Identifying the problematic units
in the chains of supplies of industrial clusters

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Abstract – **The presence of problematic units in the supply chains disturbs the links in the clusters and seriously hampers their functioning. Their identification and timely rectification is of great importance for the development of well-grounded strategic plans for developing the clusters and enhancing their competitiveness. The aim of the present article is to put forward a suggestion for an approach of identifying and analyzing the missing and weak units in industrial clusters.**

Index Terms – Industrial clusters, Chains of supplies, Problematic units, Missing units, Weak units.

I. INTRODUCTION

Based on A. Marshall's ideas [5] from the end of the 19th century, the theory of clusters starts to evolve dynamically with M. Porter's research [6, 7] from the beginning of the 90s in the last century. It has increasingly attracted the attention of researchers, politicians and business people and has gradually become the basis for substantiating a new approach to economic development. It is focused on enhancing regional and state competitiveness by developing industrial clusters comprising geographically concentrated competitive enterprises from a certain industry, their suppliers, enterprises from industries that provide support and services to them, as well as various organizations which have both relations of competition and cooperation with them. Clusters ensure a synergy effect, i.e. they achieve higher results than the sum of the results of the constituent enterprises, and being part of them, enterprises become more competitive than they would be if they worked on their own.

Achieving a synergy effect is largely due to the fact that at the basis of clusters there are the so called chains of values, i.e. chains of firms, formed on the basis of relations between a supplier and a client. Moreover, the degree of completeness of these chains and the strength of the links between their separate divisions are much bigger than between firms outside clusters. The functioning of the supply chains in the clusters leads to an increase in the productivity of the constituent enterprises by ensuring an advantageous access to timely specialized deliveries. What is more, on the basis of this, the diffusion of technological knowledge and innovations is accelerated and facilitated and the innovative capacity of the enterprises is increased.

However, well developed and effectively functioning clusters are the result of a long process of evolution and the purposeful efforts of the state to support them. In the process of their development they gradually build up their composition and provide the necessary conditions to achieve a synergy effect. At the beginning they comprise a small number of industries which are insufficient for the complete building up of the chain of supplies and for meeting the needs of the end-producers. They are still not thoroughly built up as complete economic organisms, and cannot meet all their needs on their own. What is not available are some of the industries providing specialized materials, components, machines, financial means, services, also some of the industries which manufacture auxiliary products as well as some of the related and support branches (channels of realization or consumers, etc.). Thus it becomes imperative to get supplies from import or from industries functioning outside the clusters which diminishes their competitive edge. What is of great importance for increasing the competitiveness of industrial clusters and their further development is to deal with the problematic units in the supply chains, i.e. to supply the missing ones and to strengthen the weak ones. By missing units we mean industries which are not available in the clusters and whose supplies are needed for meeting the needs of the industries that comprise the clusters. Weak units are industries in the cluster which are not developed well enough and cannot by themselves (without supplies from outside) satisfy their needs as well as expected. Identifying the missing or weak units is very important for directing the managerial and investment efforts of the generic cluster organizations and the government agencies responsible for the economic development. They should direct their efforts towards attracting investment and creating the conditions for the development of the missing or weak industries.

II. IDENTIFYING THE PROBLEMATIC UNITS IN THE SUPPLY CHAINS

In order to identify the missing and weak units in the supply chains of industrial clusters we can use the following sequence of stages.

Stage 1. Determining the extent to which the needs of the cluster are satisfied by internal sources (industries, firms).

In order to determine the extent to which the needs of the cluster are satisfied by internal sources (industries,

firms) we determine the so called index of internal satisfaction. It is calculated for each industry (firm) comprising the cluster. The index shows what percentage of the cluster needs for the respective type of supplies is satisfied by each industry (firm) inside it.

$$I^i s = \frac{Pki}{OPki}.100 = \frac{\sum\limits_{j=c}^{r} Xij}{\sum\limits_{j=c}^{r} Xij + \sum\limits_{j=c}^{r} CTij + \sum\limits_{j=c}^{r} IMij}.100 \qquad (1)$$

where: $I^i s$ - the index of internal satisfaction from products of the industry i.

i – industry within the cluster (i=c-r).

c – the leading industry in the cluster;

r – the total number of industries in the cluster;

Pki – the total value of the purchases in the cluster from the i–industry (i=c-r).

OPki – the total value of the purchases(overall demand) of the cluster (of all its industries) of products of the i-type, i.e. produced by the i-industry, including the industry within the cluster, the branch out of the country (for the regional clusters) and import from abroad.

Xij – the volume of production as a value representation, which the i-industry within the cluster (i=c-r), provides for the j-branch of the cluster (j=c-r).

CTij – the value of the purchases by the external for the cluster i-industry of the country, made by the j-industry of the cluster (j=1- r);

IMij – the value of the purchases from import of products of the i-industry, made by the j-industry of the cluster (j=1-r);

The bigger and the closer to 100 % the value of the index of the internal satisfaction is, the better developed this industry is and the higher the extent to which it satisfies the needs of the other industries in the cluster and visa versa. The value of the index for a particular industry of 100 % shows that it completely satisfies the internal cluster demand for a particular product. The different industries within the cluster can be classified according to the value of their index of internal satisfaction. Using it, we can judge the completeness of building up the supply chains. It is also used to make comparisons with industries from other clusters.

Stage 2. Determining the average degree of satisfying the needs of the cluster from internal sources (industries, firms).

The average degree of satisfying the needs of the cluster from internal sources (industries, firms) is determined as an average value of Iis for all the branches of the cluster, i.e.:

$$I^a_s = \frac{\sum\limits_{i=c}^{r} I^i s}{r}, \qquad (2)$$

By means of the average value of satisfying the needs of the cluster from internal sources we can make various comparisons – with other clusters, with the average level for all the clusters in the country and so on. These comparisons show the different extent to which the chains of supplies and the clusters are developed.

Stage 3. Determining the weak units (industries, firms) in the cluster.

In order to determine the weak or missing units (industries, firms) in the cluster we compare the indexes of internal satisfaction for each of the industries in the cluster composition (Ii s) and the average value of this index(Ia s).

When Ii s < Ia s , then there is a low degree of internal satisfying of the needs of the cluster of i-type products. To put it differently, the i-industry within the cluster is not developed well enough, and thus cannot satisfy those needs. It is necessary to import products from industries outside the cluster. In this case the i-industry is considered to be a weak unit in its functioning. It needs further efforts in order to be developed. The smaller the index of the branch in comparison with the average index for the cluster, the weaker the unit is. When Ii s = Ia s , then the i – industry within the cluster is relatively well-developed and satisfies the internal needs of the cluster to an extent higher than the average. The bigger its value is, in comparison with the value of the average index for the cluster, the better developed the cluster is and the higher the degree to which it satisfies the demand for its products inside the cluster.

Stage 4. Determining the missing units (industries, firms) in the cluster.

In order to determine the missing units (industries, firms) in the cluster we calculate an index of external satisfaction. It is determined sequentially for each branch (firm). The index shows what percentage of the needs of the cluster for a particular type of products is satisfied with supplies from outside the cluster. The following formula is used:

$$I^i es = \frac{Pei}{OPki}.100 = 100 - I^i s, \qquad (3)$$

where: I^i_{es} - the index of external satisfaction of the cluster with products of the i- type (i=1-n).

Pei – the total value of the purchases of the cluster (by all its industries) from the external i – industry.

When $I^i_{es} = 100\%$, then the needs of the cluster for a particular type products (i – type) are fully satisfied with external supplies, i.e. there are no internal supplies ($I^i_s = 0$), because there is no industry (firm) within the cluster which can provide them. Therefore the i- industry (firm), which is not developed within the cluster, but whose products are needed for the effective functioning of the cluster is identified as a missing unit. The main efforts of the agencies responsible for their development should be directed towards the elimination of the missing units. In this way, we can achieve the complete building up of the chains of supplies and the clusters start functioning as complete business enterprises creating a great synergy effect.

For the purpose of analysis we can determine an average index of external satisfaction of the cluster (I^a_{es}). It can be used to make a

number of comparisons. If, for example, when $I^i_{es} > I^a_{es}$ we come to the conclusion that in order to satisfy its needs, the cluster relies to a great extent on external supplies, and the internal industry is underdeveloped (it is a weak unit). When $I^i_{es} = I^a_{es}$ the internal satisfaction of the cluster with the products of the particular industry is high because the branch within the cluster is well developed, i.e. it relies less on external supplies. Using the average extent of satisfying the needs of the cluster from external sources, we can make comparisons with other clusters as well as with the average level for all clusters in the country, etc.

In order to make the analysis deeper, it is necessary to determine the extent to which the needs of the clusters are satisfied by various sources of external supplies – by external for the cluster industries (firms) from the country and from import. For that purpose we calculate the respective indexes. They are:

A/ the index of satisfying the needs of the cluster by external industries (firms) from the country (I^i_{esc})

$$I^i\,esc = \frac{Peci}{OPki}.100\,, \qquad (4)$$

where: I^i_{esc} - index of satisfying the cluster with products from the i- industry which is external for the cluster but is from the same country (i=1-n).

Peci - total value of the purchases of the cluster (by all its industries) from the external i – industry from the same country .

When $I^i_{esc} < I^i_{es}$ then not all needs of the cluster of i-type products are satisfied by manufacturers from the country, and some of them are satisfied from import. The smaller I^i_{esc} is with comparison to I^i_{es}, the bigger the share of the import. In this case, additional efforts must be made to improve the development of the i industry in the country in order to limit import. It is possible to have $I^i_{esc} = I^i_{es}$, i.e. all purchases of the cluster to be made from the i- industry in the country. For the purpose of analysis we also calculate an average index of external satisfaction of the cluster by industries from the country. A number of comparisons are made using it. For regional clusters the index of satisfying the needs of the cluster from external industries (firms) from the country can be dissolved into two sub indexes – index of satisfying the needs of the cluster from external industries (firms) from the region and of satisfying the needs of the cluster from external industries (firms) from other regions in the country. Thus the local authorities can get a better idea of the weak aspects of the branch structure of their regions and on this basis can better direct their managerial efforts to the development of the missing or insufficiently developed but needed spheres of activity.

B/ index of satisfying the needs of the cluster from external industries (firms) from import

$$I^i\,so = \frac{Psoi}{OPki}.100 \qquad (5)$$

where: I^i_{so} - index of satisfying the needs of the cluster with i-type products from import (i=1-n).

Psoi – the total value of the purchases of the cluster (of all its industries) of i-type products from import

When $I^i_{so} = I^i_{es}$ then all external purchases of the cluster of i-type products are satisfied from import from other countries. That is an indicator that the regional structure of the cluster, region and the country is not well developed and there is "a drain" of funds for supplying the resources needed for providing the missing unit in the chain of values. We can consider unfavorable any situation in which $I^i_{so} = I^i_{esc.}$ In both cases, it is imperative to make the effort to develop the missing or weak industries in the cluster and in the country so that import is decreased or stopped. For the purposes of analysis we also calculate an average index of satisfying the needs of the cluster from import, with the help of which we can make a number of comparisons – with other clusters, with the average level of all clusters in the country, etc.

III. CONCLUSION

At the basis of the achievement of a synergy effect in the clusters is the fact that they are geographically localized chains of independent organizations which have intensive vertical (along the line of the chain of supplies) and horizontal (along the line of competitiveness, coordination and cooperation) relations among themselves. The presence of problematic units in the chains of supplies disturbs both the commercial and non-commercial links in the clusters and seriously hampers their functioning. That is why, their timely identification and rectification is an important direction of enhancing their competitiveness.

The methodological guidelines we have considered so far make it possible to identify and analyze the missing and weak units in industrial clusters. With their help we can identify the main problems in the chains of supplies of the clusters and outline the priority areas for management action. That is of great importance for the development of well grounded strategic plans for the development of the clusters and the regions.

REFERENCES

[1] Cooke Ph., 2001, Knowledge Economies: Clusters, Learning & Co-Operative Advantage, London: Routledge;

[2] Florida R., 1995, Toward the learning region, Futures, 27(5);

[3] Jaffe A., Trajtenberg M., Henderson R., 1993, Geographic location and knowledge spillover as evidence by patent citation, Quarterly Journal of Economics (108), pp. 577-98;

[4] Malmberg A., Maskell P., 2002, The elusive concept of localization economies – Toward a knowledge-based theory spatial clustering, Environment and Planning A., 34(3);

[5] Marshall A, 1962, Principles of Economics: An Introductory Volume. Ninth (Variorum) Edition (1st Edition 1890), London: Macmillan

[6] Porter M.,1990, The Competitive Advantage of Nations, London, Macmillan;

[7] Porter M., 1998, On Competition, Boston, Harvard Business Review Books;

[8] Waits M., 2000, "The Added Value of the Industry Cluster Approach to Economic Analysis, Strategy Development, and Service Delivery", Arizona State University, Economic Development Quarterly, Vol.14, No.1, February, 2000, pp.35-50.