www.gi.sanu.ac.rs, www.doiserbia.nb.rs
J. Geogr. Inst. Cvijic. 2023, 73(3), pp. 311–324

Original scientific paper

UDC: 911.3(437.6)
https://doi.org/10.2298/IJGI2303311G

Received: May 6, 2023
Reviewed: October 9, 2023
Accepted: October 30, 2023

ASSESSMENT OF CLUSTER POTENTIAL IN SLOVAKIA: CASE STUDY IN THE UPPER POVAŽIE REGION

Jozef Gáll[1]*, *Anna Michálková*[1]

[1]University of Economics in Bratislava, Faculty of Commerce, Department of Tourism, Bratislava, Slovakia; e-mails: jozef.gall@euba.sk, anna.michalkova@euba.sk

Abstract: As clusters currently represent a significant support in the development of regions, it is important to analyze their potential in the tourism industry. In Slovakia, tourism clusters work alongside local tourism organizations for legislative reasons. The main aim of the present study is to use appropriate identification methods to map the microeconomic environment of the selected tourism region and subsequent analysis to evaluate the existing preconditions for successful and efficient operation of the tourism cluster. The results of the survey serve as an input database for the application of the Principal Component Analysis (PCA) method, which revealed the current cluster potential in the Upper Považie region. The individual determinants of the Porter's Diamond model achieved favorable results. Using multiple regression analysis, quantification and interpretation of the interrelationships between input variables were enabled. The applied analysis shows that the potential pillars for the creation of a tourism cluster in the Upper Považie region are the determinants of firm strategy, structure, and rivalry in the region, related and supporting industries, and factor conditions. The results show that the examined determinant factors create conditions for the functioning of a potential cluster in the region at an average level.

Keywords: tourism cluster; cooperation of tourism companies; cluster mapping methods; tourist regions; Slovakia

1. Introduction

Industrial clusters have been the subject of research by several world economists since the beginning of the 20th century. One of the first mentions comes from 1890, when A. Marshall (1890) introduced the concept of agglomeration of economies as a benefit resulting from the synergy that industries can create by locating close to each other. While the concept of agglomeration of economies focuses on the spatial distribution of industries, the term "industrial cluster" introduced by M. E. Porter (1990) defines the advantages resulting from vertical or horizontal relations between the industries of a given economy.

Kaufman et al. (1994) emphasize that industrial cluster analysis offers guidance to policy makers in identifying a state's competitive advantage. Similarly, Doeringer and Terkla (1995) claim that by expanding the focus of development policies, the analysis of industrial clusters

*Corresponding author, e-mail: jozef.gall@euba.sk

offers the possibility of integrating non-export and export-oriented industries into the strategy of regional growth.

Currently, the identification of industrial clusters is still an important topic of research in the public, private, and academic sectors. On the one hand, a large number of cluster observatories have been established around the world as an important resource for policy makers and planners concerned with strategic and tactical resource deployment. On the other hand, the identification of industrial clusters is also beneficial for industries, as it provides information about potential customers and suppliers, and alternative markets, and clarifies the role of industry in the national economy (Ketels & Sölvell, 2007).

Despite considerable progress in elucidating the concept of clusters, no universally accepted theory of clusters has been developed. This ambiguity also applies to the methodology for identifying industrial clusters. Since there is no common approach to identifying clusters, or measuring their size and importance, there are a number of competing methods through empirical analyzes (Martin & Sunley, 2003). Porter (1998) argues that different countries and regions tend to define industrial clusters in different ad hoc ways, using a wide range of research techniques and criteria.

Although Porter (1998) made studies mainly in the context of traditional industries, this author mentions the importance of elements belonging to the tourism industry, stating that the satisfaction of tourists does not only depend on the attractiveness of the primary offer of a tourism destination, but also on the quality and efficiency of the related business entities, such as hotels, restaurants, shopping centers, and transport infrastructure. A tourism cluster is a geographical concentration of businesses and institutions linked in tourism activities. These include suppliers, services, government, institutions, universities, and competitors (Capone, 2004). Brown and Geddes (2007) define a tourism cluster as a set of attractions, concentrated in a limited geographical area with quality facilities and services, collective efficiency, and social and political cohesion, with the coordination of the production chain and cultural associations, and with excellent network management that create comparative and competitive benefits. Nordin (2003) claims that tourism clusters are considered effective tools for management and marketing of tourism destinations and local (regional) economies. However, these tools must be used in an appropriate way to contribute to achieving optimal competitiveness through local development and to establishing the basis for sustainable development of the region in which they operate (Maráková & Šimočková, 2015).

Porter (2000) developed and presented a general framework dealing with the multi-stage process of identifying industrial clusters. This concept was applied across the entire American economy under the name of the US Cluster Mapping Project. In Europe, this cluster mapping model was first applied in 2002 in Sweden (Lindqvist et al., 2008). In 2004, all industrial clusters of candidate countries for joining the European Union (EU) were mapped in a similar way (Ketels & Sölvell, 2007). Previous efforts and experiences led to the concept of a European Cluster Mapping Project covering all EU Member States and Iceland, Israel, Norway, Switzerland, and Turkey (Sölvell et al., 2009).

To be considered appropriate, a cluster identification method should reveal cluster functioning characteristics and patterns of linkages between businesses and institutions. Broadly speaking, different cluster identification methods are classified according to bottom-up and top-down approaches (Brachert et al., 2011; Sternberg & Litzenberger, 2004). The

available literature processed by different authors (Andersen et al., 2006; Bergman & Feser, 1999; Pavelková et al., 2009; and others) reveals many different methods of identifying industrial clusters. Each work brings a different perspective on the studied issue of cluster mapping and a different selection of procedures by which local clusters are identified.

The issue of industrial clusters and their identification is not sufficiently represented in Slovakia as in the case of other European or world countries. In connection with tourism clusters, Michálková and Gajdoš (2015) conducted a survey that mapped the current situation of clustering in tourism across Slovak regions. There are also studies that dealt with the mapping of a potential cluster, such as in the case of the woodworking industry (Loučanová & Zaušková, 2008) using the localization coefficient or using the application of shift-share analysis in the environment of Žilina Autonomous Region (Potomová & Letková, 2011). As the issue of cluster mapping has not been processed in the Slovak tourism environment, the article presented will bring new knowledge and conclusions.

2. Literature review

The observation of cluster tourism organizations operating around the world provides a wide range of information on their thematic diversity. Among the world's most famous regional cluster tourism organizations are clusters in the United States of America (South Carolina's Tourism Cluster, Maryland's Tourism and Hospitality Cluster, Oregon's Tourism Cluster), Australia (Tropical North Queensland), New Zealand (The New Zealand Golf Tourism Cluster), Jamaica (Jamaica Tourism Cluster), and India (Rural Tourism Cluster) (Yalçınkaya & Güzel, 2019).

Tourism clusters also operate in Europe. Thanks to merging companies and significant support from the EU, they are constantly evolving. For several years, the European Commission (EC) has been implementing a number of initiatives to address the challenges faced by the countries of the EU. As far as cluster organizations are concerned, they are carried out on two levels—(I) formation of cluster policy and (II) management of cluster organizations.

On the first level, an example of such an initiative is the European Cluster Policy Group, which was founded and started its activity based on the decision of the EC in 2008. It is a high-level group of experts composed of the representatives from political sphere, academia, and business (i.e., participants of cluster organizations). Its main task is to help the EC and member countries develop a more strategic vision for understanding modern cluster policy tools and supporting cluster excellence. Another initiative is the European Cluster Alliance, which currently unites 22 national cluster associations (including the Slovak association—Union of Slovak Clusters) representing more than 900 clusters involved in cluster policy. It is an open platform for support and cooperation in the field of cluster policy and cluster access to markets outside the EU (European Clusters Alliance, n.d.).

As part of the second level, in 2009 the EC initiated the European Cluster Excellence Initiative program with the aim of creating world-class clusters by strengthening their excellence. In order to continue the successful work of this pan-European initiative involving 13 partners from nine European countries, the European Secretariat for Cluster Analysis was established to offer practical advice organizations for the management of industrial clusters. The European Secretariat for Cluster Analysis supports the excellence of industrial clusters through their comparison and subsequent certification in the form of gold, silver, and bronze medals (European Secretariat for Cluster Analysis, n.d.).

As in the world, the number of cluster organizations has increased significantly since 2008 in the Slovakia. The first cluster organizations started to be created in 2008, and in the following years there were many impulses from private and public sector entities to establish tourism cluster organizations. The majority of entities providing tourism services did not implement their initiative to create cluster organizations or after some time terminated the organization's activities. Some of examples are: the Novohrad cluster, "Huculská magistrala" (the cluster of tourism on the territory of the Muránska planina National Park and Čierny Hron), the Tatry cluster, the Tatry cluster of tourism of the Tatra region, etc. (Ministerstvo výstavby a regionálneho rozvoja Slovenskej republiky, 2006). A more optimistic view of the issue is represented by successful cluster organizations that cooperate on the territory of the Slovakia and strive for the development of tourism in the regions of operation. Based on the data from the Register of the Interest Associations of Legal Persons and the Non-governmental and non-profit organizations Register (Ministry of Interior of the Slovak Republic, n.d.-a, n.d.-b), there are 13 cluster organizations in Slovakia.

Initially, the successful trend of partnership of actors in the form of clusters was weakened by the introduction of a legislative measure, which is characterized as a modern system of tourism management (Zákon o podpore cestovného ruchu, 2010; Zákon ktorým sa mení a dopĺňa zákon č. 91/2010 Z. z. o podpore cestovného ruchu v znení neskorších predpisov a ktorým sa menia a dopĺňajú niektoré zákony, 2018). This foreign-inspired destination management platform is presented in the form of destination management organizations, the creation of which leads to more efficient and professional work in the field of tourism. It is important to remember that the cluster tourism organization and the destination management organization are two different concepts. This fact is also perceived by our requested members of cluster organizations. In the previous survey, 56.25% of respondents said that there was a difference between the above concepts. Respondents had multiple answers to the question and could indicate more than one option. The most frequently declared differences of cluster organization over destination management organization are creation of tourism marketing (26.42%), support of small and medium-sized enterprises (22.64%), and organization of training courses (15.09%; Michálková & Gáll, 2021).

Currently, cluster tourism organizations are not as important on the territory of the Slovakia as in the developed countries of Western Europe and the world. However, it is not excluded that we could expect this phenomenon to spread in the future. Kubičková et al. (2016) argue that clusters play a key role in national and regional development. Cluster identification has attracted increasing attention from a variety of social areas, including regionalism, economic geography, economic development, business management, etc. In recent decades, several articles on clusters have spread, demonstrating the existence of various attempts to organize different areas, concepts, and topics of cluster research in literature (Cruz & Teixeira, 2010; Lazzeretti et al., 2014). In studies by world authors dealing with cluster identification (such as Bergman & Feser, 1999; Pavelková et al., 2009; Roelandt & den Hertog, 1999; Stejskal et al., 2011; van den Heuvel et al., 2010) different methodological approaches are used.

Cluster structures can be studied at three different levels of aggregation: micro-environment (enterprise level)—identification of cooperation between enterprises, their (main) suppliers, universities, and other related institutions; meso-environment (industry level)—analyses for strategic advice on cluster competitiveness through the identification of key knowledge, designs, and modernization of strategies; and macro-environment (national

level)—network analysis cooperation in many sectors of the national economy (Roelandt & den Hertog, 1999).

In practice, different combinations of approaches are most often applied for the identification of cluster structures, combining the level of micro-environment and meso-environment. In this way, cluster identification methods adapted to the specific conditions of the country or region and the purpose of the research itself are created (Bergman & Feser, 1999).

Based on the study of the available literature, cluster identification methodology appear as a complex research problems. Slovak experiences oriented toward cluster mapping are relatively new and little researched. Although the research studies published so far by Slovak authors (Loučanová & Zaušková, 2008; Potomová & Letková, 2011) explain cluster identification methods, they are not applied in practical terms, which means that it is not possible to evaluate their real benefits or obstacles.

Due to the conflicting views of the authors on a single and unified definition of a cluster, great differences arise in the application of tools and methods of cluster mapping. Many industrial cluster mapping studies would benefit from a better balance between quantitative and qualitative approaches. Since none of these approaches applied alone is likely to bring the final results, with the right combination of individual methods (quantitative, qualitative, and combined), it is possible to achieve a comprehensive mapping of tourism clusters and evaluation in the form of proposals and measures.

3. Methodology

The object of the study is a region in the northern part of the Slovakia—Upper Považie region—which is one of the 21 tourism regions that were defined in 2004 in the territorial planning document issued by the Ministry of Economy of the Slovak Republic (Ministerstvo hospodárstva SR, odbor cestovného ruchu, 2005). Figure 1 illustrates the current state of cluster organization membership, as well as their locations within the Slovakia. It is evident that currently there is no cluster organization in the Upper Považie region. The geographical area of the Upper Považie region includes the districts of Považská Bystrica, Púchov (except the municipalities of Beluša, Mojtín, and Visolaje), Bytča, Čadca, Kysucké Nové Mesto, and Žilina. Within the mentioned areas, we cooperated with the respondents representing businesses and institutions that could form the membership base of a potential tourism cluster in the Northern region.

The main aim of the present study is to use appropriate identification methods to map the microeconomic environment of the selected tourism region and subsequent analysis to evaluate the existing preconditions for successful and efficient operation of the tourism cluster. As a basis for achieving the stated aim, we have set a research question (RQ) which is the subject of verification of the results of our research: What is the current potential of the cluster: the degree of fulfillment of the conditions for the functioning of the tourism cluster expressed as a percentage in the Upper Považie region?

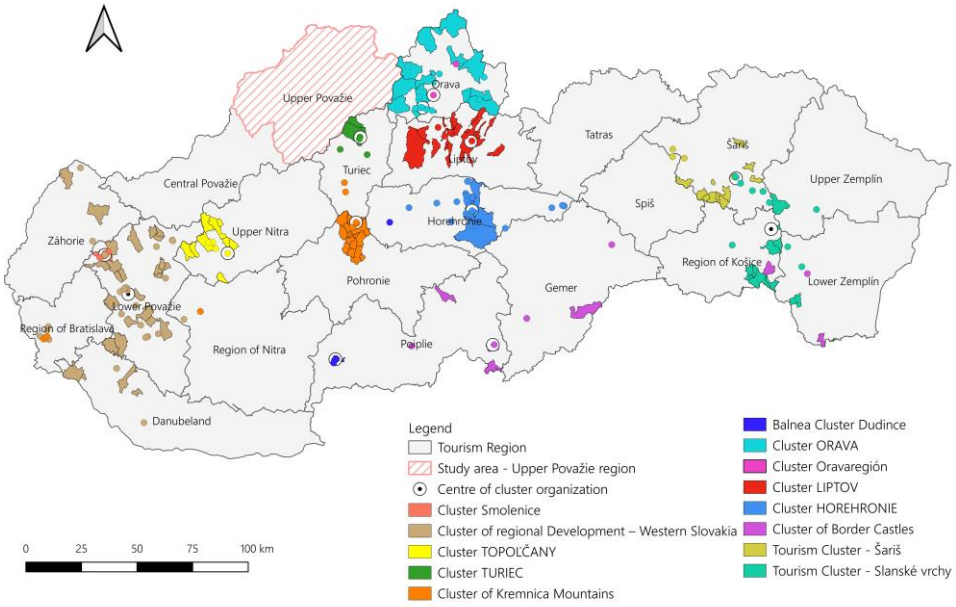

Figure 1. The location of the Upper Považie region.
Note. Adapted from "Sectoral Tourism Concentration in the Context of the Regional Policy," by A. Michálková, V. Kubičková, and J. Gáll, 2020, *Ekonomický časopis*, *68*(10), p. 1114 (https://doi.org/10.31577/ekoncas.2020.10.07). In the public domain.

For a more detailed analysis, we have expanded the RQ by dividing it into two partial tasks:

- Task I: It will test the dependence between the individual input variables—determinants of the Porter's Diamond model—which influence the cluster potential of the company (institution) in the Upper Považie region. At the level of significance (α = .05), we test the following hypotheses (H):
  – H_0: there is no dependence between the different variables, and
  – H_1: there is a dependency between the different variables.
- Task II: At the selected level of significance (α = .05), it verifies the statistical significance of the regression coefficients (localization coefficients in terms of sales LQ_T and employment LQ_Z) referring to their role in determining the potential of the cluster:
  – H_0: the localization coefficients LQ_T and LQ_Z are not statistically significant, and
  – H_1: the localization coefficients LQ_T and LQ_Z are statistically significant.

To obtain a credible image in mapping the cluster potential, the sociological inquiry method will be used in the form of a questionnaire. The questionnaire contains questions that reflect the determinants of the Porter's Diamond model. To each factor in the individual determinants of the Porter's Diamond model, the surveyed respondents assigned a rating according to the provided Likert scale (1 to 4). The distribution of the questions answered by the respondents reflects on the individual determinants of the Porter's Diamond model as follows: factor conditions in the region, firm strategy, structure, and rivalry in the region,

demand conditions, related and supporting industries in the region. We will calculate the degree of fulfillment of the conditions for the functioning of the tourism cluster, expressed in percentages, using a dataset of completed answers from survey respondents. The results obtained will then be used as input data for the subsequent application of the Principal Component Analysis (PCA).

The size of the sampled respondents is used to express the part of the population selected for any given survey. A simple mathematical relationship is used to calculate the size of the sample of the respondents (Mathews, 2010):

$$n = [Z^2 \cdot \hat{p}(1 - \hat{p})]/\varepsilon^2 \quad (1)$$

where n is sample size, Z is Z statistic for a level of confidence, $\hat{p}$ is population proportion, and ε is margin of error.

To perform the calculation, we set the margin of errors (ε = 5%) or the maximum distance of deviation from the actual value necessary for the correct estimation of the sample. The confidence interval reveals how we can be sure that the population will choose the answer within a certain range. For our confidence interval (95%), Z is equal to 1.96.

When classifying cluster potential (the degree of fulfillment of the conditions for the functioning of the tourism cluster expressed as a percentage), we will follow the scale and scoring standard of the determinants of the Porter's Diamond model according to Di and Li (2016). The application of the PCA represents a link between qualitative data and quantitative factors. PCA is a method of reducing dimensions that allows us to identify correlations and formulas in a dataset so that they can be converted into a dataset with a significantly lower dimension without losing any important information. The process of application of the PCA presented involves several steps: calculating the (multidimensional) metallization or correlation matrix of standardized quantities from the input data, calculating custom numbers and custom vectors expressed by a forgery or correlation matrix, and generating major components; each major component is a linear combination of optimally weighted original variables (Stankovičová & Vojtková, 2007).

This innovative approach maps the cluster potential of all the determinants of the Diamond model, which is also supported by expert opinion. The result is a comprehensive analysis and disclosure of the strengths and weaknesses of factors strengthening the competitive advantage of the sector at a regional level.

In this research, methods that meet the regional level of study aggregation, as well as available and high-quality statistical and qualitative data were applied. The result of these steps is a broader research material for the analysis, evaluation, and derivation of the results we have obtained.

4. Results and discussion

The first step included the application of the PCA method, which will evaluate the micro-environment of the Upper Považie region and its cluster potential. The PCA was preceded by questionnaire survey, which was addressed to the respondents representing enterprises and institutions that could form the membership base of a potential tourism cluster in the Upper Považie region. The actual selection of respondents is based on a study of available literature and the concept that the structure of the tourism cluster consists of enterprises and institutions

linked to a tourism product/service or a group of products/services (Pavelková et al., 2009; Sölvell et al., 2003). Such enterprises and institutions are spatially concentrated (in our case they are localized in the selected region) and display an internal configuration that generally includes: a) a group of tourist attractions that attract the attention of tourism visitors; b) enterprises providing tourism services—accommodation services, catering services, transport services, information services, travel agency, and agency services; c) sectors providing support to tourism services; d) institutions providing specialized qualifications, information, and human capital; and e) municipalities and other regulatory bodies that have an impact on tourism agglomerations. We surveyed a total of 375 enterprises and institutions. The return on questionnaires is 55.47%, which represents 208 respondents. The established level of reliability (95%) based on the calculation by the mathematical relation (Equation 1) represents the limit value of 190 respondents, which we met with the obtained size of the sample of respondents.

In the introduction, we surveyed respondents' knowledge of the existence of tourism clusters in the conditions of the Slovakia and the concept of a cluster. The results exceeded our expectations. More than half of the respondents (59.62%) are aware of the existence of tourism clusters and know what the term cluster means. Only 10.58% of the respondents do not know the meaning of the term cluster and almost one third of the respondents (29.81%) have no knowledge whatsoever of cluster activity.

In another question, we presented the basic definition of the cluster to respondents and asked them to consider whether the tourism cluster would be beneficial to their region and the development of tourism. The majority of respondents, more than two thirds (77.88%), are inclined to say *definitely yes* and *rather yes*. None of the respondents chose the *definitely not* option, which is a positive signal for this form of partnership between businesses and institutions in the region under examination. However, a small percentage (4.81%) of the respondents was also found not to consider clustering to be beneficial.

The distribution of the questions answered by the respondents using the Likert scale (positive and negative responses) reflects the determinants of the Porter's Diamond model: firm strategy, structure, and rivalry (*SiaV*), factor conditions (*ŠZ*), demand conditions (*DaDR*), and related and supporting industries (*PaPOaSS*). The calculated variables included in the analysis exhibit a range of cluster potential for each examined determinant, with values ranging from −100% to +100%.

The results present the current cluster potential in the Upper Považie region:

- The availability of factor conditions reached a positive value of 25.38%, which represents the second degree of fulfillment of conditions for the functioning of the tourism cluster. The Upper Považie region has an average level of specialized resources (human, material, and capital resources, scientific and technical knowledge, or infrastructure) that are necessary for the development of the tourism business environment;
- The determinant of firm strategy, structure, and rivalry in the region achieved a positive value of 49.02%. Based on the available scale, it was assigned the second degree of fulfillment of conditions. The results show that signs of mutual cooperation between enterprises can be observed;
- The determinant of demand conditions recorded the worst results. With a negative value of −0.29% we can assign it to the third degree of fulfillment of the conditions. There are differences between the factors that fundamentally affect the functioning and processes of the business environment in the region;

- Related and supporting industries is the determinant with the second-best achieved result of 26.15%. With its result, we rank it in the second degree of fulfillment of conditions for the functioning of the tourism cluster. The results mean that the market position of local suppliers, as well as their quality and level, is partially limited.

Part of the PCA is to determine whether there is dependence between the input variables. By applying multiple regression analysis, we will not only test the dependence of input variables, but also find out the significance between individual variables that affect the cluster potential of companies (institutions) in the Upper Považie region. In addition to the determinants of the Porter's Diamond model, we will use the calculated values of localization coefficients LQ_T and LQ_Z in the Upper Považie region as input variables. Subsequently, we compile a multiple regression model of the influence of regressors (Porter's Diamond determinants and values of localization coefficients) on the regressant (cluster potential of the Upper Považie region). To estimate dependency, we designed a linear model 1. In studying its statistical summary, we assessed the statistical significance between the regressors and the regressant. The regressors of *SiaV* and LQ_Z are statistically insignificant and do not have a significant impact on the cluster potential of companies (institutions) in the Upper Považie region. Therefore, we modify the estimated model in which we remove insignificant regressors. The new estimated linear model 2 has the following shape:

$$UpperPovazie = \beta_0 + \beta_1 \cdot \check{S}Z + \beta_2 \cdot DaDR + \beta_3 \cdot PaPOaSS + \beta_4 \cdot LQ_T + \varepsilon_i \quad (2)$$

Table 1 shows a statistical summary of model 2, based on which we can verify the statistical significance of regression model 2 at the level of significance (α = .05) and the contribution of the explanatory variables. To test the significance of multiple regression model 2, it is necessary to use a global test that examines whether all independent variables of regression coefficients are equal to zero (H_0: $ß_1 = ß_2 = ß_3 = ß_4 = 0$), compared to the alternative hypothesis (H_1: at least one regression coefficient $ß_k \neq 0$). To test the veracity of the null hypothesis, we conducted an *F*-test of the statistical significance of the model, which requires a scatter analysis for the regression model shown in Table 2.

Table 1. Model 2 parameter estimation

	Min	1Q	Median	3Q	Max
	−10.04	−3.32	−0.16	3.10	9.97
	Estimate	Std. Error	*t* value	Pr(>|t|)	
(Intercept)	−40.40	7.48	−5.39	1.88e-07	***
ŠZ	−0.17	0.03	−5.25	3.66e-07	***
DaDR	1.08	0.06	16.50	< 2e-16	***
PaPOaSS	−0.30	0.14	−2.08	0.03	*
LQ_t	0.35	0.13	2.67	0.00	**

Note. *p < .05; **p < .01; ***p < .001; these codes indicate how certain we can be that the coefficient has an impact on the dependent variable; The 1Q and 3Q values are the points that mark the first and third quartiles of all the sorted residual values; The Pr(>|t|) column represents the p-value associated with the value in the *t* value column; Residual standard error: 4.33 on 203 degrees of freedom; Multiple R^2 = .72; Adjusted R^2 = .71; *F*-statistic = 133.3[4] and 203 *DF*, p-value < 2.2e-16.

Table 2. ANOVA scatter analysis

	df	Sum of Squares	Mean Square	*F*	Significance *F*
Regression	4	10,039.49	2,509.87	133.30	1.2075E-55
Residual	203	3,822.10	18.82		
Total	207	13,861.59			

From the data in Table 2, we can find that the value of the calculated *F* is 133.30. The critical value $F_{0.95}$ at the significance level (α = .05) with four degrees of freedom in the numerator and 203 degrees of freedom in the denominator is 3.42. Comparison of *F* values shows that it is necessary to accept the alternative hypothesis H_1, which means that not all regression coefficients are equal to zero. This means that the significant impact of multiple regression model 2 occurs in the dependent variables. At the level of significance (α = .05), regression model 2 is statistically significant.

The adjusted coefficient of determination (Adjusted R^2) has a value of .72, which means that regression model 2, and thus the regressors, explain 72% of the cluster potential in the Upper Považie region; the rest is influenced by other factors and the random component. A correlation matrix was used in the next step to determine the dependency between variables. The correlation coefficients between the variables (Table 3) clearly showed that the explanatory variables are interdependent.

Table 3. Correlation matrix of variables—numerical interpretation

	ŠZ	*DaDR*	*PaPOaSS*	LQ_t
ŠZ	1			
DaDR	0.89	1		
PaPOaSS	0.94	0.88	1	
LQ_t	0.88	0.81	0.91	1

The results show that there is a very strong positive correlation between variables. We are interested in whether the correlation coefficients of the variables are statistically significant. Due to the high *p*-value, the test of variables at the level of significance (α = .05), we reject the H_0 and accept the alternative hypothesis H_1, since at the selected level of significance (α = .05) we confirmed the dependence between the variables.

Due to the existence of strong relationships between pairs of variables, we apply PCA, which will create new linear independent variables—principal components (PC). Table 4 shows that the PC1 explains 91.31% of the total variability and therefore can be considered the most significant. The PC2 explains 4.91%, the PC3 2.38%, and the PC4 1.40% of the total variability. In practice, several rules are used to determine the optimal number of components. Kaiser's rule recommends using PCs whose values are greater than one. The second rule recommends using the PCs that together explain at least 70% to 90% of the total variability (Stankovičová & Vojtková, 2007). It follows that only the PC1 is sufficient to explain the original variables. However, we will also take the PC2, so that the two of them together explain 96.21% of the total variability.

Table 4. Output of the PCA

	PC1	PC2	PC3	PC4
Variance	3.65	0.20	0.10	0.06
Standard deviation	1.91	0.44	0.31	0.24
Proportion of Variance	0.91	0.05	0.02	0.01
Cumulative Proportion	0.91	0.96	0.99	1.00

The following Table 5 shows the coefficients of the eigenvectors. Each principal component can be expressed as a linear combination of the original variables. From Table 5 we can identify the strengths and weaknesses of the variables analyzed (positive value shows above-average clustering potential and negative value below-average clustering potential). The PC1 is the solution of our study, as the other PCs have less or statistically insignificant information (explaining the small dispersion range of the input data) about the variability of variables in the Upper Považie region. Based on the calculations and results from Table 5, the following Equation 3 can be determined, according to which the value of component Y_1 for tourism in the Upper Považie region can be calculated:

Table 5. Coefficients of eigenvectors of variables

	PC1	PC2	PC3	PC4
ŠZ	0.51	−0.08	0.61	−0.60
DaDR	0.49	−0.72	−0.50	0.01
PaPOaSS	0.52	0.11	0.36	0.78
LQ_t	0.49	0.68	−0.50	−0.19

$$Y_1 = 0.508 \cdot \check{S}Z + 0.490 \cdot DaDR + 0.511 \cdot PaPOaSS + 0.491 \cdot LQ_T \quad (3)$$

This mathematical relationship can be called the cluster potential equation, as it contains the exact weights of individual input variables, which affect the cluster potential and competitive capabilities of the Upper Považie region. The applied PCA shows that the factors of the determinants of the Porter's Diamond model create the conditions for the functioning of a potential cluster in the Upper Považie region at an average level. With this step, the research part of the study is at a stage where it would be appropriate to supplement the circle of cooperating enterprises (institutions) as potential cluster members who have expressed an interest in forming a cluster organization in the region under review. One of the results would be a cluster map that graphically expressed the significant flows of material, products, knowledge, and innovation in the cluster between companies (production, procurement, and sales). This method makes it possible to present the interrelations between individual entities. Its task is to deeply identify and understand the profile and economy of a potential cluster and to establish the next direction of our research.

5. Conclusion

The results of the survey serve as an input database for the application of the PCA method, which revealed the current cluster potential in the Upper Považie region. The applied analysis shows that the potential pillars for the creation of the tourism cluster in the Upper Považie region are the determinants of firm strategy, structure, and rivalry in the region, related and supporting industries, and factor conditions. The results show that the examined determinant factors create conditions for the functioning of a potential cluster in the region at an average level. Analysis of the PCs helped us reveal significantly remote values, which we excluded from further analyses. Instead of the original variables, we obtained a smaller number of new variables (PCs), from which, by identifying the strengths and weaknesses of the analyzed variables, we obtained a cluster potential equation. The equation allows input data to determine how well individual variables contribute to the resulting value of cluster potential and competitiveness of the Upper Považie region. The PCA results in four variables that affect

the potential of the cluster in the Upper Považie region: related and supporting industries, factor conditions, localization coefficients in terms of sales, and demand conditions.

The main limitation for authors who will deal in the future with the issues under investigation contained in this study is the problem with the availability of statistical data. In the case of application of cluster mapping methods, it is necessary to prepare datasets and aggregated data to the level of regions on its own account. The second limitation is the provision of representative empirical data for the application of the analysis, and subsequent more detailed analysis requiring basic knowledge of stochastic methods. The need to combine quantitative methods of identifying tourism clusters with qualitative methods also stems from a substantial deficiency, which is the ambiguity of the results. The results of quantitative methods are expressed in numerical terms, which must be interpreted by experts or local actors and enriched with their subjective assumptions and opinions.

Based on a study of the available literature dealing with cluster issues, we designed and applied an algorithm to identify and analyze the tourism cluster in the region. It is a multi-stage identification of tourism clusters, which determines the sequence of individual follow-up steps to identify sources, data, and knowledge of potential clusters in tourism regions and to map them thoroughly. In the scientific research environment (but also in practice), this algorithm is applicable to all sectors of the national economy. After entering the values of standardized quantities into the cluster potential equation obtained by us in the Upper Považie region, it is possible to obtain the values of the main components as further observations that can be applied to new analyses (for example, modeling predictions of cluster potential development using a multiple regression model). The creation of the cluster potential equation in the Upper Považie region is applicable to all Slovak tourism regions. Based on the analysis of the potential of the cluster in the Upper Považie region, it is possible to apply other methods to identify the tourism cluster by local actors. The benefit is to provide feedback to the coordinators of the tourism cluster and the member companies (institutions) that participated in our survey.

Acknowledgements

This contribution is the part of the project VEGA no. 1/0271/23 entitled "Sustainable renewal of spa tourism in the Slovak Republic in the context of the impacts of civilization crises".

References

Andersen, T., Bjerre, M., & Hansson, E. W. (2006). *The Cluster Benchmarking Project: Pilot Project Report - Benchmarking clusters in the knowledge based economy.* https://www.diva-portal.org/smash/get/diva2:707125/FULLTEXT01.pdf

Bergman, E. M., & Feser, E. J. (1999). *Industrial and Regional Clusters: Concepts and Comparative Applications*. https://www.researchgate.net/publication/269709907_Industrial_and_Regional_Clusters_Concepts_and_Comparative_Applications

Brachert, M., Titze, M., & Kubis, A. (2011). Identifying industrial clusters from a multidimensional perspective: Methodical aspects with an application to Germany. *Papers in Regional Science, 90*(2), 419–439. https://doi.org/10.1111/j.1435-5957.2011.00356.x

Brown, K. G., & Geddes, R. (2007). Resorts, Culture, and Music: The Cape Breton Tourism Cluster. *Tourism Economics, 13*(1), 129–141. https://doi.org/10.5367/000000007779784524

Capone, F. (2004, August 25–29). *Regional competitiveness in tourist local systems*. 44th Congress of the European Regional Science Association: "Regions and Fiscal Federalism". Porto, Portugal. https://www.econstor.eu/bitstream/10419/117249/1/ERSA2004_627.pdf

Cruz, S. C. S., & Teixeira, A. A. C. (2010). The Evolution of the Cluster Literature: Shedding Light on the Regional Studies–Regional Science Debate. *Regional Studies, 44*(9), 1263–1288. https://doi.org/10.1080/00343400903234670

Di, J. A., & Li, H. (2016, April 26–27). *Study on the Development of Industry of Internet of Things Based on Competitive GEM Model in Fujian Province.* 2016 International Conference on Electronic, Information and Computer Engineering. Hong Kong, China. https://doi.org/10.1051/matecconf/20164402076

Doeringer, P. B., & Terkla, D. G. (1995). Business Strategy and Cross-Industry Clusters. *Economic Development Quarterly, 9*(3), 225–237. https://doi.org/10.1177/089124249500900304

European Clusters Alliance. (n.d.). *About – European Clusters Alliance.* Retrieved March 11, 2023 from https://clustersalliance.eu/about/

European Secretariat for Cluster Analysis. (n.d.). *Cluster Management Excellence*. Retrieved March 11, 2023 from https://www.cluster-analysis.org/cluster-management-excellence

Kaufman, A., Gittell, R., Merenda, M., Naumes, W., & Wood, C. (1994). Porter's Model for Geographic Competitive Advantage: The Case of New Hampshire. *Economic Development Quarterly*, *8*(1), 43–66. https://doi.org/10.1177/089124249400800104

Ketels, C., & Sölvell, Ö. (2007). *Innovation Clusters in the 10 New Member States of the European Union*. https://www.hhs.se/contentassets/f51b706e1d644e9fa6c4d232abd09e63/clusters_eu-10_publication.pdf

Kubičková, V., Benešová, D., Krošláková, M., & Michálková, A. (2016). *Dynamické podniky služieb – gazely* [Dynamic service enterprises - gazelles]. Wolters Kluwer.

Lazzeretti, L., Sedita, S. R., & Caloffi, A. (2014). Founders and disseminators of cluster research. *Journal of Economic Geography, 14*(1), 21–43. https://doi.org/10.1093/jeg/lbs053

Lindqvist, G., Malmberg, A., & Sölvell, Ö. (2008). *Swedish Cluster Maps: A Statistical Inventory of Clusters in Sweden in 2002*. https://www.researchgate.net/publication/265240234_Swedish_Cluster_Maps#fullTextFileContent

Loučanová, E., & Zaušková, A. (2008). *Klaster ako nástroj na elimináciu bariér inovatívnosti malých a stredných podnikov drevospracujúceho priemyslu* [Cluster as a tool for eliminating barriers to innovation of small and medium-sized enterprises of the woodworking industry]. Vydavateľstvo TU Zvolen.

Maráková, V., & Šimočková, I. (2015). *Integrovaná marketingová komunikácia ako predpoklad formovania pozitívneho imidžu štátu v cestovnom ruchu* [Integrated marketing communication as a prerequisite for forming a positive image of the state in tourism]. Vydavateľstvo Belianum Univerzity Mateja Bela.

Marshall, A. (1890). *Principles of Economics*. https://eet.pixel-online.org/files/etranslation/original/Marshall,%20Principles%20of%20Economics.pdf

Martin, R., & Sunley, P. (2003). Deconstructing clusters: chaotic concept or policy panacea? *Journal of Economic Geography, 3*(1), 5–35. https://doi.org/10.1093/jeg/3.1.5

Mathews, P. (2010). *Sample Size Calculations: Practical Methods for Engineers and Scientists.* Mathews Malnar and Bailey, Inc.

Michálková, A., & Gajdoš, T. (2015). Klastrovanie v cestovnom ruchu na Slovensku a jeho potenciál v podpore inovácií a podnikania [Clustering in Tourism in Slovakia as a Potential in Supporting Innovation and Entrepreneurship]. *Ekonomika a spoločnosť, 16*(1), 58–69. http://www.ekonomikaaspolocnost.umb.sk/wp-content/uploads/2020/07/1_2015.pdf

Michálková, A., & Gáll, J. (2021). Institutional Provision of Destination Management in the Most Important and in the Crisis Period the Most Vulnerable Regions of Tourism in Slovakia. *European Countryside, 13*(3), 662–684. https://doi.org/10.2478/euco-2021-0014

Michálková, A., Kubičková, V., & Gáll, J. (2020). Sectoral Tourism Concentration in the Context of the Regional Policy. *Ekonomický časopis*, *68*(10), 1105–1125. https://doi.org/10.31577/ekoncas.2020.10.07

Ministerstvo hospodárstva SR, odbor cestovného ruchu. (2005). *Regionalizácia cestovného ruchu v Slovenskej republike* [Regionalization of Tourism in the Slovak Republic]. https://www.mindop.sk/ministerstvo-1/cestovny-ruch-7/legislativa-a-koncepcne-dokumenty/koncepcne-dokumenty/regionalizacia-cestovneho-ruchu-v-sr

Ministerstvo výstavby a regionálneho rozvoja Slovenskej republiky. (2006). *Národný strategický referenčný rámec Slovenskej republiky 2007 - 2013* [National Strategic Reference Framework of the Slovak Republic 2007 - 2013]. http://rraz.sk/files/files/Narodny_strategicky_referencny_ramec.pdf

Ministry of Interior of the Slovak Republic. (n.d.-a). *Register of the Interest Associations of Legal Persons*. Retrieved October 22, 2022 from https://ives.minv.sk/rez/registre/pages/list.aspx?type=zzpo

Ministry of Interior of the Slovak Republic. (n.d.-b). *Non-governmental and non-profit organizations Register*. Retrieved October 22, 2022 from http://ives.minv.sk/rez/registre/pages/start.aspx?type=po

Nordin, S. (2003). *Tourism Clustering & Innovation – Paths to Economic Growth & Development*. https://www.diva-portal.org/smash/get/diva2:352389/FULLTEXT01.pdfillustrated

Pavelková, D., Friedel, L., Jirčíková, E., Knápková, A., Skokan, K., & Škodáková, P. (2009). *Klastry a jejich vliv na výkonnost firem* [Clusters and their influence on the performance of companies]. GRADA Publishing, spol. s r.o.

Porter, M. E. (1990). *The Competitive Advantage of Nations*. Free Press.

Porter, M. E. (1998). *Clusters and the New Economics of Competition*. Harvard Business Review. https://hbr.org/1998/11/clusters-and-the-new-economics-of-competition

Porter, M. E. (2000). Location, Competition, and Economic Development: Local Clusters in a Global Economy. *Economic Development Quarterly*, *14*(1), 15–34. https://doi.org/10.1177/089124240001400105

Potomová, J., & Letková, J. (2011). Problémy identifikácie potenciálnych odvetví vhodných pre vznik a rozvoj klastra [Identification difficulties of potential branches appropriate for cluster formation and development]. *Acta Geographica Universitatis Comenianae, 55*(1), 93–113. http://actageographica.sk/stiahnutie/55_1_05_Potomova_Letkova.pdf

Roelandt, T. J. A., & den Hertog, P. (1999). Cluster Analysis and Cluster-based Policy Making in OECD Countries: An Introduction to the Theme. In *Boosting Innovation: The Cluster Approach* (pp. 9–23). OECD Publications Service.

Sölvell, Ö., Ketels, C., & Lindqvist, G. (2009). *EU Cluster Mapping and Strengthening Clusters in Europe*. http://publications.europa.eu/resource/cellar/6f14c45f-7d6a-49c7-9bbf-785b313657d4.0001.02/DOC_1

Sölvell, Ö., Lindqvist, G., & Ketels, C. (2003). *The Cluster Initiative Greenbook*. https://www.hhs.se/contentassets/f51b706e1d644e9fa6c4d232abd09e63/greenbooksep03.pdf

Stankovičová, I., & Vojtková, M. (2007). *Viacrozmerné štatistické metódy s aplikáciami* [Multivariate statistical methods with applications]. Iura Edition.

Stejskal, J., Hájek, P., Kovárník, J., Klimovský, D., & Vlasák, T. (2011). *Průmyslové klastry a jejich vznik v regionech* [Industrial clusters and their emergence in regions]. Linde.

Sternberg, R., & Litzenberger, T. (2004). Regional clusters in Germany—their geography and their relevance for entrepreneurial activities. *European Planning Studies, 12*(6), 767–791. https://doi.org/10.1080/0965431042000251855

van den Heuvel, F. P., de Langen, P. W., van Donselaar, K. H., & Fransoo, J. C. (2010). *Identification of employment concentration and specialization areas: theory and application*. (BETA publicatie: working papers; Vol. 328). Technische Universiteit Eindhoven.

Yalçınkaya, T., & Güzel, T. (2019). A general overview of tourism clusters. *Journal of Tourism Theory and Research, 5*(1), 27–39. https://doi.org/10.24288/jttr.465912

Zákon o podpore cestovného ruchu [Collection of Law on the Support of Tourism], Slov-Lex, No. 91/2010 (2010).

Zákon ktorým sa mení a dopĺňa zákon č. 91/2010 Z. z. o podpore cestovného ruchu v znení neskorších predpisov a ktorým sa menia a dopĺňajú niektoré zákony [Collection of Law on the Support of Tourism as amended and which amend some laws], Slov-Lex, No. 347/2018 (2018).