

Online Investigation of SMEs Competitive Advantage

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Abstract: Although much has been done about competitiveness of SMEs in the last years, there are many open questions. In this paper we set out to use public Internet information and investigate big number of companies' web sites. We present a methodology that uses a business intelligence tool for online data collection and analytics for investigation. The goal is to use analytics paradigm and propose an on-line approach for the purposes of company competitive advantage investigation and prediction. We have created process allowing to collect significant empirical data sets through business intelligence tool and to analytically compare organisational competitiveness.

Keywords: SMEs competitiveness, business analytics, predictive models

1 Introduction and Previous Works

In his book and in the BBC series Niall Ferguson explained precisely why western capitalism became the leading economic and social structure of the last centuries. His argument is that the West world developed six "killer applications" that the rest lacked – competition, science, democracy, medicine, consumerism and the work ethics [2]. In the context of new technologies and globalization it is useful to investigate the role of competition, how it contributes and what is the role of small and medium enterprises (SME) competitiveness. Over the past two decades competitive companies are becoming more open, global, collaborative and less hierarchical. Adrian Slywotzky explained the paradigm of "value migration": the flow of economic and shareholder value away from more outdated business units toward others that are better prepared to create competitive product and services for customers and profit for the company shareholders [14]. He described also the competences that company managers need to recognize value shifts in their industries and to master the key moves that will determine their ability to achieve and maintain value growth. This is especially important for SMEs managers and their decision making abilities. Company offices now are completed of incredible technological facilities. World's experts in cross-cultural communication,

information networks, and the science of attention described competences that executives should cultivate to tackle new challenges: Molinsky advises that managers must overcome psychological barriers in order to act in ways that other cultures find appropriate; Davenport and Iyer – the devolution of hierarchy has increased the value of building and wielding influence through digital networks, and offer tips for how to do it; Davidson – managers to get over their fears about distraction and embrace the brain's natural tendency to divide attention [9].

According to a survey conducted by MIT Sloan Management Review, in partnership with IBM Institute for Business Value, more than 58% of the more than 4,500 respondents said their companies were gaining competitive value from analytics – up from just 37% who thought this last year [6].

Companies which value data-oriented organizational cultures usually

- Use analytics as a strategic asset;

- Insights are widely available and utilizable;

- Management supports analytics throughout all organizations.

Companies that want to be successful at using analytics need to acquire real analytics expertise.

On the other hand nowadays data overflow continues to grow and many companies, especially SMEs are under escalating pressure to invest further in information systems that generate business value and competitive advantage [1].

1.1 Previous Works on SMEs Competitiveness

Small and Medium Enterprises (SMEs) are one of the main entities that facilitate innovation and drive national economic growth. Successful and growth-oriented small SMEs are vital to an economy's health. Since the appearance of the Lisbon Strategy, the SME sector has ever more frequently mentioned in documents of the European Union with emphasis on the role of their competitiveness. Definitions and measurement of the competitiveness of SMEs, as well as development of analytical capabilities to plan, execute and determine these have become important tasks in research in many fields.

In literature and in on-line databases there are many approaches how to define and analyse company competitiveness. There is not a commonly recognized definition of competitiveness. Michael Porter defines competitiveness as company's strategies, productivity, and the results of relationship between firms and local business environment, synergy of social and economic objectives. In his definition, competitiveness is influenced by factors from external environment [10, 11]. Gal in her research, on the basis of a study of competitiveness of companies, defined competitiveness of small and medium sized enterprises, presented methods of analysis for enterprise competitiveness, and systematizes

factors of SME competitiveness. She applied the following criteria: macro- and micro-environmental, ex-ante and ex post, external and internal factors, as well as input and output side factors and tested the macro environmental efficiency factors with the specific analysis [3]. To link the characteristics of SMEs' owner-managers and their firms' performance together Man and others have developed a conceptual model, drawing upon the concept of competitiveness and the competency approach [8]. His model consists of four constructs of competitive scope, organizational capabilities, entrepreneurial competencies and performance. The central focus of the model is on the three entrepreneurial tasks that link different competency areas with other constructs of competitiveness. A paper by Romero-Martínez described the wide range of European funding programs aimed at SMEs and presented an empirical study of exactly how Spanish SMEs, and especially those in the service sector, are using European funding to innovate, together with an analysis of the effectiveness of this type of funding in stimulating innovation in SMEs [13]. Reuber and co-authors wrote that doing business in global markets is both difficult and costly. They conclude that most SME choose to operate domestically where the opportunities outweigh the risks by far [12].

1.2 Goal of the paper

Although much has been done about competitiveness of SMEs in recent years, many questions are left unanswered. In this paper we endeavour to use public Internet information and investigate big number companies' web sites. We present a methodology that uses a business intelligence tool for online data collection and analytics for investigation [16]. The goal is to use analytics paradigm and propose an on-line approach for company competitive advantage prediction. We have created process allowing to collect significant empirical data sets through business intelligence tool and analytically to compare the competitiveness.

2. Methodology and Research Design

Most of existing research methods includes questionnaires, survey and interviews prepared by companies personal or by telephone or mail. In contrast, our methodology is based on on-line web search of public data, without company stakeholder's direct involvement. We have used the process described on Figure 1 – research and prepare keywords and SMEs web site addresses, apply the 'LuckySearch' business intelligence (BI) tool and analyse collected data with IBM SPSS Statistics and Modeler.



Figure 1

On line research processes

2.1 LuckySearch' Business Intelligence Tool

'LuckySearch' business intelligence tool is developed as a Windows Desktop program [16]. It executes searches on Google, Yahoo! Search and Bing. The search queries are constructed for each preliminary selected keyword and each company's web site. Also one additional search is executed only with the company's web site, to get the count of the pages in the web site. The output of the application is one (xw x nm) matrix (corresponding to # of firms X # of keywords) saved in a spreadsheet with the results of the searches executed against one of the search engines. The results are structured in a table with columns – the selected nm keywords entered as an input + one column for the total number of pages on the web site; and rows – the xw companies' web sites. The data in the table is normalized: the number of pages of the site and the keyword counts normalized by the number of pages of the site. The application is constructed in a way that supposes further development and integration with the SPSS – data mining, customer relationship management, business intelligence and data analysis software [5].

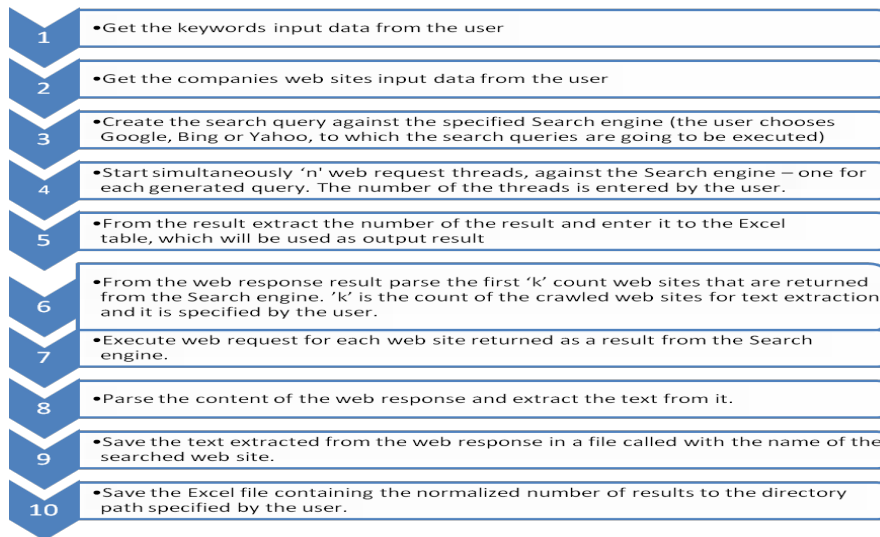


Figure 2

Process diagram of the LuckySearch application

2.2 IBM SPSS Statistics and IBM SPSS Modeler

This investigation continues with implementation of IBM SPSS Statistics and Modeler [5]. It is based on the CRISP – DM model, data mining methodology that is more efficient, enables faster handling of large data mining projects and enables to user to identify new, successful patterns [7]. The methodology consists of the following steps – business understanding, data understanding, data preparation, modelling, evaluation and deployment. It applies the PASW Modeler tool that includes a considerable number of machine learning and statistical modelling techniques, which can be classified into three main approaches to modelling – predictive, clustering and associations [4]. The challenge is to choose the best applicable predictive model, considering the multitude of models, each with specific weights or rules or other mechanics that determine precisely how the predictors are combined. PASW Modeller has many predictive modelling techniques (nodes) available, some of which are usual data mining methods while others derive from classical statistics. They include: neural networks, five different rule induction methods, support vector machines, Bayesian networks, the self-learning response model, a sequence detection method, regression and logistic analysis, discriminant analysis, Cox regression, and generalized linear regression models. It offers the most important statistical models and three Auto nodes, which can build several different types of models to predict flag or nominal fields. An auto node generates a set of models based on specified options and ranks the best candidate model according to a criterion selected by the user [4].

3. Empirical Research

SMEs competitiveness competencies investigation takes many resources and time and has distinctive challenges. In our methodology we select the keywords and web site addresses and after that analyse collected information.

3.1 SMEs Competitiveness Keywords

After an online research of databases and many different models we have chosen the following keywords for analysis of the competitiveness of SMEs and group them in five categories:

- a. **Competitive strategy (CS)** – vision, mission, strategy, BSC, scorecards, KPI, ROI, measurement, cost lowering, differentiating products, training, empowerment, leadership, knowledge management, gap analysis, university cooperation, R&D, technology transfer office, strategic competences, strategic partners
- b. **Production (Pr)** – Innovation in-side, business processes, quality, cooperation, collaboration, effective, efficiency, outsourcing, sales force, market research, redesign, research centres, research laboratories, consulting, pilot projects, new product development, opportunity competences, product innovation, technology innovation, unique product, advanced technology
- c. **Customer relationships (CR)** – customer relationship, relationship competences, customer information, sales force, value co-creation, Innovation outside, communication, cooperation, collaboration, customer knowledge, customer needs, networking,
- d. **ICT investments/applications (ICT)** – office automation, MIS, BI, ERP, CRM, SCM, e-business, Internet applications, e-mail, corporate web site, advanced ICT tool
- e. **Corporate culture (CC)** – organizational competences, communication, cooperation, collaboration, language competences, computer competences, relationship competences, staff training, empowerment, leadership, strategy communication, environment hostility, commitment competences

3.2 SMEs Components Groups and Key words

For the purpose of ‘LuckySearch’ business intelligence tool we have prepared SMEs components groups and keywords as shown in Table 1.

<i>Group</i>	<i>Keywords</i>
Competitive strategy	"vision"
	"mission"
	"strategy"

<i>Group</i>	<i>Keywords</i>
	"BSC+OR+scorecards"
	"KPI"
	"ROI"
	"measurement"
	"cost+AND+lowering"
	"differentiating+AND+products"
	"training"
	"empowerment"
	"leadership"
	"knowledge+AND+management"
	"gap+OR+analysis"
	"university+AND+cooperation"
	"research+AND+development"
	"technology+AND+transfer+AND+office"
	"strategic+AND+competences"
	"strategic+AND+partners"
Production	"Innovation+AND+in-side"
	"business+AND+processes"
	"quality"
	"cooperation+OR+collaboration"
	"effective+OR+efficiency"
	"outsourcing"
	"sales+AND+force"
	"market+AND+research"
	"redesign"
	"(research+AND+centers)+OR+(research+AND+laboratories)"
	"consulting"
	"(pilot+AND+projects)+OR+(new+AND+product+AND+development)"
	"opportunity+AND+competences"
	"(product+AND+innovation)+OR+(technology+AND+innovation)"
	"unique+AND+product"
	"advanced+AND+technology"
Customer relationships	"(customer+AND+relationship)+OR+(relationship+AND+competences)"
	"(customer+AND+information)+OR+(customer+AND+knowledge)"
	"value+AND+co-creation"
	"Innovation+AND+out-side"
	"communication"
	"customer+AND+needs"
	"networking"
ICT investments/applications	"office+AND+automation"
	"MIS"

<i>Group</i>	<i>Keywords</i>
	"BI"
	"ERP"
	"CRM"
	"SCM"
	"e-business"
	"Internet+AND+applications"
	"e-mail"
	"corporate+AND+web+AND+site"
	"advanced+AND+ICT+AND+tool"
Corporate culture	"organizational+AND+competences"
	"language+AND+competences"
	"computer+AND+competences"
	"relationship+AND+competences"
	"staff+AND+training"
	"strategy+AND+communication"
	"environment+AND+hostility"
	commitment+AND+competences

Table 1

SME components groups and key words

‘LuckySearch’ business intelligence tool outputs two spreadsheets for international (world) and Bulgarian companies. The results are based on a convenience sample of 273 international firms that were selected for being representative of the breadth of their value co-creation activities [15] and sample of 303 Bulgarian companies selected from the Bulgarian Chamber of Commerce web site <http://www.bcci.bg/english/>.

The software tool ‘LuckySearch’ gives average number of occurrence per web site of each keyword from the list. The summary of ‘LuckySearch’ application outcome is visualized in Figure 3 and it shows that international companies have web sites that have much more pages than Bulgarian.

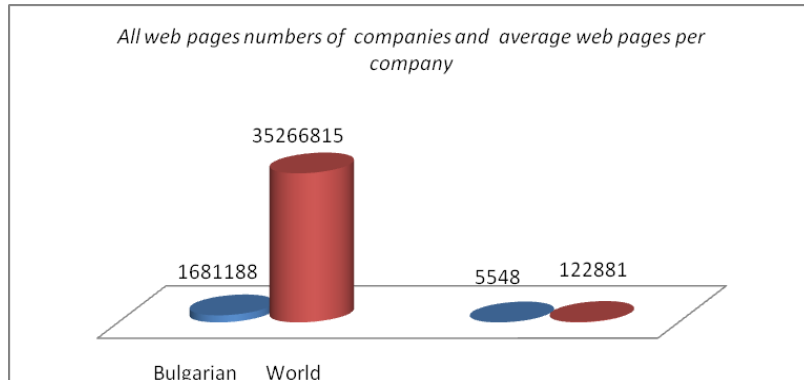


Figure 3

The summary of LuckySearch application results

Following the method we use we sum the average numbers of pages within each component (group). Thus we obtain the average number of occurrences of each keyword per site of this component. Then we sum the average numbers of occurrence per site of all components. Thus we obtain the average number of key word occurrence per site of the Competitiveness SME itself.

4. SMEs Competitiveness Analysis and Discussions

To prove the methodology we have performed two analyses of the collected data using IBM SPSS Statistics and IBM SPSS Modeler [5].

4.1 Analyze with IBM SPSS Statistics

4.1.1 Calculate the z-scores separately for each SME component and for the competitiveness of SME itself

We calculate z-scores (z-values, normal scores, and standardized variables) for the defined five SME components and for the Competitiveness of SME itself. z-scores indicate how many standard deviations an observation or datum is above or below the mean. It is a dimensionless quantity derived by subtracting the population mean from an individual raw score and then dividing the difference by the population standard deviation. This conversion process is called standardizing or normalizing; however, "normalizing" can refer to many types of ratios; see normalization (statistics) for more. [17]. Standard scores are also called "Z" because the normal distribution is also known as the "Z distribution". They are most frequently used to compare a sample to a standard normal deviate (standard normal distribution, with $\mu = 0$ and $\sigma = 1$), though they can be defined without

assumptions of normality. The quantity z represents the distance between the raw score and the population mean in units of the standard deviation. z is negative when the raw score is below the mean, positive when above.

After calculating the z -scores of Bulgarian and international companies we sort the companies in descending order by the z -scores separately for each SME component (Competitive Strategy (CS), Production (Pr), Customer Relationships (CR), ICT investments/applications (ICT) and Corporate Culture (CC)) and for the Competitiveness SME itself. Only the companies in separate Bulgarian and international files with z -scores over 1 (extraordinary values) are presented in Figure 4 - % of companies with z -scores over 1 sorted in the separate groups. These are the companies with extraordinary high average number of certain keyword occurrence per site of each SME component and Competitiveness SME itself.

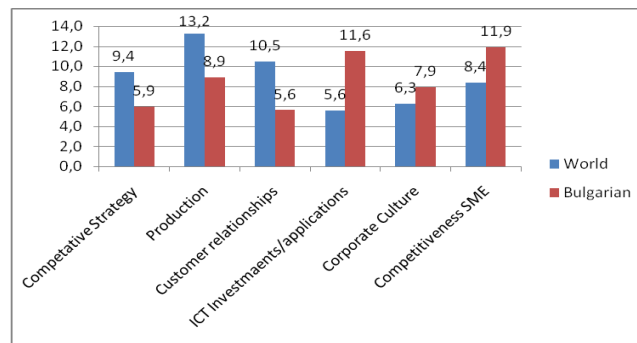


Figure 4

Extraordinary values of world and Bulgarian companies on the subject of key words

Most of the international companies have z -scores over 1 in web content about keywords in the fields of competitive strategy, production and customer relationships (compare to the worlds companies only). Bulgarian companies have bigger percentages (compare to the Bulgarian companies only) of z -scores over 1 in web site content in fields of ICT investment/applications and corporate culture. This result can be explained by the historically well developed Bulgarian ICT sector.

4.1.2 Calculating Spearman's rho

The world companies with z -scores over 1 sorted in descending order shows that the orders of magnitude in the columns are very similar about international companies. We used Spearman's rho correlation coefficient as a measure of this similarity. It is a non-parametric measure of statistical dependence between two variables. It assesses how well the relationship between two variables can be described using a monotonic function. If there are no repeated data values, a perfect Spearman correlation of +1 or -1 occurs when each of the variables is a

perfect monotone function of the other. Calculated values for our international and Bulgarian companies are presented in Table 2 and Table 3.

	CS	Pr	CR	ICT	CC	Competitiveness SME
CS	1	,856**	,695**	,634**	,614**	,921**
Pr	,856**	1	,793**	,656**	,649**	,914**
CR	,695**	,793**	1	,585**	,676**	,771**
ICT	,634**	,656**	,585**	1	,426**	,827**
CC	,614**	,649**	,676**	,426**	1	,602**
Competitiveness SME	,921**	,914**	,771**	,827**	,602**	1

Table 2

Spearman's rho for world companies

** Correlation is significant at the 0.01 level (2-tailed).

The highest ranking match is between Competitive strategy and Competitiveness SME and between Production and Competitiveness SME. In other words, the rank of Competitiveness SME depends mainly on the ranks of Competitive strategy and Production. The weakest match is between ICT Investments/applications and Corporate Culture.

Spearman's rho for Bulgarian companies is present at Table 3.

	CS	Pr	CR	ICT	CC	Competitiveness SME
CS	1	,557**	,589**	,259**	,524**	,522**
Pr	,557**	1	,504**	,298**	,371**	,599**
CR	,589**	,504**	1	,289**	,567**	,444**
ICT	,259**	,298**	,289**	1	,173**	,839**
CC	,524**	,371**	,567**	,173**	1	,306**
Competitiveness SME	,522**	,599**	,444**	,839**	,306**	1

Table 3

Spearman's rho for Bulgarian companies

For the Bulgarian companies the Spearman's rho are lower than the values for international companies. The only one higher rho is between ICT Investments/applications and Competitiveness SME itself, i.e. the rank of Competitiveness SME depends mainly on the rank of ICT Investments and applications. The weakest match is also between ICT Investments and applications and Corporate Culture.

4.1.3 Comparison between international and Bulgarian companies

After collecting all data from selected company web sites and summarizing them with the described approach, we have performed many comparisons. The next step of our analysis is the comparison between international and Bulgarian companies for all five groups – Figure 5. We have used Error bar. The small ring in the middle represents the mean and the tails represent the standard deviation. Thus the end of the upper tail is equal to the mean plus one standard deviation which corresponds to the z-score of +1. The end of the lower tail is equal to the mean minus one standard deviation which corresponds to the z-score of -1. The companies between the tails are “normal” because their z-scores are between -1 and +1. The companies above the upper tail are extraordinary because their z-scores are over +1.

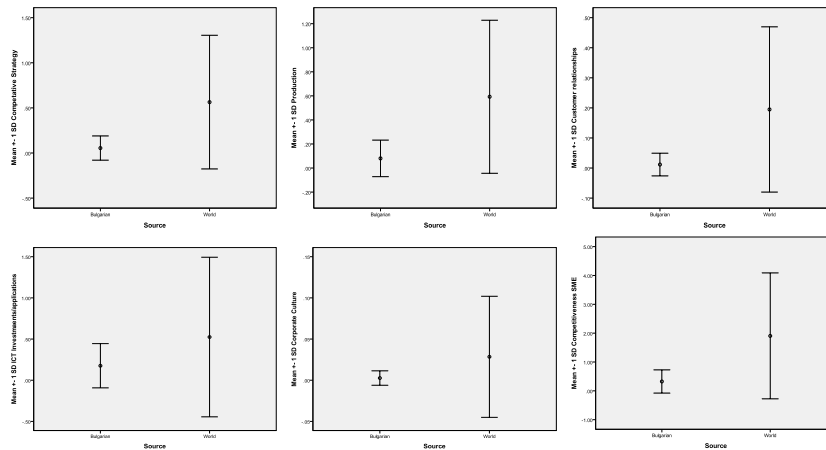


Figure 5

Error bars for the five SME components and for Competitiveness itself

As we can see on the Figure 5 the means of international companies exceed the means of Bulgarian companies for all SME components and for Competitiveness itself. This is an expected result for the current economic conditions. The smallest difference is three times (for ICT Investments/applications), and the largest is seventeen times (for Customer relationships). Another important point is that upper limits for Bulgarian companies (corresponding to +1 z-score) are much below the mean values of international companies. That means that extraordinary Bulgarian companies are below or equal to “normal” international companies.

4.2 Analyze with IBM SPSS Modeler

We chose to construct models for visualisation with plots and continuous field’s models with the Auto Numeric node [4]. Models can be compared based on

correlation, relative error, or the number of fields used. We apply predictive modelling and chose inputs data from BI search tool keywords to analyse and see the predictors for SMEs competitiveness.

4.2.1 Comparison between international and Bulgarian companies with plot charts

Plots, multiplots, and evaluation charts are two-dimensional displays of Y against X. It is easy to interact with them by defining SMEs components. We are exploring SMEs competitiveness potential of the five SME components and versus the Competitiveness SME itself. They illustrate whether there is a relationship between competitiveness keywords – Figure 6.

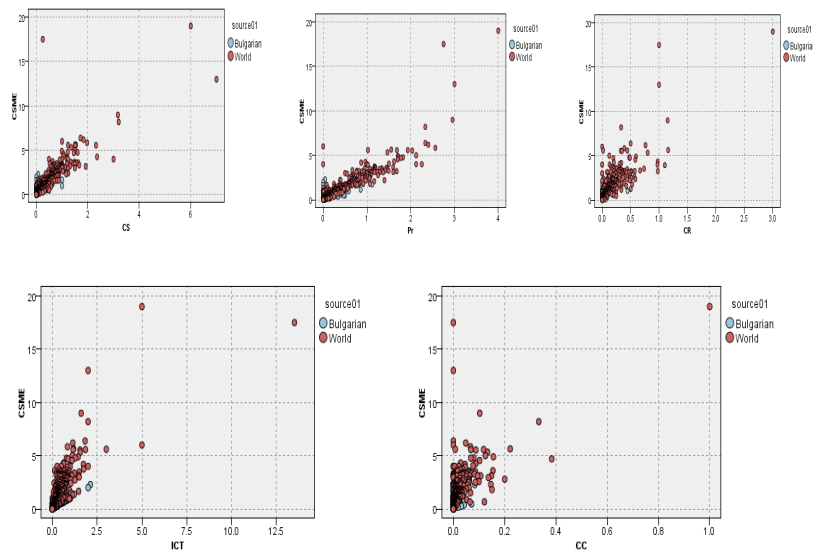


Figure 6

X-Y scatterplots of relationships between the five SME components and the Competitiveness SME itself

This figure corresponds to the Spearman's rho coefficients in Tables 2 and 3. The stronger correlation concerning Competitive Strategy (CS) and Production (Pr) can be seen as closeness of the points to an imaginary straight line and the weaker correlation concerning other SME components can be seen as dispersion of the points.

4.2.2 Predicting the competitiveness with Auto Numeric node

The PASW Modeler contains a number of different algorithms for performing a rule induction: C5.0, CHAID, QUEST, and C&R Tree (classification and

regression trees) and Decision List [4]. They all share similar functionality being able to construct a decision tree by recursively splitting data into subgroups defined by the predictor fields as they relate to the target field. They differ in several ways that are important to users. PASW Modeler provides different models for continuous fields with the Auto Numeric node. It estimates and compares models for continuous numeric range outcomes using a number of different methods, allowing the use of a variety of approaches in a single modelling run. To explore the relationships of the SMEs competitiveness in regards to the different predictors, we created models using IBM SPSS Modeler Auto Numeric models, illustrated in Figures 7 below for international and Bulgarian SMEs.

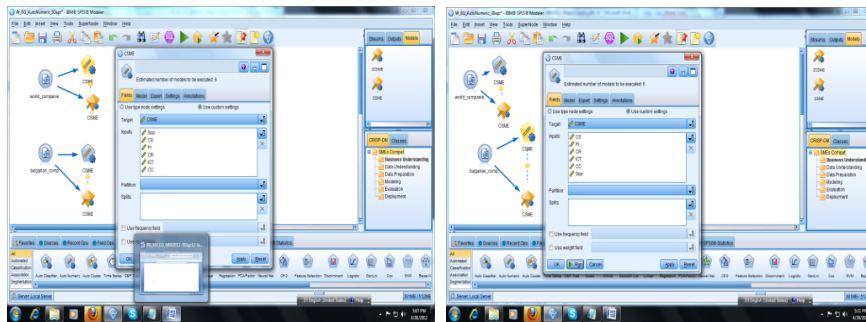


Figure 7

Target and Inputs for the Auto Numeric models for World (left) and Bulgarian companies

The application of Auto Numeric node created three relevant to our data models – Regression, Generalized Linear Models (GLM) and Neural networks – Figure 8.

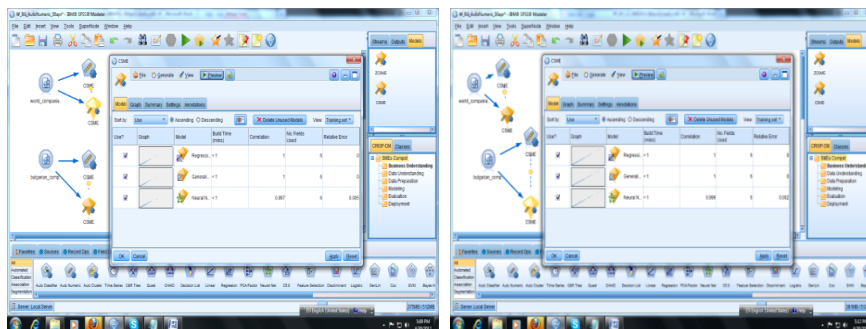


Figure 8

Most relevant models for World (left) and Bulgarian companies

The most important predictor for SMEs competitiveness is the Production, followed by CS and CR for the world and by ICT and the size of the web site for the Bulgarian SMEs – Figure 9.

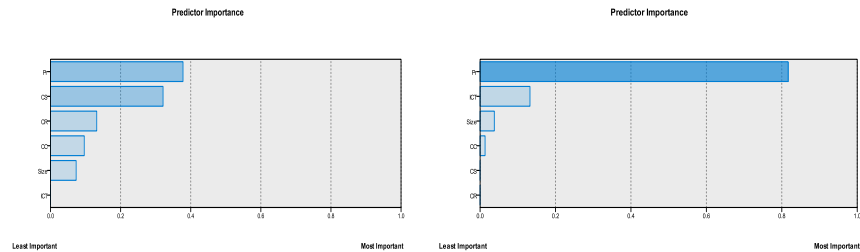


Figure 9

SMEs Competitiveness predictors importance for World (left) and Bulgarian companies

This result is related again to the Spearman's rho. The first two most important predictors are these ones with the highest Spearman's rho concerning Competitiveness SME itself.

4.3 Discussions

The described investigation and analysis above shows that it is achievable to define required keywords set, to select a list of desired company's web sites, to perform a research and to find and predict feasible competitive patterns.

Today's global, increasingly borderless information economy and society, the most promising growth and competitive opportunities for SMEs tend to lie in production, electronic and foreign markets. Relying on Internet information it is the challenge and an opportunity for SMEs managers to be more competitive. SME managers need actual competences for all described key words and especially for:

Formulating company vision, mission and values and transforming them into a persuasive company strategy;

Hiring people who share company vision and values and can choose the appropriate tactics to execute strategy;

Training and developing employee to listen to their intuition and to keep up the strategy;

Providing the right incentives and compensation so that they maintain that alignment.

Having in mind that competitiveness of SMEs is basically determined by the competitiveness of companies in the specific sector or region, there is a need to develop a future specific investigation, which could separate the company's region or sector web sites of small and medium enterprises.

Conclusions

The challenging question now is whether or not the West has lost its domination on Ferguson "killer applications" and the answer is to measure and investigate the factors.

The authors found that an on-line analyzing SMEs web site content is powerful and autonomous approach. It is one of the possibilities to predict competitive advantage patterns of a company on-line and outside the company or country. Competitive company managers can predict which factors are the most important in the region or field market and to use its strengths to increase environmental opportunities and to decrease the negative influences of others factors.

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