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USING CLUSTER AND DISCRIMINANT ANALYSES IN ORDER TO EXPLORE COMPANIES' PERFORMANCES AND TO DRAW UP BUSINESS DEVELOPMENT SCENARIOS: A CASE STUDY PERFORMED IN HUNEDOARA COUNTY, ROMANIA

Abstract. The paper displays an overview of the business environment in Hunedoara County, by providing a classification of the regional enterprises according to the levels of their main performances. To this end, we have selected a sample of 91 companies - the majority of them falling into the category of small and medium sized enterprises - and collected the 2019 data reported: turnover; income; expenses; equity; total fixed assets; total current assets; average number of employees. Further on, by performing cluster and discriminant analyses, we have highlighted three distinctive classes of companies and drew up several innovative business scenarios in order to facilitate the movement of a company – i.e. Marmosim, one of the best known actors in the field of the extraction and processing of natural rocks in Romania – from the class it has been initially ranged within, to a different class that displays higher levels of performances.

Keywords: cluster analysis, discriminant analysis, business scenarios, MANOVA analysis, SAS Enterprise Guide programme, dendogram.

1. Introduction

The county of Hunedoara belongs to the Western Region of Romania and it is one of the less developed counties across the Europe, where the gross domestic product (GDP) represents only 51% of the average 27-EU GDP. The need to elaborate development scenarios for the small and medium-sized enterprises (SME) – which play a major part in the process of re-launching the economy of the region – has represented the impulse required with a view to carry out the research grounding this paper. Being convinced that we were able to support the

development of the innovative potential and the growing digitalizing tendency in the SMEs sector, we have organized our paper as follows. Section 2 is dedicated to a short literature review on cluster and discriminant analysis, as widely used statistic tools with the purpose of acquiring an accurate typology of successful companies. Concurrently, some considerations regarding the level of development of companies from the West Region were also exposed within this paragraph. Section 3 describes the design of our methodology, while Section 4 provides the main results generated by the process of applying the above-mentioned statistical methods on a sample of 91 companies which operate in the county of Hunedoara. Finally, we drew up three significant business development scenarios for Marmosim Deva – a well-known SME from the marble extraction sector - which seeks innovative solutions in order to move forward towards the digitalization era.

2. Literature Review

According to the literature, cluster analysis illustrates a statistical technique applied in order to perform empirical typologies. A sample of companies is classified according to the values of their main economic indicators in order to individualize clusters for which the statistical variances are minimized within each group, whilst variances between groups reach their highest values. Each clustering method has its own drawbacks related to the specific manner it groups the classified objects (Kouropalatis et al, 2012). Therefore, Ward's hierarchical method represents an appropriate choice for cases in which collected data present a low number of outliers and researchers are interested in generating highly integrated clusters.

On the other hand, discriminant analysis represents a comprehensive term that encompasses several quite congruent statistical tools which are used in order to highlight dissimilarities between two or several groups of objects depicted by various peculiarities (Kočišová and Mišanková, 2014). In the context of this statistical technique, we examine the dependency established between one qualitative (grouping) variable and several quantitative variables. The main purpose of the discriminant analysis is to search out for a linear combination of predictors that set the differentiation between categories of the dependent variable, as effectively as possible (Mihalovič, 2016; Gabor et al, 2021). To this end, the discriminant analysis implies the combining of MANOVA (Multivariate Analysis of Variance) technique with multiple regression and factorial analysis with a view to determine the functions that enable the ranging of an object within a class or another, under the circumstances of minimizing classification errors (Khemakhem and Boujelbène, 2015). Discriminant analysis is frequently leveraged to endorse cluster analysis' findings.

Within this paper, we employed cluster and discriminant analyses in order to provide a performance-based empirical typology of companies from Hunedoara County, followed by specific proposals of firm-level innovative strategies, in the

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framework of a highly turbulent environment. Thus, the twenty-first-century business milieu undergoes a stage of disruption during which changes move on an abrupt and unpredictable basis (Dura et al, 2020). There is a significant body of the literature which seeks to explore the transmutations occurred within modern organizations in respect with their need to align with new technologies, innovations and digitalization trends (Lambert, 2015).

Against this background, we acknowledged that it became very difficult for managers from Hunedoara county to predict their future performances and to design the development scenarios they need to implement in order to meet long-term business transformation demands. The Strategy for 2021-2027, elaborated by the *Western Agency for Regional Development*, highlights the perpetuation of a series of economically significant, inter-regional disparities existing in this region, which can be perceived both between the urban and the rural environment of the region and among the counties belonging to the Region.

Thereby, if the counties of Timiș and Arad have lately asserted themselves as the economic development engines of the West region, the counties of Hunedoara and Caraş Severin still remain conditional on an industrial structure developed during the communist era, relying on coal extraction, steel industry and heavy industry, for which no sustainable reconversion solutions have been identified in the last 30 years (2021-2027 Regional Development Strategy). As a consequence, the modest degrees of diversification and competitiveness of the companies that are active in these counties were not able to counteract the negative effects of the abrupt decline of traditional industries (2021-2027 Territorial Just Transition Plan in Hunedoara County). Displaying a density of small and medium-sized companies representing only 20 companies per thousand inhabitants (in contrast to 56 companies/1000 inhabitants for Europe), the county of Hunedoara still shows, in accordance to the latest diagnosis analyses elaborated by the public authorities, important differences as compared to other counties in Romania with regard to productivity and investment capacity indicators. In addition, SMEs in Hunedoara display a high level of risk aversion and implement few solutions and strategies for increasing production volume, diversifying their offer of products and services or for implementing innovative projects (2021-2027 Regional Development Strategy).
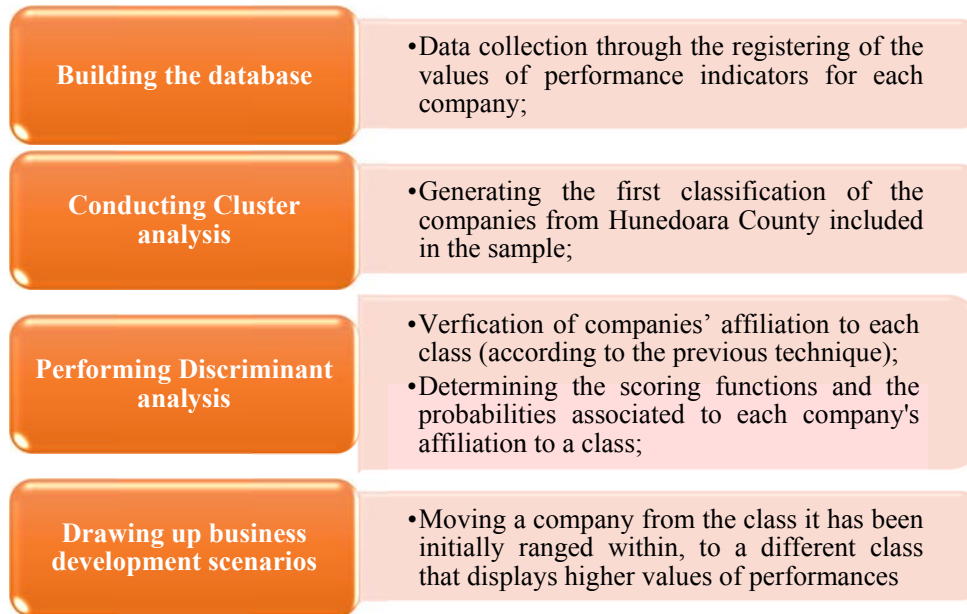
3. Data and Methodology

In order to display a realistic image of the business environment in the county of Hunedoara, we have focused on two research questions:
- Research Question 1: Is it possible to carry out an accurate classification of the companies from Hunedoara County, in accordance to their performance levels?

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- Research Question 2: What kind of business scenarios can enable the moving of certain companies from a decreased efficiency group to a group displaying higher values of performance indicators?

The methodology proposed in order to answer these questions includes several stages which are displayed in Figure 1.

Building the database	•Data collection through the registering of the values of performance indicators for each company;
Conducting Cluster analysis	•Generating the first classification of the companies from Hunedoara County included in the sample;
Performing Discriminant analysis	•Verfication of companies' affiliation to each class (according to the previous technique); •Determining the scoring functions and the probabilities associated to each company's affiliation to a class;
Drawing up business development scenarios	•Moving a company from the class it has been initially ranged within, to a different class that displays higher values of performances

Figure 1. The sequence of steps entailed by the methodology

The data base, which includes the 91 companies that carry out their activity in the county of Hunedoara as well as the values of the indicators registered for each of them - turnover, income, expenses, equity, total fixed assets, total current assets and average number of employees - has been designed through collecting the data reported during the year 2019 for the Trade Register (www.topfirme.ro).

4. Results
4.1. The Cluster Analysis

Following the steps of our methodology, a first classification is made by using SAS Enterprise Guide programme, employing hierarchical classification algorithms (cluster analysis). The first step in carrying out this approach is to get information concerning the distribution of the series of data and to identify possible abnormalities.

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Consequently, a series of descriptive statistic indicators were calculated: the mean, the standard deviation, skewness, kurtosis and bimodality. The values of these descriptive statistics are shown in Table 1.

Table 1. Descriptive statistics provided by SAS Enterprise Guide

Variables	Mean	Standard Deviation	Skewness	Kurtosis	Bimodality
Turnover (RON)	37126133	23026313	1.5807	2.5173	0.6226
Income (RON)	41763754	25029945	1.7832	2.8643	0.7006
Expenses (RON)	39214992	24497241	1.8373	3.4110	0.6719
Equity (RON)	11413073	16325695	2.2153	5.0630	0.7236
Total fixed assets (RON)	10349879	12850174	1.8818	3.3539	0.7035
Total current assets (RON)	15981369	14476969	2.0814	4.5760	0.6945
Average number of employees (No.)	126.0	141.8	3.1964	14.9651	0.6209

Skewness measures the distribution of the values around means, and, depending on the values of this indicator, the distribution chart may shift to the right (positive values) or to the left (negative values). In our case, the distribution charts of the values of all indicators are going to shift positively, displaying a longer tail in the positive part of the *Ox* axis of the chart. In the case we analyse the column called *Kurtosis* in Table 1, we get data about how flattened the chart of each series of data is (or is not), as compared to the normal distribution. Having known that the value of kurtosis indicator for the normal distribution is 3, one may notice that turnover (2.5173), income (2.8643), expenses (3.4110) and total fixed assets (3.3539) are mesokurtic, meaning that they display distributions very close to the normal one. Equity (5.0630), total current assets (4.5760) and average number of employees (14.9651) indicators display kurtosis values higher than 3; therefore, in these cases, we are dealing with leptokurtic distributions.

Table 2 provides the values of the covariant matrix and offers information concerning the possibility of removing certain indicators from our analysis.

Table 2. The eigenvalues of the covariance matrix

	Eigenvalue	Difference	Proportion	Cumulative
1	1.83557E17	1.54635E15	0.7654	0.7654
2	2.89219E14	1.65234E14	0.1206	0.8860
3	1.23985E14	1.87277E13	0.0517	0.9377
4	1.05258E14	6.44198E13	0.0439	0.9816
5	4.08379E13	3.76471E13	0.0170	0.9987
6	3.19086E12	3.19086E12	0.0013	1.0000
7	11518.4654		0.0000	1.0000

One may notice that, although from a statistic point of view the highest volume of information has been brought by the first six indicators, for a complete

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analysis of the financial situation of each company it is important not to drop any of the indicators that are included within the initial data base.

As we stated above, the criterion chosen for carrying out the cluster analysis is Ward method, which implies the minimizing of the total variance inside a cluster, while enlarging the distance between classes. The manner of aggregating the objects in classes is displayed by the dendrogram in Figure 2.
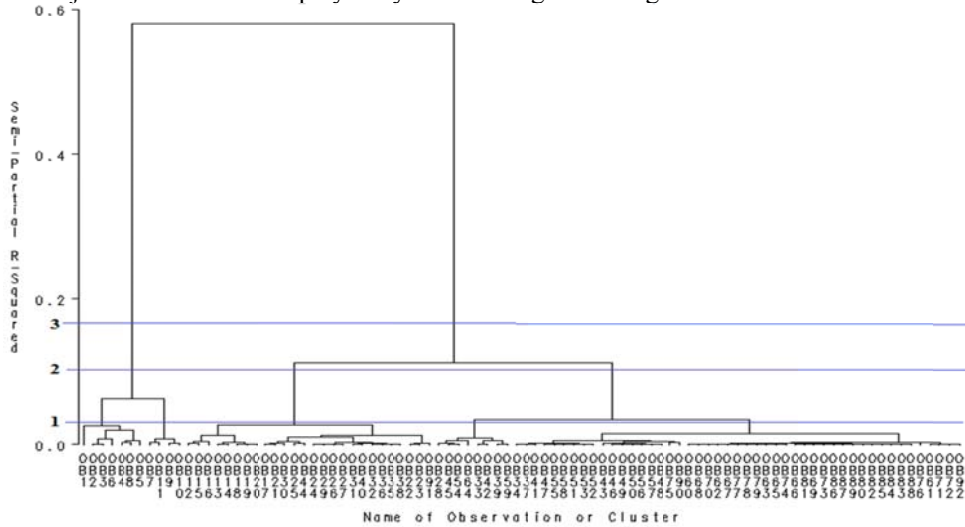
Figure 2. The dendrogram issued from SAS Enterprise Guide

As one may notice, in the case when the dendrogram is cut at the level of line 1, we get several classes of companies exhibiting characteristics very close to each other, the elements of any two adjacent classes being quite similar. In the case when we cut the chart at the level of line 3, then we get 2 different, nonhomogeneous classes, which means that the objects inside a class are not enough similar. In the case when the dendrogram is cut at the level of line 2, then three different classes result, which are quite different, so that the elements of any two adjacent classes are not going to be similar. In detail, the structure of the three classes that have come out based on the sample of 91 companies is displayed in the content of Annex 2.

4.2. The Discriminant Analysis

This analysis starts from the classes having resulted from cluster analysis and, based on the probabilities obtained, is going to re-classify the objects; the result will be a new systematization, more closed to the reality. The main steps in applying the algorithm of discriminant analysis are the following ones: a) determining the indicators of MANOVA analysis from the data series; b) estimating the coefficients of discrimination functions; c) calculating the affiliation

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probability of each object to a class and selecting the maximal value; d) comparing the classification obtained through discriminant analysis with the initial classification of the objects, provided by the cluster analysis.

By virtue of statistical tests calculated upon the data series (Wilk`s Lambda, Pillai`s Trace, Hotteling - Lawley Trace and Roy`s Greatest Root), MANOVA analysis will generate accurate information concerning the acceptance or rejection of null hypothesis.

Null hypothesis would imply that independent variables have no effect upon the evolution of the dependent variable. On the contrary, alternative hypothesis implies that independent variables influence dependent variable. The most commonly used instrument is Wilks` Lambda test. If the values of the test are close to zero, then null hypothesis is rejected and alternative hypothesis is accepted.

Table 3 displays the values of the four MANOVA tests calculated for each class. Their analysis shows that null hypothesis H_0 is rejected (the indicators do not influence a company's affiliation to a class), while the alternative hypothesis H_1 is accepted (the indicators influence a company's affiliation to a class).

Table 3. MANOVA Statistics

Statistics	Class 1	Class 2	Class 3
Wilks`Lambda	0.1809	0.8328	0.436
Pillai`s Trace	0.819	0.1672	0.5639
Hotteling-Lawley Trace	4.5261	0.2007	1.2934
Roy`s Greatest Root	4.5261	0.2007	1.2934

By taking into consideration the approach specific for discriminant analysis, *a discriminant space* and *a distribution rule of objects*, according to distinct classes of enterprises, is being built. This rule may also be used in the future, without having to resume the algorithm. Discriminant space is the result of the graphic representation of discrimination functions. A discrimination function is a lineal combination of explicative variables; in our case, we deal with indicators registered for each company. In order to determine the discrimination functions for each class, equations (1) and (2) are generally used.

$$Sk1_i = \sum_{j=1}^{7} Ij_i * Ck1_j + ak1 \,, \forall i = \overline{1,91}, k = 1,2,3 \tag{1}$$

$$Sk0_i = \sum_{j=1}^{7} Ij_i * Ck0_j + ak0 \,, \forall i = \overline{1,91}, k = 1,2,3 \tag{2}$$

where:

$Sk1_i$ represents the probability of company i to affiliate to class k;

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$Sk0_i$ represents the probability of company i to not affiliate to class k;

Ij_i represents the value of indicator Ij for company i, Ij belonging to the set that includes the following elements: turnover, income, expenses, equity, total fixed assets, total current assets and the average number of employees;

$Ck1_j$ represents the coefficients of the function that indicates the probability of a company's affiliation to class k (k=1, 2, 3), resulting from SAS Enterprise Guide Program;

$Ck0_j$ represents the coefficients of the function that determinates the probability of a company to be not affiliated to class k (k=1, 2, 3), resulting from SAS Enterprise Guide Program;

$ak1$ and $ak0$ are constants of the lineal functions that calculate the scores;

i represents the serial number of the company.

The application of discriminant analysis to the first class will have as a result the finding of the coefficients of discrimination functions, while their replacement in general equations (1) and (2) would determine equations (3) and (4), as follows:

$$S10_i = 5.05 * e^{-8} * I1_i + 3.68 * e^{-7} * I2_i - 2.15 * e^{-7}I3_i + 7.9 * e^{-9} * I4_i - 8.61 * e^{-9} * I5_i + 7.51 * e^{-8} * I6_i + 4.44 * 10^{-3} * I7_i - 4.25, i = \overline{1,91} \quad (3)$$

$$S11_i = 1.26 * e^{-7} * I1_i + 5.93 * e^{-7} * I2_i - 1.56 * e^{-7}I3_i + 1.65 * e^{-7} * I4_i - 1.64 * e^{-7} * I5_i + 4.87 * e^{-7} * I6_i + 13.65 * 10^{-3} * I7_i - 42.69, i = \overline{1,91} \quad (4)$$

The application of the same algorithm for the second class will determine the coefficients of discrimination functions, while their replacement in general equations (1) and (2) would lead us to determine equations (5) and (6):

$$S20_i = 2.42 * e^{-8} * I1_i + 3.05 * e^{-7} * I2_i - 2.48 * e^{-7}I3_i - 4.26 * e^{-8} * I4_i + 4.03 * e^{-8} * I5_i - 4.72 * e^{-8} * I6_i + 1.96 * 10^{-3} * I7_i - 1.59, i = \overline{1,91} \quad (5)$$

$$S21_i = 3.97 * e^{-8} * I1_i + 2.42 * e^{-7} * I2_i - 1.39 * e^{-7}I3_i - 3.92 * e^{-8} * I4_i + 4.3 * e^{-8} * I5_i - 1.09 * e^{-7} * I6_i - 1.23 * 10^{-3} * I7_i - 2.65, i = \overline{1,91} \quad (6)$$

The application of discriminant analysis for the third class will determine the coefficients of discrimination functions, while their replacement in general equations (1) and (2) would result in equations (7) and (8):

$$S30_i = 7.2 * e^{-8} * I1_i + 2.24 * e^{-7} * I2_i - 1.5 * e^{-8}I3_i - 1.98 * e^{-9} * I4_i + 1.25 * e^{-8} * I5_i - 8.53 * e^{-8} * I6_i - 2.57 * 10^{-3} * I7_i - 7.49, i = \overline{1,91} \quad (7)$$

$$S31_i = 3.33 * e^{-8} * I1_i + 2.86 * e^{-7} * I2_i - 1.99 * e^{-7}I3_i - 3.6 * e^{-8} * I4_i + 3.64 * e^{-8} * I5_i - 6.02 * e^{-8} * I6_i + 0.9 * 10^{-3} * I7_i - 1.55, i = \overline{1,91} \quad (8)$$

Data presented in Annex 2, together with the analysis of the charts having resulted from SAS Enterprise Guide software with respect to the distribution of the probability of companies' affiliation to each class showed that certain companies have migrated from one class to another, after having applied discriminant analysis. The probability of including a company within a certain class has been determined as the maximal company's affiliation probability to each class.

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In accordance, company Apa Prod SA has migrated from class 2 to class 1, displaying a probability of 99.74%. Telecerna SRL (70.56%) and Gamax Trading House SRL (71.50%) have migrated class 3 to class 2. The following companies have entered the third class: Borghesi (50.11%), Acomin SA (51.55%), Recom Sid SA (65.63%), Rom Leather Sofas SRL (55.88%), Grand Smithy Works International SRL (60.52%), R&G Industries SRL (62.65%), Colaris Farm SRL (60.21%) and SBT Electrocm SRL (68.12%) – see Annex 2.

Considering the fact that class affiliation probabilities are quiet similar in the case of certain objects, in order to support the decision of ranging a company within a certain class, the data regarding the re-substitution results and validation results are also employed (See Annex 1). As a result, the new classification of the companies according to the discriminant analysis approach is showed in Annex 2.

Accordingly, the average values of indicators I1-I7 for each group are displayed in Table 4.

Table 4. Average values of the analysed indicators per classes of enterprises

	I1	I2	I3	I4	I5	I6	I7
Class 1	82408174	95391790	89738774	34328725	22804945	45779798	354
Class 2	42573143	50459972	49692712	6440967	8634995	10977914	64
Class 3	26521580	28505319	26012335	8453765	8433847	11677836	100

5. Discussion

The considerations displayed in this paragraph have in view the designing of scenarios for supporting the transition of a company from a decreased performance class to the next higher class. We have exemplified these scenarios for Marmosim Company, which is one of the best known actors in the field of the extraction and processing of natural rocks in Romania (see Table 5):

Table 5: Transition scenarios for Marmosim

Scenario	Initial values of indicators	Values proposed by the scenario
Scenario 1	I4 = 40393468	I4 < 25075808
Scenario 2	I7 = 185; I3 = 29977143	I7 < 180; I3 > 33776148
Scenario 3	I2 = 34506122	I2 ≈ 50459972

Scenario A – modification of the volume of the company's own capital (I4) starts from the manner of determining the value of the own capital as difference between the total assets and the company's debts. In the case of Marmosim S.A., the present value of its own capital shows a very good capitalizing for class 3, which would enable the decrease of the capital by up to 15 %. As a result, the variants of modification of its own capital would be the following ones: the increase of the value of the debts through implementing an efficient investment policy for equipping with technological machines specialized in marble extraction and processing, that are financed through bank credits or through European

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programs and/or the removal of a series of outdated and deteriorated technological machines, before their integral depreciation.

Scenario B – modification of the value of expenditures (I3) and of the number of employees (I7). This scenario may be a consequence of the implementation of an investment strategy owing to which the value of expenditures increases, while the incomes remain constant and the number of employees decreases. As a result, in accordance to Table 5, indicator I7 (number of employees) should be smaller than 180 (which is the maximum number for class 2), while expenditures I3 may be increased to 33,776,148 RON (the amount of minimal expenditures of the companies in class 3). As the average of the number of employees in class 2 is 64, it is recommended that the number of personnel should be included within the interval [64,180], in the case of Marmosim, too.

In order to decrease the number of employees and to preserve constant the amount of the incomes, two major development courses may be adopted: re-technologizing the equipment and digitalizing the activity. Accordingly, in the case one has in view the *re-technologizing of the systems*, while considering the specific of the main activity of Marmosim, a first solution would be the use of robotised systems with integrated artificial intelligence able to carve various materials, especially marble. *Digitalizing the activities* implies the adoption of ERP (Enterprise Resource Planning) software that provides data transparency within the organization and facilitates the access to all type of information useful for carrying out the activities. As a result, an ERP program is a software system meant for the management of all the processes and operations of an organization within a unique platform. Considering the fact that Marmosim carries out its activity in several work points (quarries, processing locations, sale points etc.), we recommend the adoption of a SaaS (software as a service) product, type Cloud ERP; an example would be Odoo (On Demand Open Object) program.

Scenario C – modification of incomes (I2) implies the increase of the incomes by over 46%, that is up to the average of the incomes of the companies in class 2, namely up to 50,459,972 RON. The incomes of the company may increase, first, as a result of the increase of the amount of production sold, namely of the amount of products and/or of their price. In the case of Marmosim S.A., after 2016, the increase of the incomes has been determined by the sale of materials for the renovation of old urban centres – Sibiu, Alba Iulia, Oradea – whose financing was made from European development funds, for the renovation of a series of important buildings such as the National Bank, the Telephones Palace or the National Library or of certain museums, airports, cathedrals etc. We estimate that this ascendant trend is also going to continue during the period 2021-2027, being determined by other determinants of the future strategic development: implementation of European financing projects for the infrastructure, ascendant trend of the constructions field and diversification of the portfolio of products and services offered by Marmosim S.A. etc.

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4. Conclusions

The present research displays an overview of the business activity in the County of Hunedoara, being useful both for the businessmen in the area and for the potential investors from abroad. From a pragmatic perspective, the managers of the companies included in this sample may find in this analysis a series of milestones for improving performances and building scenarios for the future development of their businesses. As far as the research courses considered with a view to improve the results obtained through the statistical analyses displayed by this paper, the authors have in view the elaboration of a complex statistic-mathematic model implying a perceptron multilayer neuronal network, in order to carry out a classification, based on multi-criteria, of the companies in the county, depending on their economic and financial performance.

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Annex 1. Data base including indicators I1-I7 for each company.
Re-substitution and Cross-Validation Results after performing the discriminant analysis

Company	Turnover (RON), I1	Income (RON), I2	Expenses (RON), I3	Equity (RON), I4	Total fixed assets (RON), I5	Total current assets (RON), I6	Number of employees, (No.) I7	Re-substitution Results			Validation Results		
								Class 1 (%)	Class 2 (%)	Class 3 (%)	Class 1 (%)	Class 2 (%)	Class 3 (%)
Confezioni Andrea Romania SRL	35310076	133911638	133910550	7267606	9984280	57008577	356	100	70.38	0.01	100	99.46	0
Geraico ProdCom SRL	113967020	114691875	112643358	3541577	3020291	26220743	242	100	96.24	0	100	99.27	0
Fares Trading SRL	113162899	113213808	113000005	1224350	19119	40169421	357	100	89.23	0	100	96.47	0
Farmaceutica Remedia SA	104200954	111135883	108466539	44547474	37650248	36893889	346	100	89.11	0.01	100	95.34	0
Besser Romania SRL	101095535	102815756	86657568	55799831	26393357	62454856	194	100	29.47	0.12	100	34.51	0.08
Italrom Leather SRL	92507574	89352713	89170107	-6677741	19734887	47143886	233	100	67.25	0.26	100	84.76	0.19
Laboratoarele Fares Bio Vital SRL	81970319	85836979	72275265	69878601	8055011	76717812	392	100	4.04	1.44	99.12	2.1	2.21
Drupo SRL	74430640	104622204	102380351	36491061	22667894	32025341	197	100	89.16	0.02	100	94.42	0.01
Reva SA	73813268	79347472	73971993	71451365	51410755	53946718	588	100	14.34	2.84	100	14.73	4.86
Sarmismob SA	72023913	74538137	57754088	70787477	38499787	48911621	265	100	12.37	9.17	100	12.21	15.96
Adaconi SRL	70200366	74743292	61067903	57614979	10229316	54389386	94	100	17.43	2.92	100	18.28	3.79
Landbruk SRL	69753334	76248187	70791277	25075808	32206828	23111806	34	4.44	81.43	1.04	100	76.28	1.14
Mogyi Romania SRL	61378209	61615351	67756397	-2618478	7221769	18343255	114	0.01	86.17	1.69	35.04	83.33	1.93
Spedition Transcontinental SRL	61370939	61411952	58418480	6010815	393471	16273896	79	0.03	74.69	4.84	0.05	73.16	5.25
Indprodcom SRL	60985114	64258448	57638046	23071516	19964932	7460922	168	0	76.58	6.48	0.03	69.15	8.97
Apa Prod SA	56215521	60491728	65567557	18124	45994396	13475321	985	0.01	31.42	55.15	0.01	0.1	99.89
Borghesi SRL	53894297	53098254	39956887	18952222	6712146	25239599	37	0.06	29.62	50.11	99.74	15.44	69.52
Comsid SRL	53007272	53199293	52335834	-4302382	333166	16613809	32	0	71.3	13.72	0.43	69.14	15.42

Proactiv SRL	52119016	52403787	50998946	1705548	2537136	9096053	106	0	74.25	15.58	0	73.09	16.99
Rotary Park SRL	51140535	51285830	50140515	3513499	383995	4983371	1	0	83.38	10.51	0	82.14	12.02
AVIS 3000 SA	50481847	50406980	50323602	21489492	7523104	14980845	180	0	63.77	14.51	0	59.09	17.26
Avis Fresh Com SRL	8181051	48350288	48304498	618025	2009877	5345319	14	0	70.42	46.79	0.01	62.6	62.48
Calibra M&D Impex SRL	7778474	56320702	55359081	2762961	5521699	9655702	84	0	65.557	36.2	0	52.54	55.31
Top Tech SRL	42983252	44025820	42370828	1434170	1080800	10621362	79	0	62.3	41.69	0	61.49	43.85
Acomin SA	42777076	48163982	48696326	11063781	36438709	31418060	156	0	38.02	51.55	0	21.64	72.41
Mixt Evita Com SRL	42365205	42409140	43265388	702653	2571803	2023470	13	0	80.82	27.68	0.01	79.72	31.31
Sava Exim SRL	42074727	42137371	41964114	1399532	13934178	3318248	33	0	76.83	40.71	0	75.41	45.78
Telecerna SRL	41594975	41690174	41312480	6469033	31740442	6126699	85	0	70.56	55.95	0	75.52	46.39
Tawil Metal Recycling SRL	41591348	41591900	41959649	2135567	2007465	7530556	23	0	72.44	34.8	0	71.56	37.5
Recom SID SA	40458723	41147583	38021893	26485605	6780490	29942722	220	0	20.18	65.63	0	13.75	74.45
Rom Leather Sofac SRL	40120510	40814578	40091237	10975365	4685877	20303886	146	0.17	41.14	55.88	0.31	38.34	59.63
Grand Smithy Works International SRL	39237005	39588044	37612853	2997013	4110476	10551352	77	0	55.85	60.52	0	55.23	62.76
Swiss Trade SRL	9073223	43773265	36840903	18243440	23681682	12578032	126	0	31.91	89.69	0	35.81	86.04
Chick SRL	38156229	33379381	30974265	17533479	11184071	16667444	101	0	37.88	77.32	0	38.42	76.33
R&D Industries SRL	37659134	37668865	34900168	9217960	2009500	12790156	34	0	51.31	62.65	0	50.34	65.13
Coralis Farm SRL	37071717	37122657	35800296	4788965	4070661	10129103	17	0	59.52	60.21	0	58.8	62.89
Tin Lavir Serv SRL	37043493	37122959	30834047	14921101	4412123	17803008	23	0	35.14	77.04	0	35.76	75.79
SBT Electrocm SRL	36754815	36768656	34539026	6072902	654699	18979021	24	0	42.31	68.12	0	39.35	72.43
Marmosim SA	36744389	34506122	29977143	40393468	29148151	19681476	185	0	26.39	82.53	0	27.81	78.97
Alis Prod Impex SA	36203660	44095928	43875253	15126984	9724245	14774995	51	0	61.22	35.44	0	59.39	38.44
Valnel Construct SRL	34582587	34704226	28078907	20854857	18995501	12826371	37	0	38.41	85.02	0	39.75	83.56
Simcor Var SA	3943282	34144596	32890736	27343306	20234630	14836205	71	0	35.49	87.82	0	39.28	84.16
Gamax Trading House SRL	33886674	33908931	33776148	108978	124851	838959	2	0	71.5	62.12	0	73.17	59.27
Cirrus Comexim SRL	33357786	49088464	48665117	13550788	21690216	24364430	41	0	51.94	37.2	0	45.52	44.76
Pernat Romania SRL	33262638	33910405	33136950	8746522	34459963	9359261	69	0	55.47	83.33	0	60.48	79.15
Salubritate SA	33106493	33283177	27441778	7858411	7997708	7720968	287	0	26.35	93.95	0	27.89	93.01

Rolux SRL	31701179	32268186	30721633	11316741	6030099	18349705	138	0	30.82	84.73	0	31.29	84.01
Dolce Sofa SRL	30868038	31095000	30746272	724971	2121181	17267668	196	0	28.74	89.19	0	29.56	88.25
Bosco Amico SRL	30746090	33109550	32595794	5238661	5107743	11446789	115	0	45.15	80.02	0	45.48	79.51
Caminico Imex SRL	30625819	30664265	28965147	6966142	1949503	6042691	21	0	54.95	78.88	0	55.66	78.02
Zona D SRL	30402882	31151977	24990877	8289126	4582090	14534594	122	0	24.9	93.54	0	25.44	93.12
Parapharm SRL	29964381	30433232	19563898	11825162	9811274	24240370	48	0	12	97.44	0	11.9	97.14
Strade Conscom SRL	29929045	29933353	22932589	11636325	3225443	14351261	47	0	26.93	92.99	0	27.54	92.53
Savrom Mulaj SRL	29421462	28266174	32244067	9543663	29903993	9696710	103	0	57.02	82.74	0	62.65	77.9
Roben SRL	29388628	29600372	26491643	14038235	5494657	16662605	93	0	29.39	89.26	0	29.73	88.87
Confex Matex International SA	28269413	28602246	27555270	5978100	5710749	8677147	249	0	32.22	92.58	0	33.12	92.03
Farmacia Revitalia SRL	28160447	28203364	26452809	2898401	3034456	10557115	52	0	41.46	89.21	0	41.83	88.87
Teba Brad Industry SRL	27737309	28671229	29849181	11356384	6187185	19279112	125	0	32.05	85.67	0	33.49	83.71
Insemex Petrosani	26310160	27006980	21548863	37436537	25194452	15638176	121	0	23.35	93.92	0	24.34	93.13
Idea Relax Leather SRL	25737794	27167147	26796348	1543100	307442	4974195	147	0	43.83	90.46	0	44.72	89.92
Bivaria Grup SRL	24736414	25549933	19372091	17360613	6986788	15107366	34	0	23.84	95.46	0	24.23	95.23
Damias AS SRL	24592157	20954113	19582361	1926871	2341458	4727221	46	0	42.37	94.91	0	42.88	94.71
Apa Serv Valea Jiului SA	24359198	27547517	26336585	6475446	62401769	19680686	448	0	46.7	91.41	0	47.19	91.11
Totalitaris Com Divers SRL	24342926	24421045	24138735	4435923	5299166	5785103	60	0	11.58	99.42	0	10.79	99.61
Elcompet SRL	23973893	24185667	20057529	3547195	2331980	13833482	114	0	22.31	96.98	0	22.72	96.83
Asm Oil Invest SRL	23791763	24033048	23524188	598291	2495617	4828841	19	0	49.68	91.48	0	50.25	91.16
Duo Ekart Societate in nume colectiv	23740566	25013974	24655211	4275392	1223547	5157469	55	0	48	90.07	0	48.67	89.64
Sigma Struct Invest SRL	23330811	23554606	18997630	5120784	2345164	7570179	173	0	24.48	97.45	0	25.12	97.32
Edy Ursu ComImpex SRL	22760996	29759986	28864128	2184928	2577361	1697158	115	0	51.98	87.87	0	53.09	87.14
Viva Construct SRL	22751984	24168669	19041994	13199958	7271123	7198404	62	0	32.04	95.87	0	32.62	95.68
Keops Serv SRL	22665432	22740224	15078995	15542615	8263428	8939755	108	0	20.82	98.09	0	21.35	98
Fabri SRL	22409895	22699477	15572092	6378262	4938324	8900505	224	0	15.56	98.89	0	15.87	98.88
Instant International SRL	22175204	22419562	21693386	7928458	6924581	7200057	78	0	39.35	94.25	0	39.83	94.03

Chimsport Automotive SA	22107203	23366069	25037918	-2325073	24561721	12274271	138	0	34.86	96.59	0	37.03	96.26
Barbarul SRL	1767795	20900157	21455837	-555200	2783540	3203612	34	0	41.87	96.99	0	43.4	96.81
Gigli Cars SRL	21706872	22259000	22220508	735767	297072	3330427	3	0	51.62	91.96	0	52.46	91.58
Alosco SRL	21415305	24371527	24156635	-1204810	6120402	4103100	59	0	47.96	93.33	0	48.45	93.09
Transporte Spedizione Mobile SRL	21148700	22450789	21252673	1064862	7167726	3058585	68	0	44.24	95.35	0	44.71	95.18
DHS Bike Parts SRL	21109111	21240610	21024282	3014682	408849	8529840	33	0	39.66	94.15	0	40.38	93.86
Ro Xi Wood Systems SRL	20889895	22914193	23098338	8639918	2045348	13947126	111	0	29.59	94.05	0	30.45	93.6
Adige Manufacturing SRL	20458414	20458414	18165137	1962349	1331142	5507017	350	0	18.02	98.74	0	18.74	98.72
Mca Invest Industrial SRL	20145801	20674584	20656304	1849412	4201189	6149192	79	0	39.38	95.6	0	39.89	95.43
Gaminator Games SRL	19988208	19989937	17918690	4958943	47041	4572612	13	0	40.64	95.59	0	41.23	95.4
Hypocrat SRL	19639947	19733464	19181065	1383568	792467	6066448	9	0	42.04	95.27	0	42.7	95.06
Prest Iulian Com SRL	19545716	18196842	17352990	7779476	3728907	10279906	91	0	28.56	97.05	0	29.09	96.91
DHSBaby SRL	19508999	20092770	17049427	3248270	1749852	11312553	13	0	28.77	97.15	0	29.3	97.02
Simausrom Comserimpex SRL	19087990	19586585	18770658	2503011	3856016	3500436	125	0	36.27	96.96	0	36.84	96.84
Zencom Global SRL	18927722	19191623	13976604	4466222	485374	9143161	7	0	26.19	98.05	0	26.78	97.97
Urbicon Team SRL	18646204	27572241	27318967	-12735093	47633	21599639	37	0	25.8	95.11	0	27.95	94.12
Palrom Products SRL	18636300	44290921	44905877	4123870	3094925	13116665	85	0	55.58	54.83	0	51.75	61.28
Comexim R SRL	18600090	18986939	15814966	12242756	9904260	6813929	166	0	24.22	98.25	0	24.65	98.19

Annex 2. Classification of companies from Hunedoara county according to the cluster analysis and the discriminant analysis approaches

Classes	Cluster Analysis	Discriminant Analysis
Class 1	Confezioni Andrea Romania SRL, Geraico Prod COM SRL, Fares Trading SRL, Farmaceutica Remedia SA, Besser Romania SRL, Italrom Leather SRL, Laboratoarele Fares Bio Vital SRL, Drupo SRL, Reva S.A., Sarmismob S.A., Adaconi SRL	Confezioni Andrea Romania SRL, Geraico Prod Com SRL, Fares Trading SRL, Farmaceutica Remedia SA, Besser Romania SRL, Italrom Leather SRL, Laboratoarele Fares Bio Vital SRL, Drupo SRL, Reva S.A., Sarmismob SA, Adaconi SRL, Apa Prod SA
Class 2	Landbruk SRL, Mogyi Romania SRL, Speditiion Transcontinental SRL, Indprodcom SRL, Apa Prod SA, Borghesi SRL, Comsid SRL, Proactiv SRL, Rotary Park SRL, Avis 3000 SA, Avis Fresh COM SRL, Calibra M&D Impex SRL, Top Tech SRL, Acomin SA, Mixt Evita Com SRL, Sava Exim SRL, Tawil Metal Recycling SRL, Recom Sid S.A., Rom Leather Sofas SRL, Grand Smithy Works International SRL, R&G Industries SRL, Coralis Farm SRL, SBT Electrocm SRL, Alis Prod Impex SA, Cirrus Comexim SRL, Palrom Products SRL	Landbruk SRL, Mogyi Romania SRL, Spedition Transcontinental SRL, Indprodcom SRL, Comsid SRL, Proactiv SRL, Rotary Park SRL, Avis 3000 SA, Avis Fresh Com SRL, Calibra M&D Impex SRL, Top Tech SRL, Mixt Evita Com SRL, Sava Exim SRL, Telecerna SRL, Tawil Metal Recycling SRL, Alis Prod Impex SA, Gamax Trading House SRL, Cirrus Comexim S.R.L., Palrom Products SRL
Class 3	Telecerna SRL, Swiss Trade SRL, Chick SRL, Tin Lavir Serv SRL, Marmosim SA, Valnel Construct SRL, Simcor Var SA, Gamax Trading House SRL, Pernat Romania SRL, Salubritate SA, Rolux S.L, Dolce Sofa SRL, Bosco Amico SRL, Caminico Imex SRL, Zona D SRL, Parapharm SRL, Strade Conscom SRL, Savrom Mulaj SRL, Roben SRL, Confex Matex International SA, Farmacia Revitalia SRL, Teba Brad Industry SRL, Insemex Petrosani, Idea Relax Leather SRL, Bivaria Grup SRL, Damias AS SRL, Totalitaris COM Divers SRL, Apa Serv Valea Jiului SA, Elcompet SRL, Asm Oil Invest SRL, Duo Ekart Societate in nume colectiv, Sigma Struct Invest SRL, Edy Ursu ComImpex SRL, Viva Construct SRL, Keops Serv SRL, Fabri SRL, Instant International SRL, Chimsport Automotive SA, Barbarul SRL, Gigli Cars SRL, Alosco SRL, Transporte Spedizione Mobile SRL, DHS Bike Parts SRL, RO Xi Wood Systems SRL, Adige Manufacturing SRL, Mca Invest Industrial SRL, Gaminator Games SRL, Hypocrat SRL, Prest Iulian Com SRL, DHSBaby SRL, Simausrom Comservimpex SRL, Zencom Global SRL, Urbicon Team SRL, Comexim R SRL	Borghesi SRL, Acomin SA, Recom Sid SA, Rom Leather Sofas SRL, Grand Smithy Works International SRL, Swiss Trade SRL, Chick SRL, R&G Industries SRL, Coralis Farm SRL, Tin Lavir Serv SRL, SBT Electrocm SRL, Marmosim SA, Valnel Construct SRL, Simcor Var SA, Pernat Romania SRL, Salubritate SA, Rolux SRL, Dolce Sofa SRL, Bosco Amico SRL, Caminico Imex SRL, Zona D SRL, Parapharm SRL, Strade Conscom SRL, Savrom Mulaj SRL, Roben SRL, Confex Matex International SA, Farmacia Revitalia SRL, Teba Brad Industry SRL, Insemex Petrosani, Idea Relax Leather SRL, Bivaria Grup SRL, Damias As SRL, Totalitaris Com Divers SRL, Apa Serv Valea Jiului SA, Elcompet SRL, Asm Oil Invest SRL, Duo Ekart Societate in nume colectiv, Sigma Struct Invest SRL, Edy Ursu Comimpex SRL, Viva Construct SRL, Keops Serv SRL, Fabri SRL, Instant International SRL, Chimsport Automotive SA, Barbarul SRL, Gigli Cars SRL, Alosco SRL, Transporte Spedizione Mobile SRL, DHS Bike Parts SRL, Ro Xi Wood Systems SRL, Adige Manufacturing SRL, Mca Invest Industrial SRL, Gaminator Games SRL, Hypocrat SRL, Prest Iulian Com SRL, DHSBaby SRL, Simausrom Comservimpex SRL, Zencom Global SRL, Urbicon Team SRL, Comexim R SRL.