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CONSOLIDATED ASSESSMENT OF COMPOSITE COMPETITIVENESS INDICATORS: THE CASE OF MANUFACTURING ENTERPRISE

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Abstract. The paper deals with the framework of consolidated assessment of a totality of composite business competitiveness indicators for a specific manufacturing enterprise based on the multiple criteria of the Simple Additive Weighting method as well as developed assessment principles and models. The assessment process includes establishment of pillar indexes and determination of the total competitiveness index. The identified non-financial competitiveness indicators were assessed by applying the performed process to a Lithuanian manure manufacturing enterprise according to the 2013 situation and the scenario of predicted changes of the examined indicators.

Keywords: business competitiveness, composite indicators, evaluation criteria, indicator pillars, multiple criteria SAW method.

JEL classification: C39, L25, O16.

1. Introduction

The creation of a modern knowledge-based economy, transformation of entrepreneurship and growth of its competitive advantage are the strategic priorities of the economic development in the new EU countries. At the same time, a business strategy must take into account expected competitive advantage-oriented changes (effective determinants) as well as effective optimal control methods that stimulate competitiveness growth. Moreover, it is especially important to evaluate complex business competitiveness, especially by reasoning the strategic development decisions.

The authors, such as Fleisher (2003), Adner, Zemsky (2006), Iturrioz *et al.* (2009), McGee *et al.* (2009), Geoff *et al.* (2009), Gao (2010), emphasize the separate significant indicators (marketing strategy, innovations, goods (services) competitiveness, diversification, production and export of high-tech goods, etc.) which have the largest impact on a firm's business effectiveness. The link between innovation capability (its effects) and a firm's business performance was disclosed by Saunila, Ukko (2012). These authors also discussed effect measurement problems.

Conceptualizing the competitiveness issue at the firm level, Ma, Liao (2006) take into account primarily the fact that firms are increasingly being exposed to international competition. Lechner, Leyronas (2009) note that an effective marketing strategy has to increase the efficiency of business value-added creation; hence, it is important to integrate the small business group formation and the concept of sustainable competitive advantage as implementing a value-creating and resource-based management strategy.

The results of a study by Man, Lau, and Snape (2008) provide evidence of the relationships existing among innovative strategic competencies that affect the long-term performance and competitive scope as well as organizational capabilities of SMEs. Olavarrieta and Friedmann (2008) highlight the role of knowledge-related resources as key antecedents of the continuous creation of competitive advantages. In order to produce optimal results of technological innovation and business performance, Donate, Canales (2012) also focus on a firm's knowledge-based strategy, which leads to the growth of the firm's competitive potential.

Actually, as noted by Cepeda, Vera (2007), it is important (based on a firm's knowledge management perspective) to clarify the link between operational and dynamic capabilities. Specific literature on strategic management focuses more on dynamic capability as a source of competitive advantage. In this context, Wong (2005) conducted a systematic

investigation of so-called critical success factors and proposed their expanded set to be adopted in implementing knowledge management in SMEs.

On the basis of an extensive review of theoretical works and summarizing the practice of assessment of competitive strategies, Parnell (2008) also indicates such themes as strategy formulation, execution or implementation, and evaluation (control) as directions for future research. Thus, a review of related research papers has shown that relevant studies essentially deal with disclosing the main economic competitiveness factors at the corporate level; now more than ever, we need a system of integral measurement of competitiveness which would mainly define the business strategy. To tackle the research problem, this study focuses on the measurement framework of a totality of exceptional business competitiveness indicators.

Moreover, it is purposeful to perform an analysis of selected entrepreneurship competitiveness indicators on the basis of World Economic Forum (WEF) data.

The *objective of research* is to develop the main principles and measurement techniques on the basis of the models designed for assessing the totality of business competitiveness indicators. *Research methods*: a systemic review of scientific publications, analysis of WEF global competitiveness indicators for Lithuania, multiple criteria evaluation Simple Additive Weighting (SAW) method.

2. Analysis of selected Lithuania's economic competitiveness indicators

It may be stated that the standard WEF indicators determining the pillars of a country's global competitiveness index and having a relationship with the country's entrepreneurship competitiveness may be taken into account when investigating business competitive advantage in detail. In order to examine Lithuania's business competitiveness, an analysis of related WEF data (144 country rankings) in 2011/2012–2013/2014 has been carried out.

The purposefully selected standard indicators for Lithuania investigated by the WEF, as it can be seen from Table 1, are at comparable levels in 2011/2012, 2012/2013 and in 2013/2014 (The Global Competitiveness Report, 2011/2012–2013/2014). For example, this can be observed as regards creation of value chain breadth (ranks 37–40, scoring 4.1–4.2), availability of latest technologies (ranks 37–38, scoring 5.7), companies spending on R&D (ranks 63–67, scoring 3.1–3.2), state of cluster development (ranks 109–115, scoring 2.8–3.3). However, by firm-level technology absorption the progress is from rank 63 (score 5.0) in 2011/2012 to 42 place (score 5.2) in 2013/2014. Similarly, by production process sophistication the progress is from rank 53 (score 3.9) to rank 45 (score 4.2).

Table 1. Comparative ranking data of Lithuania's economic competitiveness in 2011/2012 – 2013/2014 by selected standard WEF indicators*

Selected standard competitiveness indicators included into WEF pillars of the global competitiveness index	2011/2012		2012/2013		2013/2014	
	Rank	Score	Rank	Score	Rank	Score
Production process sophistication	53	3.9	50	4.0	45	4.2
Capacity for innovation	48	3.3	47	3.4	40	4.0
Creation of value chain breadth	37	4.1	40	4.1	37	4.2
Extent of marketing	44	4.6	43	4.5	38	4.7
Firm-level technology absorption	63	5.0	53	5.0	42	5.2
Availability of latest technologies	38	5.7	37	5.7	38	5.7
Companies spending on R&D	67	3.2	64	3.2	63	3.1
Nature of competitive advantage	66	3.6	52	3.7	59	3.7
Intensity of local competition	34	6.0	48	5.1	36	5.4
State of cluster development	114	2.8	115	3.0	109	3.3
Pay and productivity	22	4.6	23	4.6	14	4.7

Composed by the authors on the basis of:
http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2011-2012.pdf;
http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2012-2013.pdf;
http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2013-2014.pdf.
Note: * Weighted average is indexed from 1(lower evaluation) to 7 (highest evaluation).

WEF experts also note that for Lithuania, cluster development and the growth of companies spending on R&D are also hardly problematic. As WEF data show, for example, the problematic indicators determining the Estonia's business competitiveness are different when compared with those determining Lithuania's business competitiveness.

On the basis of the performed analysis, it may be noted that such composite indicators as capacity for innovation, creation of value chain breadth, technology absorption can be encompassed when assessing business competitiveness in the conceptual approach. The viability of the consolidated assessment framework presented below is determined by the fact that it helps to define the relative competitive abilities of a specific enterprise among competitors in the market and may be applied to reasoning the strategic business decisions.

3. Consolidated assessment principles and technique

3.1. Generalized model

When examining the competitiveness phenomenon, one must first and foremost focus on its impact on business competitive strategy as well as on development of sophisticated theoretical and methodological evaluation tools; attention must also be paid to the possibilities of application of multiple criteria decision-making (MCDM) methods (Brauers, Ginevičius 2013; Yazdani-Chamzini *et al.* 2013). Certainly, it should be noted that a matter of importance is reliability determination by measuring the overall competitiveness dimension (allowing for different reliability levels), because many integrated characteristics of competitiveness actually are of stochastic nature. The present paper also provides the measurement of relative business competitiveness by means of the deterministic approach, which in principle requires the formalization of interrelations in the investigated system, which comprises evaluation criteria and total competitiveness.

Therefore, a background (general matrix) expression of the total competitiveness dimension as vector $\{TC\}$ can be presented in the following way:

$$\{TC\}=f[\{CI_1\},\{CI_2\}, ..., \{CI_m\}], \quad (1)$$

where $\{CI_1\}$, $\{CI_2\}$, ..., $\{CI_m\}$ are composite indicators in vectorial similitude (as primary criteria determining the total competitiveness dimension, i.e. the vector$\{TC\}$); the function f expresses the direct and indirect relations of the composite indicators, which have different influence directions as well as various values, within the vector $\{TC\}$; m – the discrete number of the composite indicators.

In the utilitarian tasks of competitiveness measuring, this conceptual model must be also recomposed corresponding to a specific evaluation method.

3.2. Reasoning behind the method of multiple criteria evaluation

Preconditions for the evaluation of the social processes determined by multitude of criteria have been examined in such analytical studies as those by Zvirblis, Buracas (2012), Buracas *et al.* (2012). Moreover, the provided quantitative evaluation technique (compatible with a qualitative – SWOT – analysis and the scenario method) as a useful methodical tool is linked with the analytical background adaptation.

Conceptual solutions for the quantitative assessment of equivalent integral dimensions are extensively considered in research works of Ginevicius, Podvezko (2009). In principle, multiple criteria evaluation methods, as a basis of the MCDM system, are suitable by the nature of raised tasks, actually the SAW (Simple Additive Weighting), COPRAS (Complex Proportional Assessment) and TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) methods.

Research papers, such as those by Dombi, Zsiros (2005), Zavadskas, Turskis (2011), Podvezko (2011), deal with application of the COPRAS and TOPSIS methods. These methods are first and foremost associated with arrangement of considered alternatives in order of their preference and effectiveness of reasoning. They are most widely used for assessment solutions when a totality of data (discrete number of alternatives) is to be described.

The SAW method is suitable in the cases when maximizing criteria alone are used. Besides, in order to include minimizing criteria they may be easily converted into maximizing ones by means of well-known formulas, for example, those presented by Podvezko (2011). Primary criteria usually have different units of measurement and a different optimization direction. Thus, we have wide possibilities of constructing an adequate system of primary evaluation criteria when applying this method. Along with the impact parameter of each primary criterion, it needs to be taken into account that they may also differ according to the impact on the general measure. By applying this method, the impact parameter values may be de-

termined by means of calculations on the basis of objective information (in particular, using the Analytical Hierarchy Process software) or by expert evaluation; only the most significant primary criteria must be investigated.

The performed analysis reveals that the priority should be given to application of the SAW method in cases of evaluation of a given system's efficiency, i.e. comparative competitiveness of a specific business. This method has an advantage compared to the COPRAS and TOPSIS methods described above due to classical circumstances of their application, i.e. when several alternatives are evaluated, compared and ranked. We propose a consolidated evaluation methodology based on expert examination of composite evaluation criteria and determination (using the SAW method) of the overall competitiveness measure, allowing for the impact of different criteria on this measure.

3.3. Typical criteria pillars

When investigating (by means of the SAW method) a multitude of primary evaluation criteria, i.e. composite competitiveness indicators, it is expedient to compile their task pillars. The typical pillars (configured taking into account scientific publication findings, WEF economic competitiveness indicators, also accomplished initial investigation) are presented in Table 2.

Table 2. Idiosyncratic pillars of primary composite indicators (not ranked)

Name of the pillar	Primary composite indicators in the pillar
Pillar (*A*) of composite competitiveness indicators	A.1. Capacity for innovation A.2. Export share of goods/services A.3. Marketing sophistication A.4. Production diversification A.5. Production process sophistication A.6. Financial management efficiency A.7. Competitiveness of production (services) A.8. Cash flows equilibrium. A.9. Creation of value chain breadth
Pillar (*B*) of composite competitiveness indicators	B.1. Adaptation to influence of macro factors B.2 Knowledge-based competitive strategy B.3. R&D expenditure B.4. Availability of latest technologies B.5. Firm level technology absorption B.6. CSR level B.7. Inclusion into cluster structure

Evidently, the parameter of the impact of these composite indicators on the overall business competitiveness measure may have rather different-sized values.

As it can be seen, some designated indicators (for example, CSR level) are in principle multidimensional and in turn must be examined using the adequate assessment technique of integrative components.

The main principles indicated above have made it possible to establish the indexes of each pillar (as partially integrated criteria in the consolidated quantitative evaluation system) using respective multiple criteria evaluation models. Finally, the idiosyncratic model has made it possible to determine the total competitiveness index based on the previous established pillar indexes.

3.4. Equations adopted for assessment by means of the SAW method

Under the circumstances indicated above, the presented assessment models focus on the application of the SAW method and refer to the estimation of pillar indexes as well as the total index (the overall dimension).

In order to estimate, by means of the SAW method, the pillar index $A(I)$ of the pillar (A) of composite indicators (as the first partially integrated criterion), the following equation may be employed:

$$A(I) = \sum_{i=1}^{i=r} a_i A_i; \sum_{i=1}^{i=r} a_i = 1, \qquad (2)$$

where $\sum_{i=1}^{i=r} a_i$ – the sum of coefficients of the direct impact of compound indicators A_i (Table 2) on the index $A(I)$; r – the number of the indicators determining the index $A(I)$.

The index $B(I)$ of the pillar (B) as the second partially integrated criterion may be defined as follows:

$$B(I) = \sum_{i=1}^{i=n} b_i B_i; \sum_{i=1}^{i=n} b_i = 1, \qquad (3)$$

where $\sum_{i=1}^{i=n} b_i$ – the sum of coefficients of the direct impact of compound indicators B_i (Table 2) on the index $B(I)$; n – the number of the indicators determining the index $B(I)$.

The value of the total index *TCI(I)* (as the overall competitiveness dimension) may be established on the basis of the previously determined indexes $A(I)$ and $B(I)$ enabling the weights of these partially integrated criteria:

$$TCI(I) = k_s A(I) + k_e B(I); \sum k = 100\%, \quad (4)$$

where k_s, k_e – weights (determined by way of expert examination) of the partially integrated criteria $A(I)$ and $B(I)$ respectively.

3.5. Procedures of the assessment process

The suggested assessment consists of the procedure of expert examination and evaluation of primary criteria (composite indicators) in points, i.e. on a 10-point scale (5 points – medium score, 7 points and more – good or very good score, and 3 points or less – satisfactory or poor score). In this case, the score of the overall dimension, i.e. of the total index *TCI(I)*), is also expressed in points. The non-dimensional coefficients of the direct criteria impact have been determined by the method of pairwise comparison based on the experts estimates.

The concordance coefficient W and the Pearson's chi-square test – the concordance coefficient significance parameter χ^2 – must be calculated for each procedure (Kendall 1979).

Such sophisticated approach determines an assessment process that is based on the following background procedures:

a) the configuration of the criteria system;

b) the expert examination and determination of values as well as impact coefficients of composite indicators;

c) the establishment of pillar indices as partially integrated criteria;

d) the estimation of the general dimension (total index) of the enterprise's business competitiveness;

e) the simulation of alternative trend variants with due account taken of examination tasks.

The computer-generated process includes adequate procedures; the process algorithm is shown in Figure 1.

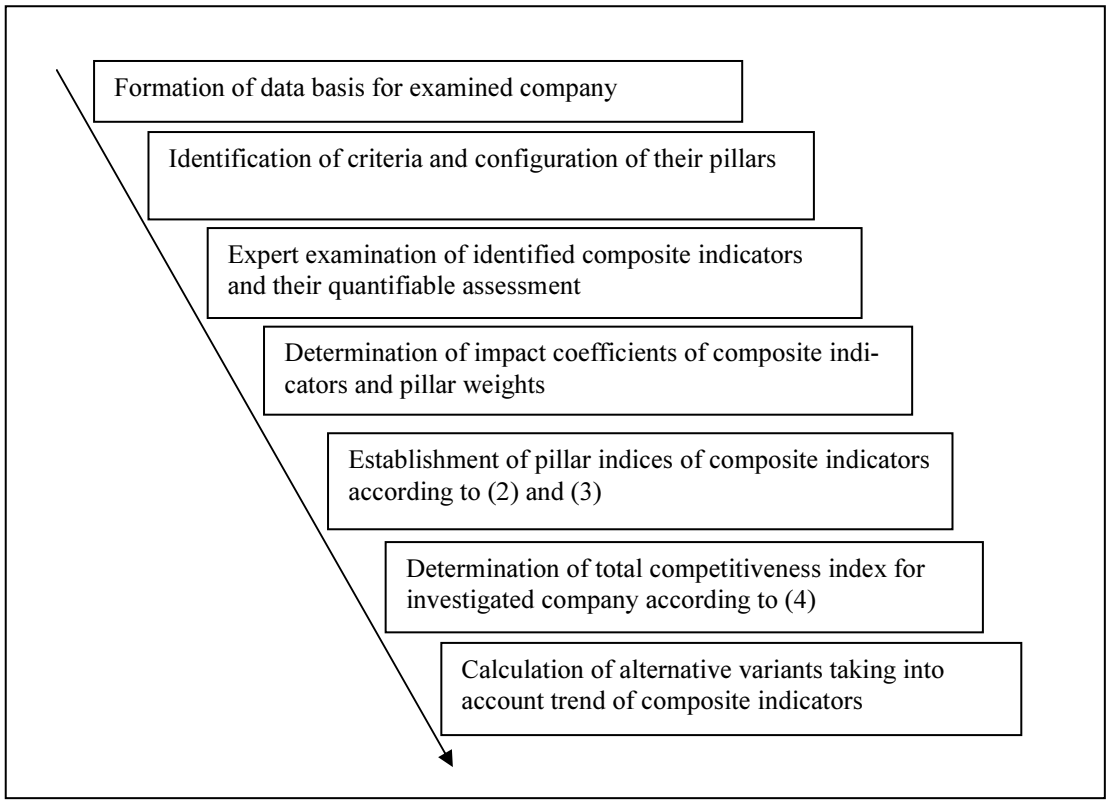

Fig. 1. Typical algorithm scheme of the multiple criteria assessment process

4. Assessing results in the case of the Lithuanian manure manufacturing enterprise

In order to illustrate the described assessment technique, a specific case evaluation study is presented. The study was conducted on a Lithuanian manure manufacturing business enterprise according to the situation in 2013 (I in Tables 3 and 4) and following the predicted indicator trends (II in Tables 3 and 4). At the first stage, the identified composite indicators were assessed (on a 10-point scale), and their (non-dimensional) impact coefficients were estimated by experts. According to the expert method, satisfactory estimation accuracy was achieved by a research team consisting of 5 professional experts. The necessary reliability of expert examination was also acceptable: the values of the coefficient W at the pre-selected level $\alpha = 0.05$ and at the pre-selected level $\alpha = 0.01$ were better than marginal values (Kendall 1979). As a result, the impact coefficients of identified indicators were also determined (Tables 3 and 4).

It can be stressed that such composite indicators as production diversification and financial management efficiency for this enterprise have scored >5.0 points, i.e. higher than average evaluation; also creation of value chain breadth has scored <4.0 points, i.e. poor evaluation (Table 3).

Table 4 shows that the scores of composite indicators also differ: the extent of clusterization has scored <4.0 points, i.e. poor evaluation, while R&D expenditure – >5.0 points.

On this basis and according to the introduced equations (2) with $r = 6$ and (3) with $n = 5$, pillar indexes $A(I)$ and $B(I)$ have been established: they amount to 4.8 points and 4.7 points for (I) and respectively 5.2 points and 5.0 points for (II) (Tables 3 and 4).

Finally, the values of the total index *TCI(I)* of investigated business competitiveness have been estimated (according to the equation (4), where $k_s = 0.55$ and $k_e = 0.45$): 4.75 points (I) and 5.1 points(II).

Table 3. Expert examination of composite indicators (pillar A) and determination of the index $A(I)$ by means of the SAW method

Pillar A of identified composite business competitiveness indicators	Symbol	Assessment (in points)		Indicator's impact coefficients
		I	II	
Financial management efficiency	A_6	5.1	5.6	$a = 0.20$
Capacity for innovation	A_1	4.9	5.3	$a = 0.18$
Extent of marketing sophistication	A_3	4.6	5.0	$a = 0.18$
Relative export share	A_2	4.7	5.4	$a = 0.16$
Production diversification	A_4	5.3	5.6	$a = 0.16$
Creation of value chain breadth	A_9	3.8	4.0	$a = 0.12$
Level index	***A*(*I*)**	**4.8**	**5.2**	

Table 4. Expert examination of competitiveness indicators (pillar B) and determination of the index $B(I)$ by means of the SAW method

Pillar B of identified composite business competitiveness indicators	Symbol	Assessment (in points)		Indicator's impact coefficients
		I	II	
Adaptation to influence of macro factors	B_1	4.6	4.9	$b = 0.25$
Knowledge-based competitive strategy	B_2	4.9	5.2	$b = 0.23$
R&D expenditure	B_3	5.3	5.6	$b = 0.20$
CSR level	B_6	4.6	4.9	$b = 0.17$
Extent of clusterization	B_7	3.6	4.1	$b = 0.15$
Level index	***B*(*I*)**	**4.7**	**5.0**	

Summing up the results of assessment, a conclusion may be drawn that the growth of competitiveness for the manure manufacturing enterprise concerned (similarly to other enterprises of this Lithuanian industry) may be improved first and foremost by concentrated creation of value chain breadth and, concurrently, expansion of the relative export share.

It has been observed that the introduced assessment process may integrate several scenarios interpreting the predicted composite indicator trends. At the same time, it is an undoubtedly important theoretical tool when revealing the growth reserves of a company's competitive potential. This study is probably the first to provide an integrative assessment perspective of business competitiveness indicators allowing for the implementation of modern business control systems and their application for the purpose of justifying strategic business decisions.

As the reliability of assessment results in this case is limited by the reliability of the examination of competitiveness indicators at the first hierarchical level, future analytical research could be focused on the preparation of derivative quantitative characteristics of these composite indicators.

5. Conclusions

The analytical investigation of entrepreneurship development problems and solutions for the increase of corporate competitive advantage is introduced in the scientific publications under review. The components of sustainable competitive advantage are still analyzed insufficiently as a whole, also there is a shortage of studies dedicated to the complex assessment of business competitiveness as an economic phenomenon; the appropriate quantitative evaluation methodology is still not integrated with expert evaluations.

It may be seen that, when comparing the rankings (according to WEF data) of economic competitiveness indicators for Lithuania, for example, creation of value chain breadth (ranks 37–40, scoring 4.1–4.2), availability of latest technologies (ranks 37–38, scoring 5.7), are at comparable levels in 2011/2012, 2012/2013 and in 2013/2014.

The approach to quantitative assessment of a particular business competitiveness level considers the multiple criteria evaluation methodology. For the purpose of application of an adaptable theoretical basis and sophisticated methodical tools, several conceptual approaches may be formulated:

- the discrete number of evaluation criteria must be encompassed;
- the different direct and indirect impact of particular criteria must be expressed.

The Simple Additive Weighting (SAW) method is suitable for deterministic measuring of the competitiveness level when examining a specific company. It may be implemented using the proposed assessment models on the basis of two pillars of primary assessment criteria (in this instance, the key composite competitiveness indicators essentially determining business competitiveness) developed for this case.

The following assessment process procedures may be also indicated: expert examination and scoring of composite indicators as well as estimation of their impact coefficients; establishment of pillar indices as partially integrated criteria; estimation of the total index (as overall dimension) of a firm's business competitiveness.

The process algorithm for such assessment and simulating the changes of the presented competitiveness indicators (according to the possible scenarios allowing their impact on business strategy) may be recommended to apply for justifying the enterprise's strategic business decisions.

The performed investigation and assessment of the business competitiveness indicators of one of Lithuania's manure manufacturing industry enterprises shows a comparatively favourable level (the total index scores respectively 4.75 points according to the situation in 2013 and 5.1 points according the predicted changes of the examined indicators). The growth of business competitiveness for this enterprise may be improved primarily by concentrated creation of value chain and by developing the export share in the future.

As the reliability of assessment results is limited, first of all, by the reliability of the expertise at the first stage of the consolidated evaluation process, future analytical research could be focused on the preparation of derivative quantitative characteristics of the investigated composite indicators.

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