Knowledge Flow in the World of Cooperation: A Study on the Efficacy of Accredited Clusters in Hungary

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Abstract

Several high standard studies analyzing the effects of knowledge flow of organizations have appeared since the fact that the creation of applicable novel knowledge is fundamental to economic growth was acknowledged (ROMER, 1986).

According to PORTER (2000) the regional alliance of small and medium-sized enterprises as well as supporting institutions could provide these businesses such competitive advantages that enable them to keep up with multinational companies, even in a globalised market environment. Accredited clusters, subsidized by the EU, are specific kind of alliance formations, which facilitate competence and innovation. At present (February 2010), there are 18 accredited clusters operating in Hungary – a dozen and a half company associations which met the economic and cooperative criteria defined by the EU and thus reached all the important stages of accreditation in the process of cluster development. These clusters are the subject of the present study and analysis.

The first part of this paper introduces different theoretical approaches to the cluster phenomenon, including the observation and analysis of intra-cluster knowledge flow characteristics. The main purpose of the present study is to describe and assess the actual cluster formation process of accredited Hungarian clusters in order to compare them to each other and to measure them in terms of efficacy. The contrastive analysis is based on quantifiable public data and interviews carried out with cluster management leaders. We also describe the theoretical framework of an alternative methodology for monitoring cluster knowledge processes and measuring cluster performance.

Knowledge transfer between cluster members is essential for innovations. The new methodology reviews and induces the measurement of emerging knowledge processes in

order to assess intra-cluster knowledge flow sector-specifically. This novel, applied methodology differs from conventional analytical practices on several points and makes use of innovative solutions in order to be more in line with the aims stated above, i.e. to capture "volatile" knowledge flow in the innovation-oriented clusters.

1. Introduction

What do the following have in common? Nokia, Avatar, Mercedes-Benz, Citigroup and Benetton? These world-famous brands are the frontiers of cooperation. These co-operations are clusters. Are they successful? Do they use knowledge? Do they support their geographical environment? Do they really function like clusters? In this paper we research the Hungarian cluster concept; we will universalize the results in order to measure and answer the above questions in the future, as well.

Since PORTER's (1998, 2000) original definition of clusters as 'geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries and associated institutions in a particular field that compete but also cooperate', the emphasis of cluster analysis has changed. By STEINER (2006) the initial concentration on the usefulness of the predominantly Porterian cluster concept as a model of 'regional competitiveness' has been subjected to several well-argued criticisms which point to many fundamental conceptual, theoretical and empirical questions and that urge a 'much more cautious and circumspect use of the notion' (MARTIN and SUNLEY, 2003).

Common conventions and norms as well as readily available knowledge about the reliability and trustworthiness of individual economic actors (GERTLER and WOLFE, 2006) further support the local flow of knowledge – both tacit and codified – within local industry clusters (STORPER and VENABLES, 2004). The same conditions enrich close collaborative vertical interactions with local customers and suppliers, both in users and producers (LUNDVALL, 2002).

Recent debate has focused more on how far and in what ways clusters foster knowledge-creation organizational learning, emphasizing the organic-evolutionary dimension of cluster-based industrial agglomerations (STEINER, 2002). Growth of the knowledge base depends on intended and unintended individual processing of experiences, while the interpretation, transfer and use of experiences are influenced by interaction between individuals and between organizations (COHEN and LEVINTHAL, 1989; ANDERSON, 1995; HARTMANN, 2004).

Summing up the above mentioned we have to stress the importance of knowledge and transfer within clusters because clusters are the key agents of a new economic: knowledge-, network-, cooperation- and knowledge-flow oriented organizations. In the future these features will set the basis of economic and general development in the world (BARABÁSI, 2002).

2. Research Methodology

Our main object is to examine the Hungarian cluster concept in different dimensions based on the evidence of literature review and empiric survey. To compare and to analyze Hungarian accredited clusters we have created a special questionnaire. It was sent out to 12 Hungarian accredited clusters to fill it in. In this paper we focus on clusters of health and IT sectors. The most of the accredited clusters are operating in these sectors. The questions of the survey were based on the cluster's accreditation stage. To bring about this paper we have examined numerous documents, papers and publications as well as presentations about cluster concepts in the EU, the USA and Hungary.

Those methods we used in the analysis of the Hungarian cluster concept were adopted and transformed to make a correct approach of our theory and hypotheses. The following diagram draws up our research process and also represents our paper's guideline principle.

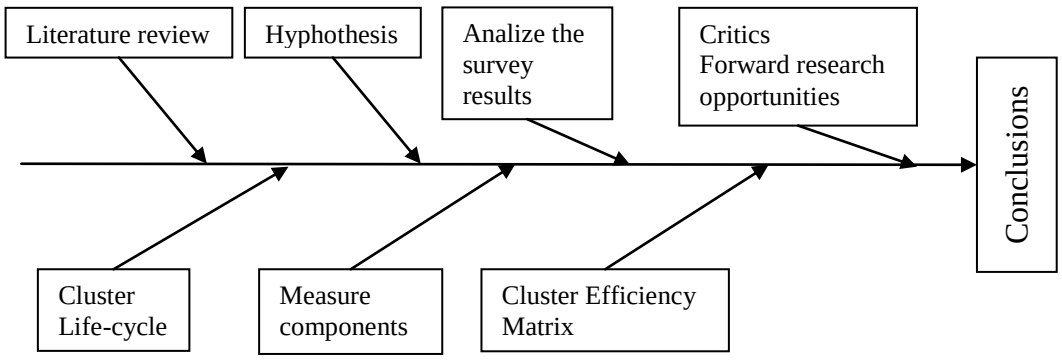


Figure 1 The process of our study

Source: The author's own edition.

The above diagram shows the logical structure of our study. In the next part of the paper the Hungarian cluster concept will be presented and explained how it supports our examinations.

3. The Distinctiveness of Hungarian Clustering

In Hungary the Government has also realized the importance of clusters and has made efforts to foster the settlement and provide them with support. In April 2010, there were 21 accredited clusters in Hungary. These accredited clusters are the results of a long-term oriented process (horizontal, vertical and complex). In Hungary, this process is called the Pole Program which is governed by the National Development Agency since 2007. The Pole Program provides professional and financial support to those clusters which are emphasizing to become accredited. The ground for this support system is a well-structured and hardly bureaucratic framework. The first Hungarian cluster was established in 2000. Financial support for clusters only was around 290mEUR[1] from the Pole Program until 2008. Accredited clusters in Hungary have had a portion in this budget of 117mEUR until 2008. Up to 2013, conditions of call for proposals for clusters in the four development phases are the following in Hungary.

Table 1 Parameters of call for clusters in Hungary

DEVELOPMENT PHASES	SUBSIDY (BILLION, EUR)
Start-up initial clusters	0,08 – 0,2
Developing clusters	0,2-0,8
Accredited clusters	1-6
Innovation clusters	6-17

Source: Pole Program Office, 2010

Obviously the Hungarian clustering activities are over the start-point but the clusters have the opportunity and even the requirements to grow. As it can be seen from Table 1, we conclude that accredited clusters have more potential to get a very high level of subsidy. The reason for that is the accreditation of a crucial milestone in cluster development. The accreditation of clusters is based on a rigorous expert evaluation system with the aim of selecting the most promising initiatives.

Financial background of clusters in Hungary does not show significant differences since the subsidy system is strongly centralized (National Development Agency and Pole Program Office). The 20 accredited clusters give only about 10% of the total number of clusters in Hungary. The accredited clusters operate in 6 different NUTS 2 regions throughout the country:

[1] 1 EUR = 270 HUF

- South-Plain (Dél-Alföld),
- Middle-Hungary (Közép-Magyarország), involving Budapest,
- South-Transdanubium (Dél-Dunántúl),
- Middle-Transdanubium (Közép-Dunántúl),
- North-Hungary (Észak-Magyarország),
- North-Plain (Észak-Alföld).

In the West-Hungary region there is no headquarters of any accredited cluster or cluster management. This case is very special: in West-Hungary the high-tech industry and the related branches have a very significant role in local and national economic growth. In this region, organizations have allocated all the capital, high-tech skills (Audi), human resource, innovation facilities, education (Széchenyi István University) and, of course, professional logistic infrastructure (well-engineered highway and railway). In this informal, non-accredited cluster firms are linked in some way, clusters are composed of interconnected firms and associated institutions linked by commonalities and complementarities. (FELDMAN, 2000) Due to the positive business and general economic results, these informal clusters have not been accredited yet. Cooperation structure in West-Hungary demonstrates the viability of informal clusters, too.

Due to the considerable EU development sources and the fact that the accredited clusters can play an important role in Hungary's sustainable development, this paper focuses on accredited clusters.

Accredited clusters represent 6 sectors in Hungary:

- Energetics (1),
- Food (1),
- Environment (3),
- **Health (8),**
- **IT (5),**
- Plastic/packaging (2).

In this paper we concentrate on the most numerous accredited cluster sectors in Hungary: IT and health. Clusters in IT and health sectors play a direct and intensive role in expanding the "knowledge economy"; some have labeled that as the "New Economy" (KAPLAN and NORTON, 2001). Health and IT based accredited clusters represent the added value and export-orientation in operations and competitiveness knowledge management on high level within

clusters in Hungary. These knowledge oriented clusters have crystallized intellectual property flow and transfer features.

The present chapter demonstrated the importance of accreditation point in the dimension of subsidy; the following chapter will describe the importance of accreditation point in the view of the evolution of a cluster.

4. Cluster Lifecycle

Now we will explore the relationship between classic life-cycle theory (PORTER, 1993) and cluster concept. The phenomenon is relevant by clusters because the clusters show a natural evolution containing major milestones. These milestones were shown in details in the part about the subsidy for clusters. Moreover these milestones we put our focus on the accreditation point. At this step the clusters have to pass a well defined development level (the accreditation of clusters is a rigorous expert evaluation system with the aim of selecting the most promising initiatives (LENGYEL and DEÁK, 2002): so we can analyze a group of clusters with the same structural and financial features. We made the decision to take the knowledge transfer and the operation effectiveness within these clusters under the loupe. The accreditation point is an intermediate stage in the midst of development the clusters. We group clusters by their state of development (POLE PROGRAM OFFICE, 2010; SZANYI et al, 2008). The clusters have general evolution stages:

1. start-up initiatives cluster,
2. developing cluster,
3. accredited cluster,
4. "innovation" cluster.

The above mentioned evolution is sequential and organic: every subsequent level is based on the previous stage. In the following figure we bound the above explained cluster evolution stages with the well-known product/SBU (Strategic Business Unit) life-cycle model together.

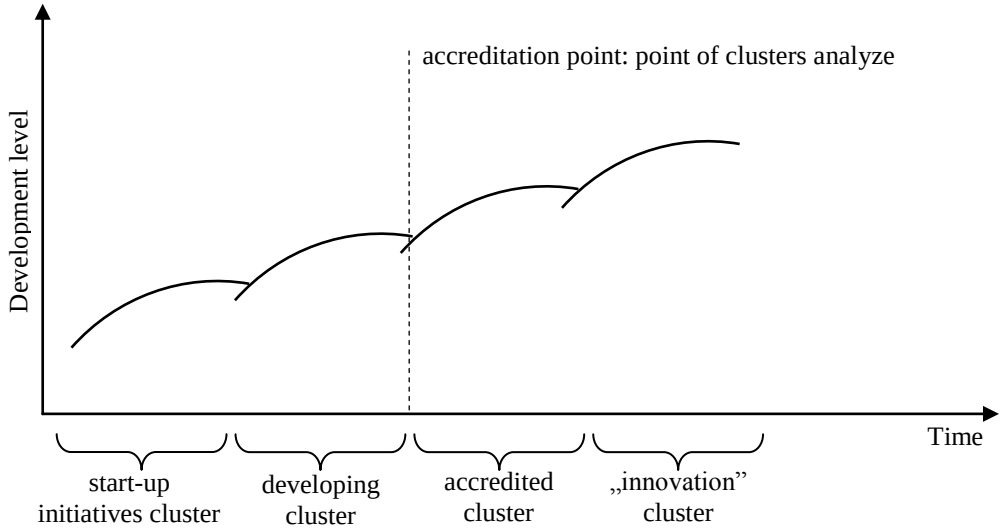


Figure 2 Cluster Life-cycle

Source: Proactive Consulting Management, 2008.

Our survey asks for information and data observed at the cluster-accreditation point. Due to the facts that

- Hungarian accredited clusters are young,
- structure, management and membership of clusters at the accreditation point is stationary,
- as well as subsidy framework is the same at the cluster-accreditation point.

our paper concentrates on accredited clusters.

National cluster policies, that include the European Union cluster-protocols, set a growth-target for those clusters that are declared accredited. The poorly mentioned general objects for clusters are ingrained in Hungary by the Government and the National Development Agency:

- linkages and networks
    - linkages (both formal and informal) among actors both within and across sectors
    - linkages (both formal and informal) with economic actors in other localities, in different regions, as well
- cluster governance
    - decision processes of the cluster, and those of its firms and non-firm actors
    - cooperation and conflict between actors in the cluster during making strategic decisions.

The above detailed theoretic approach can represent development policies without correct and complex business and strategic requirements for cluster management organization. Due to the theory-oriented cluster concept in Hungary and EU cluster management organizations do not have well-structured business and strategic guideline.

We aim to establish on the ground of the above explained structural elements the Hungarian cluster concept, the practical and theoretical background. We considered in our work the theoretical best practices founded by different authors and offices. The next parts will demonstrate the results and the conclusions reached through our empirical research.

5. Hypothesis

Starting out the basic, above mentioned factors and the Hungarian cluster concept, we suggest the following (later defined) hypothesis that refer to the measurement of knowledge (whether tacit or explicit) flow and transfer in organizations. We have examined the operations within clusters as well, i.e. the relations and interactions between intellectual capital and business operations. The following hypotheses are based on the above mentioned factors.

Hypothesis 1: Accredited clusters in Hungary could be measured and classified by a knowledge-management and business-operation-based model.

Hypothesis 2: Hungarian clusters focus on Business Operation and Intellectual Capital & Cooperation in equal proportion at accreditation point.

Hypothesis 3: Business Operation and Intellectual Capital & Cooperation in Hungarian accredited clusters have functional interaction at accreditation point.

We tested Hypotheses 1 and 3 with the below detailed Cluster Effectiveness Matrix (CEM). Hypothesis 2 will be supervised by a theoretical approach.

6. What and How to Measure within Clusters?

SWANN (2006) tried to summarize, in a very simple way, some of the different interpretations of the cluster concept (Table 2). It is a simple one-dimensional spectrum of interpretations, from rich to shallow. Now, some will say that the characteristics at the top of Swann's concept are not sufficient evidence of clusters: a cluster is only a cluster when it has the things at the bottom of the list. Some quantitative studies tend to provide us with a fairly shallow definition of cluster (towards the top of the spectrum) and find evidence that there are such cluster effects. Some detailed qualitative studies tend to work with a fairly rich definition of clusters and find little or no evidence of such rich cluster effects.

Table 2 describes the contradictory approach of measuring and the 'importance" of the component. The below presented components are general factors. They are based on studies written by cluster oriented authors (PORTER, 2000).

Table 2 Different interpretations of the cluster concept

Co-location	Shallow Easy to measure
Co-location and technological proximity	
Input/output table complementarities	
Co-location and superior performance	
Marshallian externalities	
Network firms	
Labour mobility	
Explicit collaboration	
Informal knowledge spillovers	Rich Hard to measure

Source: SWANN, 2006

The Table describes the difficulties of quantifying knowledge, i.e. the components (collaboration and spillovers) do not have well-defined features, the measure by them is usually only a correct estimation. However, we can only estimate these soft components which have represented the property of knowledge and network based organizations (MATOS and LOPES, 2008), such as clusters. Therefore, we used to determine the knowledge transfer and intellectual property in an innovative method and use own generated indicators partly defined by the above mentioned components.

Swann's cluster concept describes the required functions, features and framework to become a cooperation to cluster. Cluster requirements dovetail by Swann (2006) and by the Pole Program – the theoretic and the practice approaches complete each other. Because of this result, we establish our adopted and transformed method on the above detailed approach.

The following section highlights our measurement methodology, i.e. the Cluster Effectiveness Matrix (CEM). Our theory – CEM – is based on two methodology elements:

- knowledge transfers in clusters,
- business process and economic performance in clusters.

The CEM has two keenly separated dimensions:

- Intellectual Capital & Cooperation Indicator,
- Business Operation Indicator.

Table 3 CEM dimensions

Knowledge transfers	Intellectual Capital & Cooperation Indicator
Business process and economic performance	Business Operation Indicator

Source: The author's own edition.

Previous part of this paper explained the difficulties of knowledge measurement, including spillovers and networking, as well. The following chapters will draw up the CEM's components in detail; furthermore, will present methods and their professional background.

6.1.Knowledge Transfers in Clusters - Intellectual Capital & Cooperation Indicator

In the cluster oriented literature regarding the social contexts of innovation and the development of regional industrial clusters, the relationships are formed by skilled workers by means of work and social networks. These events are believed to enable knowledge transfers. Knowledge transfers are held to be facilitated by mutually reinforcing cycles of trust and reciprocity accrued through familiarity and shared experiences (SAXENIAN, 1994).

We also have documents and data about Hungarian accredited clusters from their accreditation application form. The abscissa of CEM is formed by knowledge transfer elements in clusters, perhaps about cluster management organizations. This dimension demonstrates the knowledge oriented cooperation, performance and values within a cluster and among cluster members. The abscissa of Cluster Effectiveness Matrix (Intellectual Capital & Cooperation Indicator) is drawn up from the poorly mentioned components:

- R&D&I/revenue: total R&D&I expenditure of the cluster members in the year prior to accreditation divided by total revenue of the cluster members in the year prior to accreditation;
- Innovation projects/revenue: total expenditure of the cluster members on innovation in the year prior to accreditation divided by total revenue of the cluster members in the year prior to accreditation,
- Academic degree per capita: total number of academic degrees among cluster members in the year prior to accreditation divided by total number of cluster members in the year prior to accreditation,
- Conferences and workshops per year: total number of conferences and workshops in cluster serviced by cluster management in the year before the accreditation,

- Mails sent by cluster management per week: total number of sent e-mails to cluster members by cluster management per week in the year prior to accreditation,
- Cooperation within clusters: total number of co-operations serving development projects by cluster members in the year prior to accreditation,
- Average number of cooperating members: average number of cluster members in one project team to execute a project,
- Distance between the two most distant members of a cluster (measurement unit: travelling minutes by car).

All the parameter values were gathered from the time of accreditation and the previous year. Regarding clusters, we have analyzed cluster management as well as cluster members. These components describe the operations (knowledge transfer) by analyzed clusters.

To summarize the above outlined part, we describe the CEM's component by knowledge and intellectual property: "soft" factor by hard features to measure and compare (GOTTFREDSON et al, 2005). The hard components – to describe the business operations of clusters – will be described in the following part. These indicators formed the CEM's dimensions.

6.2.Business Process and Economic Performance - Business Operation Indicator

The present part describes the indicators to measure business operations within clusters. Firstly, we summarize the literature review about the opportunities and difficulties in order to classify and value. In 2003, MARTIN and SUNLEY published a powerful review of clusters. By pointing out growing concern and dissatisfaction, they sought to deconstruct a concept that, for them, has become "chaotic" in its universalistic reification of a diversity of economic processes of localization. Identifying, among other things, the theoretical eclecticism, methodological inconsistency and "power of the brand", they eventually challenged the "value added" of cluster theory (Henry et al, 2006). We also faced with the above mentioned theories and difficulties during our research. In this paper we handle these factors through the following methods and approaches.

We use cluster's documents to create the offset of the CEM. The offset is based on financial indicators of cluster members. We analyzed balance sheets, income statements and cash flows of cluster members from the year prior to accreditation. The offset of Cluster Strategy Matrix (Business Operation Indicator) is created from the hardly mentioned components:

- Total revenue per capita: aggregated total revenue of cluster members in the year prior to accreditation divided by the total number of cluster members in the year prior to accreditation,
- Added value: EBIT plus Human Cost,
- Export revenue: aggregated total export revenue of cluster members in the year prior to accreditation,
- R&D expenditure: aggregated total R&D expenditure of cluster members in the year prior to accreditation.

All the above mentioned BOI components are measured as an aggregated value of all cluster members and are measured in the year prior to accreditation. The BOI components are corrected with the aggregated total revenue of cluster members in the year prior to accreditation divided by the total number of cluster members in the year prior to accreditation.

The components in CEM are relative – they are compared to each other. We gave scores from 1 to 5, the lowest is 1 and the highest is 5. The highest value got the score 5 and then we compared the other scores by components to this score. Finally, we made an aggregated score from component's scores to measure the BO Indicator.

6.3.Cluster Effectiveness Matrix

6.3.1. Fundamentals

Our model – Cluster Strategy Matrix – is based on the well-known portfolio-matrix theories. There are a lot of models in management literature about different matrices (KLEIN, 1964; KOTLER, 2002). These matrices have the following features:

- compare SBUs within companies,
- classify the elements with two dimensions,
- dimensions are based on some (more than 3 per dimensions) classifying components,
- components map the business and strategy operations of company,
- soft and hard components are also measured,
- the result (portfolio matrix) is usually complex and subjective due to the soft components.

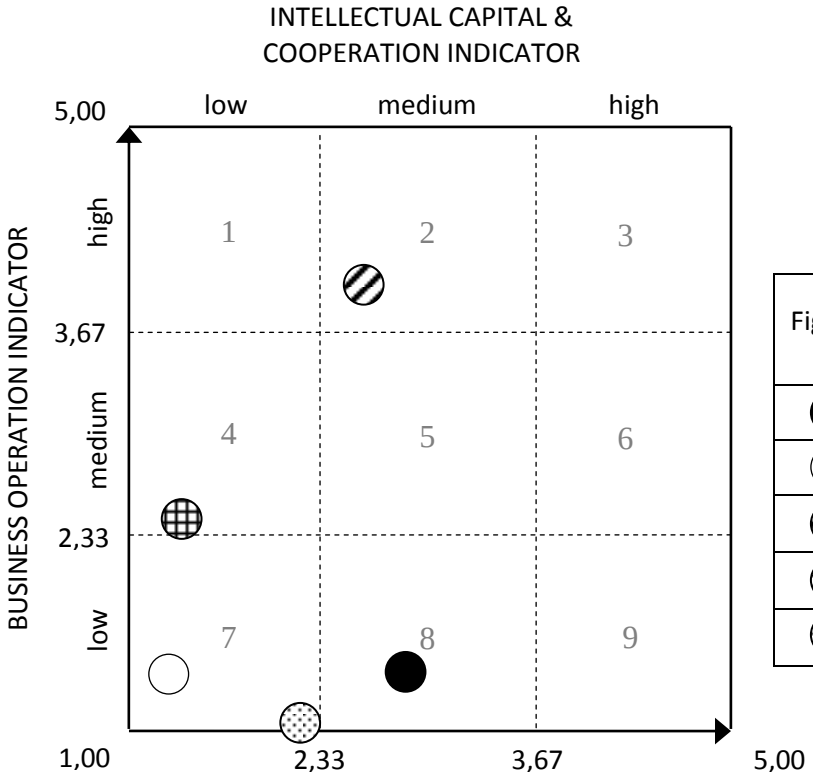
Multinational companies and firms with difficult business operations in a turbulent environment and with some geographically distant markets gladly use these measure systems

(JOHNSON and SCHOLES, 1997). We adopted and transformed this methodology to classify the clusters.

Thus, classification of the Hungarian accredited clusters with a transformed matrix is carried out with the Cluster Effectiveness Matrix. Dimensions of the matrix have been argued above with the detailed components. While forming the CEM, components were taken into consideration in equal proportion. Doing so, we prefer to be careful, because no paper has ever studied cluster concept and portfolio matrix methods for one occasion. Further components are weighted in the model with the purpose to receive a more stable view of cluster operations and strategies. On one hand, the CEM is a snapshot: it gives an insight to the point of cluster-accreditation, on the other hand, some desirable operations and intellectual strategies from this snapshot can be derived to achieve clusters their definite objects.

We have examined 5 clusters from the 12 accredited Hungarian clusters in IT and health sector. Some clusters do not allow to estimate their inside operations and intellectual capacities, involving patents and human resources.

6.3.2. The Results in Cluster Effectiveness Matrix



Notes

Figure	Score		Sector
	ICCI	BOI	
●	2,72	1,28	IT
○	1,19	1,24	Health
▨	2,51	3,93	Health
▦	1,30	2,37	Health
⁘	2,25	0,70	IT

Figure 3 Cluster Effectiveness Matrix

Source: The author's own edition.

Scores and results (and similarly the location of the clusters in the CEM) are relative: we compare the clusters to each other. Figure 3 demonstrates the result of clusters in comparison to each other. In the future, we are planning to analyze more clusters, analyze international data, and finally we are intending to create the general unit of CEM's dimensions.

By breaking the CEM into elements, we have found that there are 9 clearly isolated cells. Our analyzed clusters can be found in 4 different cells in CEM:

- In cell 7, there are 2 clusters: they represent clusters in IT sector and in Health sector.
    - They have low Business Operation Indicator score and
    - low Intellectual Capital & Cooperation Indicator score, as well.
- To represent IT sector there is a cluster in cell 8:
    - low BO Indicator score and
    - medium ICC Indicator score.
- In cell 4, there is a cluster operating in Health sector:
    - low ICC Indicator score but
    - its ICC Indicator score reaches the medium level.
- The most professional and developed cluster from the estimated clusters is in cell 2. Its performance is definitely higher than those of the others:
    - BO Indicator score is at a high level and
    - ICC Indicator score is at a medium level, too.

With the help of the CEM, we can point out that the clusters make themselves heterogenic, and their operations and management are also heterogenic. There are opportunities for development by clusters because there is no cluster in cell 3: high Intellectual Capital & Cooperation and high Business Operation. There is no functional interaction between intellectual capital and business operations, because 4 clusters are not on the diagonal line of CEM. To reach a more stable CEM, there is a need to build further accredited clusters into the research.

To summarize, we could conclude that Hungarian clusters were classified obviously by CEM. Five accredited clusters were classified in this paper: they were the examples or pilots to measure clusters performance with the detailed available dimensions available. The results suggest that there are industrial differences among the clusters. Both of the IT sector clusters had relatively high ICC scores compared to the health-care sector, but on the flip side the efficiency and BO Indicator seems to be higher in the health-care industry. Since our sample is small, we can supervise restrict our hypothesis, but this statement could be a basic assumption for a following research.

7. Hypothesis Supervise

We have defined three hypotheses in the first part of this paper and also explained the CEM and its background, reviewed related literature; finally we supervise our hypotheses.

Hypothesis 1: Accredited clusters in Hungary could be measured and classified by the knowledge-transfer management and business operation based model.

This hypothesis is verified.

The CEM based on two different dimensions:

- Intellectual Capital & Cooperation Indicator, involving 8 components,
- Business Operations Indicator, involving 4 components.

Hypothesis 2: Hungarian accredited clusters focus on Business Operation and Intellectual Capital & Cooperation in equal proportion at the accreditation point.

This hypothesis is also verified.

To supervise this hypothesis we did not use the results of CEM, but we started from the innovative infrastructure theory. In contrast to CEM, the clusters focused on Business Operation and Intellectual Capital & Cooperation in equal proportion at accreditation point. They have correct and unambiguous criteria to become an accredited cluster. They have the same criteria; however, the innovation infrastructure (Feldman, 1994) is very different. The capital of Hungary and the West-Hungary Region dominates the innovation infrastructure, so clusters outside of these two regions have a fundamental disadvantage. Due to these disadvantages, clusters have a different view of Intellectual Capital & Cooperation Indicator; however, they have been focused on Business Operations and Intellectual Capital & Cooperation in equal proportion.

Hypothesis 3: Business Operation and Intellectual Capital & Cooperation by the Hungarian accredited clusters have functional interactions at accreditation point.

This hypothesis is refused.

Taking into consideration the CEM, there *is* interaction between Business Operation and Intellectual Capital & Cooperation by clusters but

- the sample is small,
- the interaction is functionally not stochastic.

To summarize the hypothesis supervision, we strongly state that the application of CEM in classifying and measuring the cluster effectiveness is challenged at some points. After some configuration in the future, we will be able to measure the success of cluster features by popular well-known clusters with world-famous brands, e.g. Nokia, Avatar, Mercedes and Benetton.

8. How to Generalize the Cluster Effectiveness Matrix?

Estimating the CEM, we have the view on the top of clusters concept. We can measure and generate scores representing inside values (soft and hard) of clusters, and as a result, an effectiveness oriented model (CEM) is formed. Applying the portfolio-matrix theory on cluster concept, we create some characteristics about the following scopes:

- attitude on the market,
- human management,
- development opportunities – innovation requirements,
- general business process
    - investment strategy,
    - cash-flow.

The following Figure is based on management science (SHELL MATRIX-KLEIN, 1964), involving strategy, regional and business (labour, investment, leadership, positioning) oriented theories.

In this paper we introduce the cluster characteristics with the following considerations:

- necessary intensity of investments
- effectiveness of cluster management
- intensity of intellectual investments
- intensity of cooperation

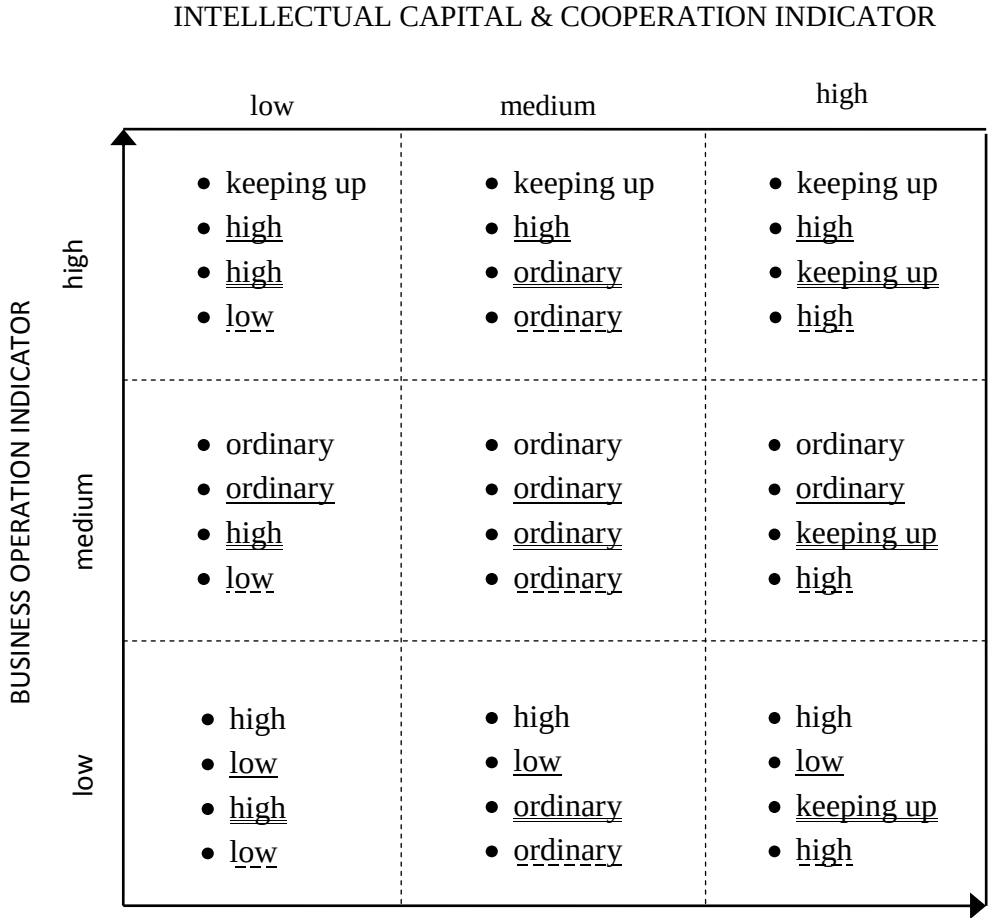


Figure 4 Cluster characteristics by CEM

Certainly, these characteristics are generally interpreted characteristics. These have to be adopted and transformed considering the following:

- ✓ inside operation,
- ✓ location,
- ✓ sector,
- ✓ long term objects,
- ✓ consistency of the devoted cluster.

Generalizing the CEM, the clusters have the opportunity to transform the above shown method according to its own requirements. So, they can classify themselves or their own

sector compared to the other accredited Hungarian clusters. There will be even a chance to compare the multi-dimensional performance with their short, medium and long term objects.

9. Conclusion

In knowledge-based economies, clusters are considered as drivers of economic development. In these alliances, one of the most important processes is knowledge flow which, according to literature, has an effect on the alliances' own economic performance. In Hungary, clusters have a very short history, however, in Western Hungary, spontaneous, bottom-up initiatives have appeared and the Hungarian government has also realized that clusters should be supported. Literature argues the different cluster definitions and there are also heavy debates on from what point companies' cooperation should be defined as a cluster. By taking into account the company life-cycle and the Hungarian government support policy, we have linked this point to the accreditation date and have analyzed it. We have also examined the knowledge flow and operation characteristics of the Hungarian IT and health industry clusters at this time. With the help of the CEM matrix, we found that at the time of accreditation:

- clusters, compared to each other, are heterogeneous in terms of both operation efficiency and knowledge flow
- there might be industry specific features in terms of both BOI and ICC
- there is no functional interaction between intellectual capital and business operations

As a result of the further improvement of the CEM model, both government sector and clusters themselves can get a picture about their future development and improvement potentials.

An obvious weakness and drawback point of the experiment is the low element number of the sample; however, we believe this does not harm the validation of the model. Besides these facts, we think that defining the axes of the CEM model in absolute value could be one direction of further improvement.

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