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EVALUATION OF BUSINESS CLUSTER PERFORMANCE DURING ITS LIFECYCLE

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Abstract

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Business clusters as geographic groupings of firms and other organizations and associated institutions are for more than two decades considered to be the efficient instrument in regional and industrial policies which enable to increase the innovation and competitiveness of firms and other institutions and regions. The assessment of their benefits and performance is an issue often discussed in professional literature with various approaches. The composition and structure of clusters develop during their lifecycle from establishment to maturity or decay and different parts of firms in cluster contribute to cluster results in a variety of ways. The main aim of paper is to design a methodology for evaluation of business cluster performance during its lifecycle based on cluster analysis and time series analysis of business clusters and to reveal which parts of clusters called sub-clusters exert the decisive impact on business indicators by which the performance may be measured and to predict the future development of cluster and its parts. The methodology is verified on the case of the Czech machinery cluster with the longest life time in the Czech Republic. The results show that development of cluster is significantly affected by its structure and by performance of firms in sub-clusters.

Keywords: business cluster, life cycle, performance evaluation

1 INTRODUCTION

Business or industry clusters became very popular concept in business and regional economies in the last two decades not only in professional literature but among politicians and decision-makers as well. They are recognised as an important instrument for promoting industrial development, innovation, competitiveness and growth. The first ideas on clustering of firms were presented by the concept of industrial districts already in the end of 19th century by A. Marshall (1920). The modern outbreak of clusters is closely connected with Michael Porter who described the tight relationship between cluster participation and the competitiveness of firms and industries in his seminal work Competitive advantage of nations (1990) and proposed the first cluster definition.

Generally clusters are composed of various types of organizations including manufacturing firms, service providers, consultancy, research, educational institutions etc. which cooperate and compete and they bring economic benefits to all participants in cluster and the cluster environment (regions, nations).

As cluster develop, they have their life cycle in which the structure, number of cluster firms and other organisation change and the contribution of cluster members to overall cluster performance varies as well. The frequent issue in literature is the question how to measure the benefits of clusters, where these benefits appear and how to make their assessment.

This paper focused on the measurement and assessment the business performance of clusters in their lifecycle based on selected financial indicators. We assume the cluster participants may be divided into groups of firms with similar characteristics (sub-clusters) which contribute to the cluster performance in a different way. With the knowledge of sub-cluster characteristics and performance we can make an estimate of projections of future cluster performance.

The aim of the paper is to design the methodology for assessment of cluster performance in their lifecycle which is measured by selected financial indicators and to validate this methodology in the case of concrete Czech machinery cluster. We also want to show that in clusters with different entities we can find homogeneous groupings of firms which have different impact on the whole cluster. This knowledge may enable better cluster management for meeting cluster goals in the future. The overall objective of the methodology is to develop an instrument for assessment the benefits of clustering of firms for firms themselves.

The paper is organized as follows. In the next section we present the brief literature review on clusters which is followed by methodology of research and data used. In the section Results and discussion we describe the Czech machinery clusters and its structure first followed by the results of cluster analysis, time series analysis in cluster life cycle and the discussion of outcomes gained. The paper is completed by Summary.

2 LITERATURE REVIEW

In theoretical literature we can find many definitions of clusters based mostly on that of M. Porter (1990) who saw clusters as geographic concentrations of interconnected companies and institutions in a particular field. He later added that clusters include, for example "suppliers of specialized inputs such as components, machinery, and services, and providers of specialized infrastructure and, finally, many clusters include governmental and other institutions – such as universities, standards-setting agencies, think tanks, vocational training providers, and trade associations – that provide specialized training, education, information, research, and technical support" Porter (1998). Porter's theory of clusters has become the standard concept and was further elaborated by many followers to state only a few of them as Rosenfeld (1997), Asheim *et al.* (2006), Karlsson (2008) and others who further developed the cluster concept or discussed it from different views from positive or negative sides. Critical view to this theory was presented e.g. by Martin and Sunley (2003) who argue for cautious use of the notion and grant this definition rather chaotic.

Clusters are not created from outside by some government or business interventions in a short time. The cluster development may take years or decades of years depending on industry they belong to. They develop gradually and they have their lifecycle. Cluster evolution theory mainly deals with the emergence and the development of clusters. Evolutionary approaches emphasize the unpredictability of future cluster trajectories but stress that they are constrained by the past. Menzel and Fornahl (2010) proposed the concept of cluster life cycles, a concept that is derived from product- and industry life cycle approaches. They expect clusters to move through a set of stages (emergence, growth, sustainment and maturity, decline or transformation) all of which feature different factors that are relevant for cluster development.

Clusters can be either institutionalized (they have a proper cluster manager or cluster management organisation) or non-institutionalized. Institutionalized clusters are mostly the outcomes of organized efforts known as cluster initiatives, which are viewed by Sölvell *et al.* (2003) as conscious actions taken by various actors to create or strengthen clusters.

Clusters bring economic and social benefits. They have a positive influence on innovation and competitiveness, skills formation, information, growth and long-term business dynamics (Porter, 1998, 2003). By Kettels and Memedovic (2008) clusters enable higher productivity of firms, higher level of connectivity and innovations and new business formations tend to be higher in clusters. Clusters are expected to bring benefit not only to their business members but to the regions they operate in and to universities as well. Firms in clusters can be more specialized and can better cooperate than in isolation. They can also reach the higher level of innovation due to the knowledge spill-over in a proximity, clusters also stimulate the new start-ups, etc. Cluster activities cover many joint actions in areas of networking, human resources and training, research and development, marketing, internationalization, standardization, financing and others (Pavelková *et al.*, 2009; Pawliczek, Piszczur, 2013; Stejskal, 2011). Jirčíková *et al.* (2013) in their survey of world clusters showed the most preferred activities of clusters are networking, research and innovation.

To better use expected benefits from clusters since early 1990s cluster support policies are developed by many national governments and international organizations such as European Union, OECD, etc. Generally the cluster policy is an intersection of different policies. The most important of them are by OECD (2007) regional policy, science and technology policy and industrial and entrepreneurship policy. Cluster policies in EU offer a wide ranges of Community or national and regional programs and initiatives which offer various forms of cluster financing mostly by EU Structural funds. After 2000 European Commission launched many initiatives focused to cluster development support, e.g. European Cluster Alliance in 2006, European Cluster Observatory in 2007, European Cluster Excellence Initiative, World Class Clusters (EC, 2010).

Clusters in the Czech Republic are relatively new form of company network organization and the concept itself was introduced only recently. Their development can be divided into two phases (Pavelková *et al.*, 2009). The first stage covers the years 2002–2006, in which the cluster concept was presented in the Czech professional literature, to the public authorities at both the national and regional levels and to company managers in industries with clustering potential. It includes also the announcement of first cluster programme called CLUSTERS supported from the EU Structural funds for the search for prospective clusters and their establishment in the first programme period 2004–2007. In this stage also the first Czech institutionalized cluster was established in Moravia Silesia region in engineering and machinery. The second stage covers the years 2007 up till now (2014), when the established clusters developed or new clusters appeared and gained the access to public funds offered by the programme COOPERATION funded by EU structural funds in the EU programme period 2007–2013. The EU support for cluster establishment and development reached EUR 55 mil. in 2013 and in total 89 cluster projects were prepared in both programmes during 2004–2013 (MPO, 2013).

The clustering processes lead to various cluster structures characterized by the involvement of firms from different and not always associated industries (see Porter's definition) and of different size of firms and other organisations which have the impact on cluster performance and its development. Natural approach to cluster performance assessment is benchmarking, other methods are described in many projects and initiatives (Pavelková *et al.*, 2009). One of possible approaches to measuring performance of business clusters is the application of traditional indicators of cluster growth and performance, e.g., employment, number and size of companies, turnover, exporting levels and gross value added. Another approach to evaluate the cluster's competitiveness was developed by questions based on Porter's diamond model, as well as on the overall perception of the competitive position of the cluster (Sölvell, 2009). Questions concerned the factor conditions, demand conditions, context for firm rivalry and strategy, cluster's competitive position and cluster's level of innovation.

Temouri (2012) proposed the cluster scoreboard for measuring the performance of local business clusters in the knowledge economy. By him the performance of clusters is gauged through six indicators: share of firms aged below 5 years (entrepreneurialism), employment growth in cluster firms, economic growth (turnover growth in cluster firms), profitability growth (average growth rate of returns on total assets in cluster firms), financial viability (liquidity ratio growth and solvency ratio growth). However the application of each approach is dependent on data availability. In our case we present the approach based on selected indicators available from financial statements of cluster firms and application of cluster analysis (Beranová *et al.*, 2013; Skokan, 2013) and time series analysis methods.

3 MATERIALS AND METHODS

In this section we describe data we used in the research, financial indicators by which we made evaluation of cluster performance and methods used for analyses.

3.1 Data

For research of business clusters it is necessary to have data of firms and organizations the cluster comprises. As firms are mostly the private entities it is very difficult to get all company data needed for deep analyses. In our approach we designed the database which is derived from business and financial indicators comprised in official financial statement, i.e. Profit and Loss Statement and Statement of Assets and Liabilities Position. They are both comprised in annual reports to shareholders. In the Czech Republic they can be found and are available in the Commercial Register, administered by the Ministry of Justice. The system contains information on trade names, registered offices, business activities, statutory bodies, associates, membership contributions and authorized stock. It is possible to gain access to the Collection of Documents including the annual reports etc. Although the majority of the data is in Czech, the forms for searching the database have an option for English (JUSTICE, 2013).

In our database we included following information of each cluster member (manufacturing firm) and for each year in the period 2005–2012: costs of sales, consumption of production, personal expenses, total assets, equity, registered capital, turnover, production, revenues products services, added value and profit. All these indicators were calculated from the profit and loss statements of firms in cluster. For explanation we add following: Sales stands for the amount of money, that firm gets from sales during a corresponding year. By revenues we mean the revenues from own products and services. Production stands for revenues from own products and services plus change in inventory of own products plus capitalization. The time period was limited by years 2005–2012 as CMC started operations practically two years after establishment (see below) and data are completed in Commercial register with at least annual delay. We extracted data from about 400 annual reports of manufacturing firms, data for non-manufacturing organizations were not available so they are not included to analyses. However as they mostly do not generate profit or their profit is negligible with that of manufacturing firms this restriction has little effect on the results.

3.2 Financial Indicators

This paper also contains financial indicators EBIT, ROA and ADDED VALUE which we use for evaluation of cluster performance in the period of lifecycle.

EBIT (Earnings before Interest and Taxes) is used in financial analysis to financial ratios. It assesses business performance regardless of the chosen method of financing and taxation. Investors prefer this indicator for its complexity (Needles *et al.*, 2007).

ROA (Return on Assets) shows how profitable are company's assets in generating revenue. It is a useful for comparing competing companies in the same industry. This number mean how profitable a company is before gearing:

$$ROA = \frac{EBIT}{Avarage\ Total\ Asets}\ . \qquad (1)$$

ROA refers to the production power and measures the profit with total assets invested in the business regardless of the financing method. Important is, whether the enterprise can use its capital so effectively.

ADDED VALUE is difference between a particular product's final selling price and the direct and indirect inputs used in making that particular product. Difference is profit for the firm after all the costs and taxes. This indicator may help investors to decide if this business is worth investing, or that there are other and better opportunities. Added value is a higher portion of revenue for integrated companies, e.g., manufacturing companies, and a lower portion of revenue for less integrated companies, e.g., retail companies.

3.3 Methodology

Our methodology for evaluation of cluster performance includes the following steps:

1. Analysis of cluster composition in analysed life time, i.e. finding the number of cluster members in each year and composition of cluster firms by industry.
2. Analysis of business cluster by CA method to find if there are more homogenous sub-clusters which can have impact on future cluster development.
3. Analysis of time series of cluster and sub-clusters and the estimate of future developments for selected business indicators.

Each business cluster is composed of number of very heterogeneous member companies. For purpose of our analysis it is necessary to group these members according to their similarity into smaller homogeneous clusters. We used a cluster analysis method included in statistical software SPSS (Statistical Package for the Social Sciences).

Cluster analysis (CA) is multivariate statistical method whose primary purpose is to group objects based on the characteristics they possess (Hair, Black *et al.*, 2009). Cluster analysis is a major technique for classifying a large number of information to subgroups, called clusters. It allows to identify similarity of objects and to combine them to homogenous groups. Method of cluster analysis requires that transformed data have zero mean and unit variance. The resulting cluster of objects should exhibit high internal (within-cluster) homogeneity and high external (between-cluster) heterogeneity (Hair, Black *et al.*, 2009).

The most popular procedures of CA are represented by the hierarchical methods and non-hierarchical methods. The hierarchical cluster analysis (agglomerative or divisive) we have chosen uses the dissimilarities such as distances between objects during the formation of the clusters. We used the Euclidean distance (Řezánková *et al.*, 2009):

$$D_{ES}(x_i, x_j) = \sum_{l=1}^{m} (x_{il} - x_{jl})^2\ , \qquad (2)$$

where
x_{il} ...... value of l-th observation on the i-th element,
x_{jl} ...... value of l-th observation on j-th element.

Finding similarities of objects (firms) we obtained from the matrix of distance (Proximity Matrix). The greater the value of the distance, the smaller degree of similarity between objects. The so called Ward's method was selected as the clustering algorithm, i.e. the rules that govern between which point distances are measured to determine cluster membership.

From our source database we used data representative of the Inputs and Outputs of member companies described in Tab. I.

I: *Categories of data for cluster analysis*

Inputs	Outputs
costs of sales	turnover
consumption of production	production
personal expenses	revenues from products/ services
total assets	added value
equity	profit
registered capital	

Source: Authors' selection

The last step of cluster analysis is the graphical representation of distance at which clusters are combined through the special figure, called dendogram. From dendograms developed for CMC in years 2005–2012 we received the exact composition of sub-clusters with similar characteristics and were able to get database for further processing.

The principle of time-series analysis is the prediction of future developments based on the assumption that history always repeats itself. Generally, the graphs are used for time series illustration. These graphs show the trend of the individual indicators in the time period and the prediction of future development.

Cluster members were divided by the application of CA into three homogeneous groups (sub-clusters) for which we examined time series of derived indicators. All three groups underwent changes in composition, as well as in values in the time period 2005–2012. The time series of Czech Machinery Cluster are compared with time series of sub-clusters to determine the impact of individual sub-clusters on the development the Czech Machinery Cluster. We tried also to verify the hypothesis that in line with the trend of the global crisis, our three indicators: EBIT, ROA and ADDED VALUE for Czech Machinery Cluster were declining. Consequently, the prognosis of the future development will be a downward trend.

The trend reflects a general trend effect for a long period and can be described by trendy features. In this paper we used a polynomial trendline. This is suitable to use with fluctuating data for estimated representation of the direction and prediction. The degree of the polynomial trend can be determined by the number of variations in the data or the number of curvature (maxima and minima) in the curve. Therefore, a second-degree polynomial trendline has usually one top (Cipra, 1986). The level of conformity of time series data and the polynomial trendline model is expressed by the value of R squared (R^2) coefficient of determination which ranges from 0 to 1. Values closer to 1 express the higher coincidence of model with real data.

The proposed methodology is validated further in the case of concrete Czech machinery cluster.

4. RESULTS AND DISCUSSION

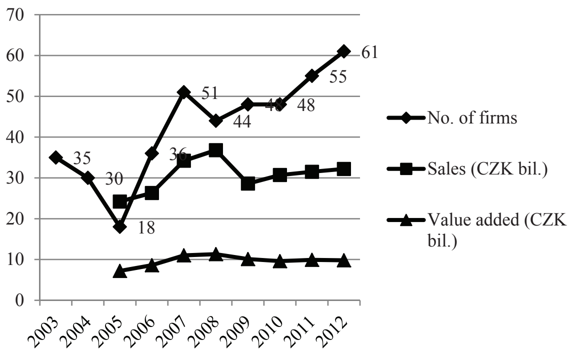
For demonstration of our methodological approach we use the case of Czech machinery cluster (CMC). The reason is that it is the first institutionalized cluster which was established in the Czech Republic and for evaluation of lifecycle we have ten years of record of its history.

Originally at the time of establishment in 2003 the cluster was designed as a horizontal platform for the whole engineering sector in the region with a tendency to quit metallurgy and heavy machinery in the future (Skokan, 2014). These broad objectives, weak management under the head of Union for the Development of the Moravian Silesian region and unclear financing of its activities lead to crisis in financing, concept, specialisation and membership, when the member base turned down from 35 in 2003 to 18 members in 2005. The strong impetus for cluster development came in 2005 when the leadership took over the leading machinery company in the region, Vítkovice machinery group.

The main activities of cluster are focused to supply chains – enabling smaller cluster members to participate in big contracts for power industry, nuclear power and ecological engineering; purchase alliances – cost reduction of joint purchasing based on quantity discounts; internalisation through export and investment; cooperative projects in innovation and training engineers for nuclear power; energy resources of the 21st century; innovation in professional training at secondary schools; HRD for R&D teams, new talents for science and research. What is important, all these outcomes stem from business and requests from companies and not from public sphere, they are business driven.

4.1 Results of Cluster Structure Analysis

The development of pilot Czech cluster was not straightforward and is documented at Fig. 1, where the time series of number of cluster firms and total clusters values for turnover and value added are depicted. For analysis of financial indicators were used available data in the period 2005–2012.



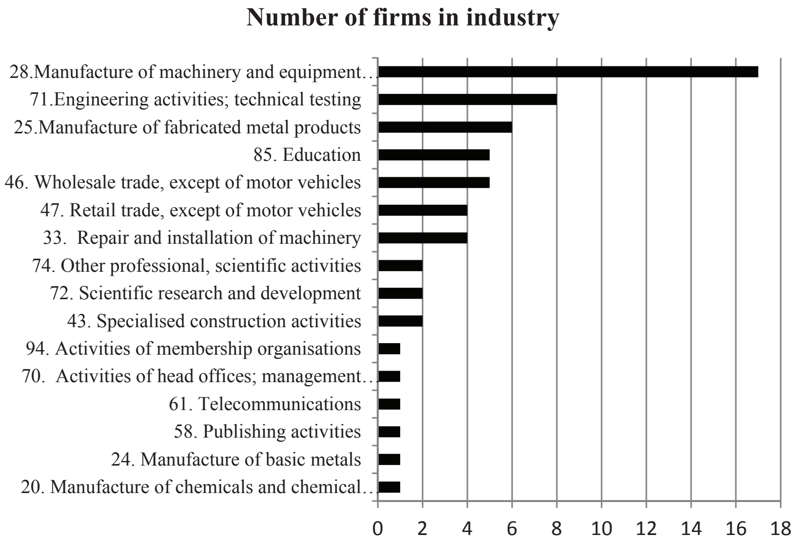
1: *The development characteristics of CMC during its lifecycle*
Source: Authors

The gradual growth of number of cluster firms is based on value chain related companies and was interrupted in the years of financial crises. Surprisingly the volume of sales and total value added of cluster companies did not followed the growing trend of cluster members as not all new member are manufacturing firms with their own production or their outputs are negligible in comparison with cluster founders.

By Porterian definition clusters do not have homogenous structure and comprise firms of given and related industries and also organizations of various associated and other sectors. We made detailed analysis of industrial structure for CMC (the year 2012) by NACE codes with the results shown in Fig. 2.

Out of 61 member organizations included in Czech machinery cluster in 2012 the highest number of 17 firms belonged to the NACE group 28 – Manufacture of machinery and equipment followed by 8 firms from the group NACE 71 – Engineering activities, 6 firms from NACE 25 – Manufacture of metal products, etc. To associated institutions belong organizations providing e.g. education, publishing activities, activities of membership organizations etc. which do not participate directly on generation of profits. This structure was similar for other tested years (2005–2011).

The consequence of this heterogeneous structure is that not all participants generate the profit



2: *CMC structure by industry*
Source: Skokan, 2013

and have available data for in their financial statements for further analysis.

4.2 Results of Cluster Analysis

Application of cluster analysis using all eleven variables according to Tab. I was the next step in evaluation of cluster performance. The aim was to get intelligence of possible sub-clusters which form the machinery cluster and how they contribute to required business outputs by which the performance may be measured. We analysed the cluster firms in years 2005–2012 and found out the whole cluster in these years was formed by 3 sub-clusters with similar composition of firms.

First cluster is composed of rather smaller, less significant member companies, which are expected that do not affect significantly the cluster business performance. In different years it comprises about 40 to 55 firms and organisations including universities. The second cluster consists of three to four larger companies that have more significant influence to business results. To these companies belong ŽĎAS, a. s., SANDVIK CHOMUTOV PR TUBES, spol. s r. o., VÍTKOVICE POWER ENGINEERING, a. s., supplemented by either VÍTKOVICE HEAVY MACHINERY, a. s. or VÍTKOVICE, a. s. The third cluster is formed alternatively only by one company which was between years 2005–2007 the VÍTKOVICE HEAVY MACHINERY, a. s. and from 2008 to 2012 VÍTKOVICE, a. s. All these firms belong to larger firms as to number of employees and the volume of production and sales. They became the members of cluster shortly after its establishment.

The results of these analyses for years 2005–2012 are in Tab. II and in Fig. 3. In Tab. II we see what companies formed sub-cluster 2 and sub-cluster 3.

Fig. 3 presents the dendogram of cluster analysis for the year 2012, simile dendograms were prepared for cluster in all years 2005–2011 and are not presented in the paper.

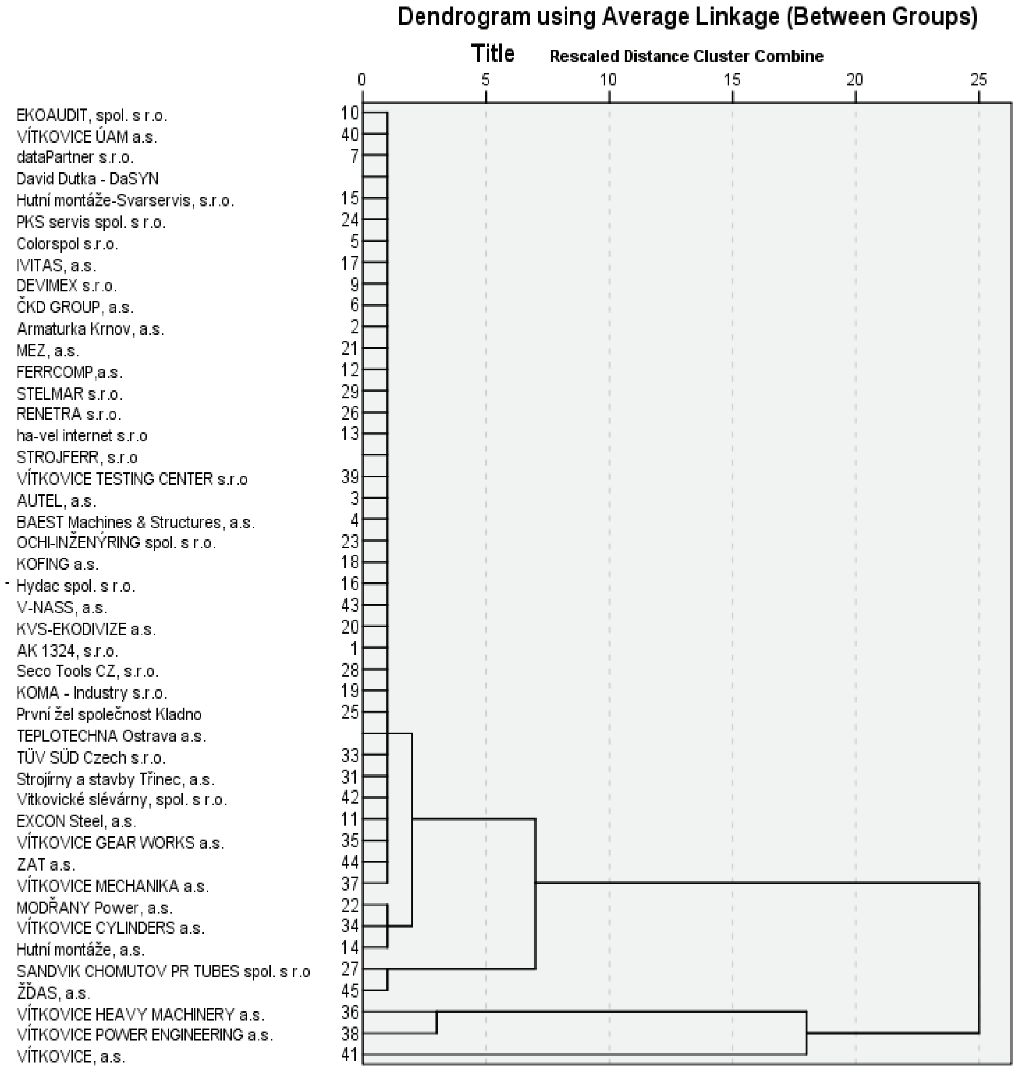
As not all member firms in cluster generate revenues, profits, added value etc. which can be calculated in financial statements, the cluster analysis in 2012 continued only with 45 organizations (firms) for which the financial statements were accessible. The situation in other years was similar.

Cluster analysis in years 2005–2012 enable to generate database of data necessary for further time series analysis of individual sub-clusters in corresponding years and the Czech machinery clusters as a whole.

II: *Structure of sub-cluster 2 (C2) and sub-cluster 3 (C3) during 2005–2012*

Company	2005		2006		2007		2008		2009		2010		2011		2012	
	C2	C3	C2	C3	C2	C3	C2	C3	C2	C3	C2	C3	C2	C3	C2	C3
VÍTKOVICE	X		X		X			X		X		X		X		X
VÍTKOVICE HEAVY MACHINERY		X		X		X	X		X		X		X		X	
VÍTKOVICE POWER ENGINEERING							X		X		X		X		X	
SANDVIK CHOMUTOV	X		X		X		X		X		X		X			
ŽĎAS	X		X		X		X		X		X					

Source: Authors



3: *Dendogram of CMC in 2012*
Source: Authors

4.3 Results of Time Series Analysis for Cluster Lifecycle

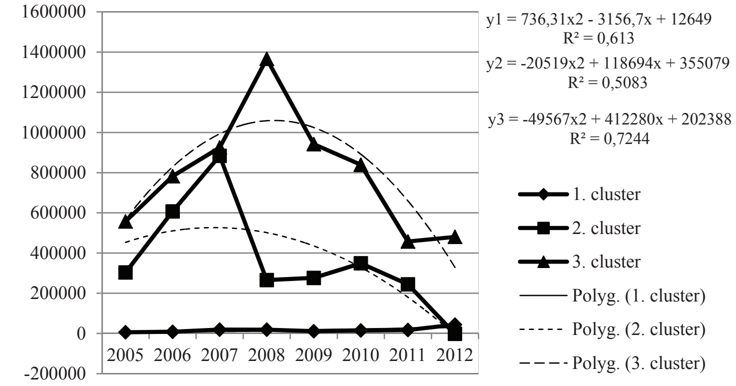
For structures described by sub-clusters in dendograms the summaries and the means of indicators EBIT, ROA and VALUE ADDED were calculated for each of sub-clusters and cluster as a whole in each year. These derived indicators were analyzed by the time series analysis with polynomial trend-lines. Fig. 4 brings the analysis for indicator EBIT.

In Fig. 4 we see time series and trendlines of sub-clusters 1, 2 and 3 of Czech machinery clusters and derived model in equations y1, y2 and y3 which describe the polynomial trendlines. The relatively high values of R^2 (above 0.5) confirm the level of goodness of fit of calculated models for prediction of future development of EBIT indicator for sub-clusters 1 and 3.

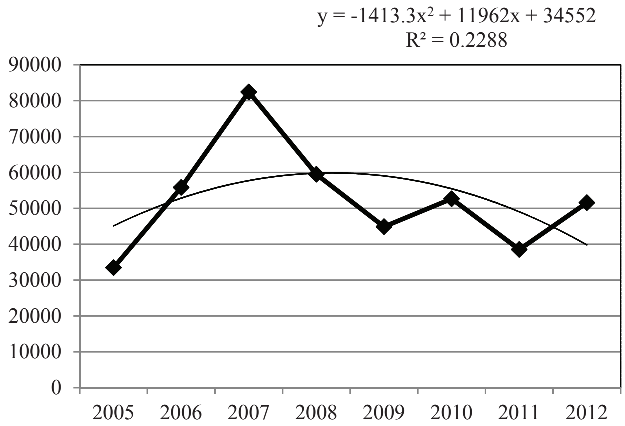
Values of EBIT for cluster_1 are very low as cluster is composed of smaller firms, however the trend is growing. It may be explained by the fact that the higher is the number of firms in sub-cluster the lower will be the effect of fluctuation of summary value in failure of few firms. Here we can conclude that smaller firms were able to react faster to the impact of crisis in 2009–2010.

The real data and trendlines for sub-cluster 2 and sub-cluster 3 have opposite tendency, they are descending. The explanation may be the larger companies were not able to react to consequences of crisis as fast as the smaller ones however this pays of course only for concrete situation in this industry. As sub-cluster 2 is formed only by 2 firms and sub-cluster 3 only by one firm, the failure in business indicators is clear at first sight.

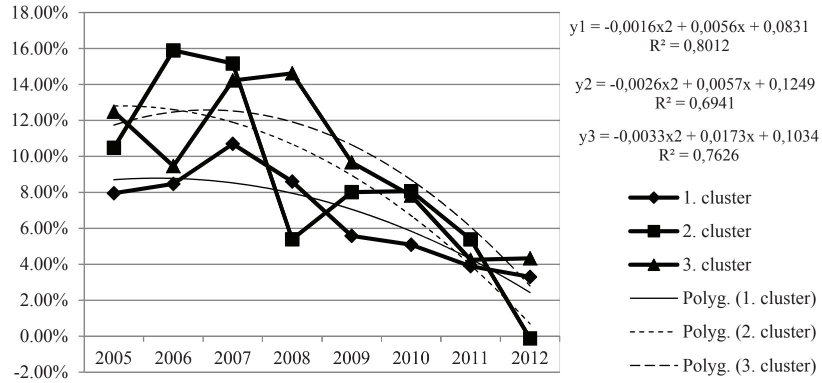
Fig. 5 shows EBIT time line for entire Czech Machinery Cluster. Real data have quite large fluctuations in years 2009–2012 so it is difficult to predict future development (low value of R^2 confirms this conclusion).



4: *Time series for EBIT of sub-clusters*
Source: Authors



5: *Time series for EBIT of the Czech machinery cluster*
Source: Authors

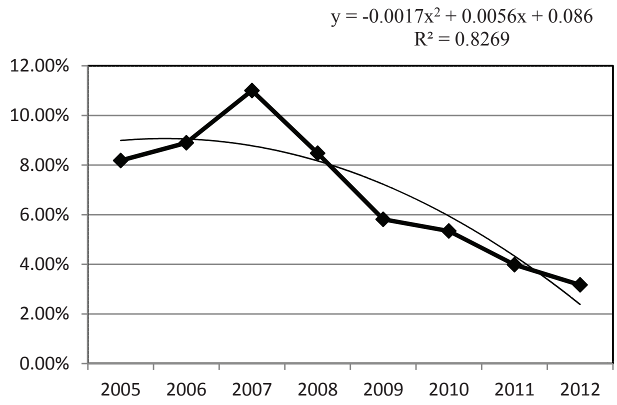


6: *Time series for ROA of sub-clusters*
Source: Authors

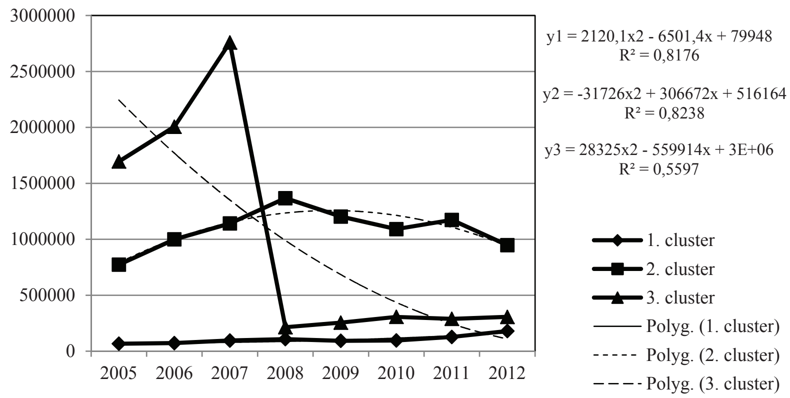
The calculated model described by equation (y) in Fig. 5 presumes projected decline of EBIT in the next years and confirms our hypothesis about the significant influence of large firms on cluster performance and cluster behavior.

Similar evaluation may be done for other financial indicators by which we would like to assess the total cluster performance. As an example we added ROA, where real values and trendlines expressed by equations are shown in Fig. 6.

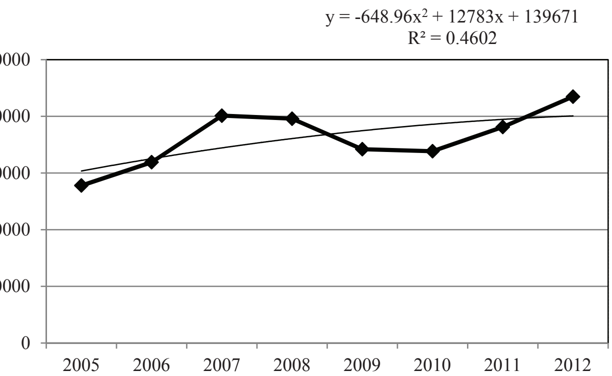
In Fig. 6 we see the descending curves of ROA for all 3 sub-clusters which are further confirmed by model equations y1–y3 and by relatively high values of coefficient R^2. This confirms the same projection for indicator ROA of entire Czech machinery cluster as it is shown in Fig. 7.



7: *Time series for ROA of CMC*
Source: Authors



8: *Time series for ADDED VALUE of sub-clusters*
Source: Authors



9: *Time series for ADDED VALUE of CMC*
Source: Authors

This again confirms our research assumption on the deep impact of crisis on cluster development.

The third financial indicator we defined for performance evaluation was ADDED VALUE, the curves of sub-clusters and their models are described in Fig. 8.

Concerning ADDED VALUE here we have quite different curves for sub-clusters. Sub-cluster 1 has after stagnation between 2008–2010 a slightly upward-sloping trendline, sub-cluster 2 has since 2008 descending trendline. Sub-cluster 3 has after deep fall in 2008 slightly growing curve or stagnation. However the projection in model (y3) is not stable with low coefficient R^2 (value 0.5597) so it is difficult to make reliable estimate for the future. This is also confirmed in Fig. 9 with time series for entire CMC.

Prediction for ADDED VALUE is again very difficult (like for EBIT) due to fluctuations of values (R^2 = 0,462) with slight growth so we could judge to the increase of profit and returns of assets which trendlines for EBIT and ROA did not confirmed.

The indicators of EBIT, ROA and ADDED VALUE used in this case were selected as an example how the performance may be measured and in concrete cases we may use other indicators depending on data availability and objectives of assessment. From the trend lines in Czech Machinery cluster in 2005–2012 we cannot come to conclusion that clustering had remarkable impact on cluster business performance. However benefits of clustering cannot be simplified only to financial indicators and their assessment would deserve deeper research of other factors and outcomes.

SUMMARY

The objective of the study was to present the methodology for assessment the cluster performance in their lifecycle measured by selected financial indicators with future projections of cluster behaviour which could enable to examine business benefits of clustering. In growing phase clusters change their structure with newcomers which can have diverse impact on cluster behaviour. Following Porterian definition of clusters as heterogeneous structures of various firms and organisations we wanted to show that by application of cluster analysis method it is possible to identify more homogenous groupings of firms in cluster which we called sub-clusters with similar business characteristics and various impact on cluster in the lifecycle. For the proof of similarities we used eleven business indicators available in financial statements of companies. From the projections of selected indicators measuring business performance for these sub-clusters during lifecycle we can presume by application of time series method the future development of performance of the whole cluster.

The proposed methodological approach was applied to the Czech machinery cluster with more than ten year's history in the period 2003–2013 which grew from 35 companies in 2003 to 68 organizations in 2013. The cluster exhibits the high level of heterogeneity as in 2012 only 45 firms out of 61 members belonged to machinery and engineering industries. Cluster analysis revealed it is possible to identify 3 sub-clusters with similar characteristics however the most significant impact on selected indicators of EBIT, ROE and ADDED VALUE had in fact five leading and largest firms organized in two sub-clusters which belonged to founders of cluster. As during examined lifecycle the financial crisis 2008–2010 broke out the impact of leading firms on the whole cluster was significant and their failure in business could negatively affect the business performance of the whole cluster. From the time series of selected indicators due to the crisis period it is not possible to evaluate the benefits of clustering as curves for indicators of EBIT and ROA are descending in reported period 2005–2012 and only ADDED VALUE is slightly growing. The application and results of methodology are limited by length of cluster lifecycle, the availability of data for firms in clusters and exogenous impacts from outside of clusters. The more comprehensive analysis of other factors is necessary in further research.

Acknowledgement

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