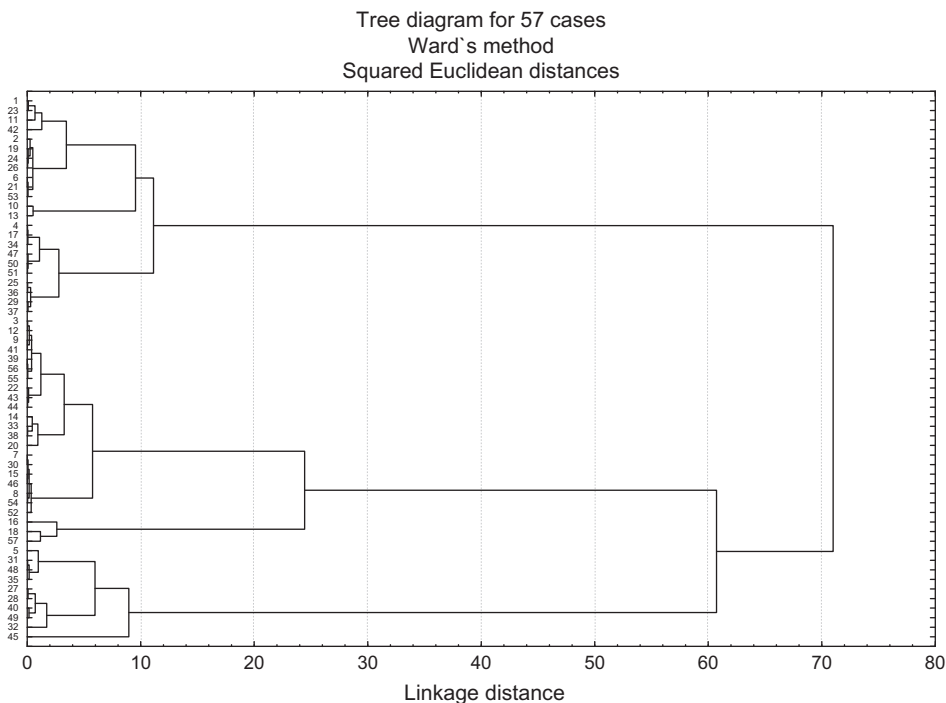


Figure 2. Dendrogram of cluster analysis.

Note: 1 to 57 represent codes for firms – members of clusters included in the analysis.

Source: Calculated and drawn by the authors.

In deciding how many clusters to use in K-means method, an analysis of variance can be conducted which is shown in Tables 3 and 4. In a non-hierarchical cluster analysis the researcher can use the number of clusters selected in a hierarchical cluster analysis (which is three, as mentioned above), but in order to check if that is statistically significant the solution for two chosen clusters (minimum number of clusters) is tested too. Factors 1 and 2 as shown in Table 3 represent factor scores that were calculated in principal component factor analysis and used as input variables in a non-hierarchical cluster analysis (as well as in the hierarchical cluster analysis that was presented before).

It is evident from the variance analysis for two clusters that the chosen solution is not appropriate because as the results in Table 3 show, the means between the two proposed clusters do not differ significantly i.e. at the significance level of 5%. The analysis of variance in Table 4 indicates significant differences between the means of the three clusters. The results of the provided non-hierarchical cluster analysis are shown in Table 5. We note that the structure of the clusters obtained from hierarchical and non-hierarchical cluster analyses are identical. In order to make our conclusions more complete and final, the results of the analyses are further elaborated using the variables included in our study according to BIOS (2010) database.

If we look upon the results of the cluster analysis and make a comparison with the attitudes of cluster members on clustering, it can be noted that members of clusters with negative opinion about clustering are grouped together with the cluster members that think clustering is a good idea but does not work in practice (which refers to cluster 3). Except for firm 25 (grouped in cluster 3), most of the firms with positive opinion are grouped together in cluster 2.

The authors have also analysed the descriptive statistics of the given clusters that indicates that those cluster members who think that clusters are not necessary are not satisfied with either different marketing complementarities and lobbying (factor 1 from factor analysis) or with the joint investments in research and development and education (factor 2 from factor analysis).

Detailed analysis of certain variables included in our analysis confirms this fact. Namely, most of the firms that think clusters are not necessary are dissatisfied with the exchange of information, joint education and joint approach to customers, joint investments in research and development, joint purchase, joint market research, lobbying, joint distribution and did not defined positive or negative attitude towards their satisfaction with joint promotion and joint appearance at fairs, etc. It is possible that the mentioned cluster members see some benefits in cluster's joint promotion or joint appearance at fairs but these activities too must become better. The same is true with the other observed categories of satisfaction that are important for active functioning of clusters. A strategy of direct and simple communication by the cluster governance with small firm representation and support organisations could help in conveying information about needs and economic opportunities (Miranda and Potter, 2009). Most of the cluster

Table 3. Analysis of variance for two clusters.

Factor	Between SS	df	Within SS	df	F	signif. p
Factor 1	37,48405	1	18,51595	55	111,3431	0,000000
Factor 2	0,12112	1	55,87888	55	0,1192	0,731200

Source: Calculated by the authors.

Table 4. Analysis of variance for three clusters.

Factor	Between SS	df	Within SS	df	F	signif. p
Factor 1	35,95427	2	20,04573	54	48,42753	0,000000
Factor 2	29,90859	2	26,09141	54	30,95010	0,000000

Source: Calculated by the authors.

Table 5. Classification of firms by K-means method.

Members of clusters	Cluster	Distance	Members of Clusters	Cluster	Distance
1	3	0,59	30	2	0,53
2	3	0,38	31	1	0,53
3	2	0,18	32	1	0,99
4	3	0,53	33	2	0,43
5	1	0,47	34	3	0,44
6	3	0,21	35	1	0,43
7	2	0,47	36	3	0,49
8	2	0,29	37	3	0,41
9	2	0,06	38	2	0,29
10	3	0,86	39	2	0,30
11	3	1,06	40	1	0,57
12	2	0,30	41	2	0,02
13	3	1,29	42	3	0,82
14	2	0,42	43	2	0,61
15	2	0,54	44	2	0,62
16	2	1,68	45	1	1,42
17	3	0,51	46	2	0,49
18	2	0,91	47	3	0,52
19	3	0,21	48	1	0,55
20	2	0,82	49	1	0,30
21	3	0,29	50	3	0,60
22	2	0,45	51	3	0,65
23	3	0,63	52	2	0,52
24	3	0,21	53	3	0,14
25	3	0,37	54	2	0,38
26	3	0,09	55	2	0,35
27	1	0,45	56	2	0,31
28	1	0,28	57	2	1,62
29	3	0,60	Cluster 1: N = 10, Cluster 2: N = 24, Cluster 3: N = 23		

Note: 1 to 57 represent codes for firms - members of clusters included in the analysis.

Source: Calculated by the authors.

members, those that think clustering helps, are satisfied with the exchange of information and with all the joint activities, but did not define positive or negative attitudes toward satisfaction with joint approach to customers, joint research and development or joint purchase (that must be changed – unambiguously in positive direction in the future). The results have confirmed the benefits of clustering as explained by Kovárník (2007). Cluster members that are grouped in cluster 1 are satisfied with marketing complementarities and lobbying but not with joint investments in research and development and education, they find it is necessary to strengthen these activities in the mentioned clusters, especially in face of fact that human capital is the cornerstone of the

development of clusters (Miranda and Potter, 2009). To strengthen the cluster cohesion and growth, joint projects in financing, marketing and communication, ICT establishment of sales channels, development of technologies, internationalisation, strengthening of assets and resources, etc. should be encouraged (Möhring, 2005b, p. 220).

It can also be emphasised that most of the firms in clusters with negative opinion are firms with small number of employees (small in comparison with other clusters). The results leads to the conclusion that it is possible that some of the small firms did not recognise clustering as a potential for strengthening competitiveness even though they see several of the mentioned benefits. The result obtained by Lindqvist, Ketels, and Sölvell (2013) is further confirmed in our analysis that innovation and research and development objectives are most critical to larger cluster organisations.

Our examination further shows that most of the firms with negative opinions about clusters do not necessarily have negative attitude towards the state support and see the need to define purpose and aims of the clusters in a much clearer way. A critical opinion about the state support is held by those cluster members that think clustering is a good idea but does not function in practice. This is also true for some firms in the clusters with the positive opinion about clustering. These two groups of cluster members do recognise the possibility for strengthening state support. Effective government cluster policies need to mobilise a broad coalition of partners that integrate and encourage activities that meet the needs of specific clusters while policies at the national and regional level have a crucial impact on the ability of clusters to reach their full potential⁹.

4. Concluding remarks

In our investigation we have tried to identify the main reasons as to why the attitudes of the cluster members differ in Croatia. Keeping in mind the low number of active clusters in Croatia, we believe that our analysis could be of some help not only in determining the gaps but in further promoting and strengthening the clusters. Based on the results of the multivariate analysis presented in this article, it follows that cluster members that think clusters are not necessary, are also the cluster members with a small number of employees who are not satisfied with different jointly organised marketing complementarities, lobbying, research and development and education. Thus, the result implies that it is necessary to make more efforts in trying to use the possibilities and benefits of clustering, which can be accomplished through defining the purpose, aims and benefits of clustering in a clearer way. At the other end of spectrum are the determined cluster members who think that clustering helps and they are satisfied with most of the mentioned joint activities. They also recognise the possibility for strengthening through state support.

A valuable initiative in Croatia is the project *Support to Cluster Development* of the Government of Croatia in the implementation of its *Cluster Development Strategy 2011–2020*. It will be interesting to see if the results of the research presented in this article will be different after the full implementation of the project. We believe that regional development agencies can help in changing the negative opinion about clustering by *bottom-up* approach, whereas an incentive for cluster policy creation should come from the business sector. We also feel that it will be useful to identify the cluster managers having similar opinions about the benefits of clusters. It can be done by using BIOS and Audeo databases.

Finally, we must also mention that the major constraint to this analysis has been the lack of data on cluster members and the fact that the number of active clusters in

Croatia is low. From multivariate analysis, it can be seen that it is possible to conduct separate analyses only by observing the group of cluster members that have positive or negative opinion about clustering with sufficient data. It will definitely be useful to collect and include in future studies more quantifiable economic indicators about observed cluster members, data about cluster growth performance that can be correlated with other characteristics and qualitative data on cluster failures, etc.

Notes

1. For details see Rosenfeld (1997); European Commission (2008); Dragičević (2012); Dragičević and Obadić (2013).
2. Besides strengthening the competitive advantages, the development of clusters can strengthen collaborative advantages that are explained in Afrić Rakitovac (2011). More about benefits of clusters can be found in Möhring (2005a), McDonald, Huang, Tsagdis, and Tüselmann (2007), Delgado, Porter, and Stern (2010, 2011), Alslev Christensen, Meier zu Köcker, Lämmer-Gamp, Solgaard Thomsen, and Olesen (2011), Anderson, Solitander, and Ekman (2012), Dragičević and Obadić (2013), International Cleantech Network (2013).
3. For details on obstacles to the further growth and development see Mărginean (2009), Miranda and Potter (2009), Potter and Miranda (2009), Obadić and Aristovnik (2011), Lindqvist and Sölvell (2012), Huber (2012).
4. More about the factor analysis can be found in Fulgosi (1988), Halmi (2003), Hair, Tatham, and Anderson (1998). Cluster analysis is also presented in more detail in Romesburg (2004), Everitt, Landau, Leese, and Stahl (2011), Hair et al. (2010).
5. It is interesting to note that the response rate in the *Global Cluster Initiative Survey 2012* was 14% (more in Lindqvist, Ketels, and Sölvell, 2013).
6. This criterion is applied also in Rašić Bakarić (2012) who clarifies that justification for using the factor analysis implies determining whether input variables are significantly and sufficiently correlated. Only if manifest variables are correlated factors can be identified as hypothetical components of a non-correlated variable, sufficient for expressing manifest variables (Rašić Bakarić, 2012, p. 400).
7. Kaiser-Meyer-Olkin measure is explained in Kurnoga Živadinović (2004), Kurnoga Živadinović, Dumičić, and Čeh Časni (2009).
8. In the natural sciences the factoring procedure usually should not be stopped until the extracted factors account for at least 95% of the variance. In contrast, in the social sciences, where information is often less precise, it is not uncommon to consider a solution that accounts for 60% of the total variance (and in some instances even less) as satisfactory (Hair et al., 2010, p. 109).
9. Porter is of the opinion (1998, p. 655) that once a cluster begins to form, government at all levels can play a role in reinforcing it. Miranda and Potter (2009, p. 219) too suggest that governments could do more to stimulate bottom-up networks.

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