Aplinkos tyrimai, inžinerija ir vadyba, 2010. Nr. 2(52), P. 25-31 *ISSN 1392-1649*
Environmental Research, Engineering and Management, 2010. No. 2(52), P.25-31

Methodology of Sustainability Indicators Determination for Enterprise Assessment

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(received in May, 2010; accepted in June, 2010)

Lithuanian small and medium enterprises (SMEs) need the indicators system for evaluating their sustainability. Because of some difficulties to quantify the aspects of sustainability, not only quantitative but also qualitative indicators are recommended. To select sustainability indicators, an initial set of quantitative indicators was compiled from both sustainability indicators and separate environmental indicators systems. A qualitative indicators set was compiled from one developed qualitative indicators system. The survey of experts was organized for determining qualitative and quantitative sustainability indicators. Budget allocation processes were used as a weighting method. To adjust indicators and weighting coefficients for enterprises in developing or developed countries determination and weighting procedure by national experts should be repeated. Assessment according to the standardized methodology can show only essential problems and it is the first step towards the improvement process.

Key words: *sustainability assessment, sustainability indicators, qualitative and quantitative indicators.*

1. Introduction

Business sustainability can be defined as ‘‘*adopting business strategies and activities that meet the needs of the enterprise and its stakeholders today while protecting, sustaining and enhancing the human and natural resources that will be needed in the future*’’ (Deloitte and Touche 1992).

There are various approaches to measuring, monitoring and assessing an enterprise progress towards sustainability used for awards schemes, investors’ criteria, indicators for external communication, etc. (Székely and Knirsch 2005).

Dow Jones sustainability index is most popular among stock indices for sustainability assessment. The Global Reporting Initiative guidelines are mostly used globally for preparing sustainability reports. Standardized procedure is suggested only for environmental performance evaluation in ISO 14031 (EN ISO 14031, 1999).

A quantitative methodology allows quantification and more precise estimation of probabilities and potential negative consequences. Application of a qualitative method, on the other hand, provides a better understanding of the system performance from the very beginning, even before any quantitative information becomes available (Diakaki et al. 2006).

A primary advantage of quantitative methodologies is a clear assessment procedure according to the methodology and quantifiable goals for improvement. Disadvantages of quantitative methodologies to mention are time demanding because of complexity and data needed for calculation of indicators, especially for SMEs.

Advantages of qualitative methodologies are time efficient, easy to use, orientation to the ideas generation on sustainability rather than to accurate evaluation. Disadvantages of qualitative methodologies are a high level of subjectivity, difficulty to set up goals with clearly defined quantified metrics (Kinderyte 2008).

Qualitative sustainability assessment methodologies at an enterprise level are more oriented toward SMEs while quantitative ones are more oriented toward big enterprises, but some of them have been adapted for SMEs as well (Kinderyte 2008). The best approach is combination of both qualitative and quantitative methods (Diakaki et al. 2006).

The following are qualitative sustainability assessment methodologies for enterprises: Sustainability Assessment for Enterprises, SAFE (Rohn et al. 2001), Sustainability Competency & Opportunity Rating and Evaluation, SCORE (Hitchcock and Willard 2006), etc.

Due to a great number of qualitative and quantitative indicators systems for sustainability assessment, selection and evaluation of indicators significant to SMEs under Lithuanian conditions are of great importance. Research work was carried out to develop a sustainability performance system and its methodology but it does not suggest a final set of indicators (Staniškis et al. 2008).

An objective of this research is sustainability performance of enterprises. The target of research is to develop methodology of determining sustainability indicators. This target is split into tasks: 1) compilation of sustainability indicators into a set for assessment at an enterprise level; 2) development of methodology of determining sustainability indicators for particular economic, social and environmental conditions; 3) application of developed methodology on sustainability indicators determination for Lithuanian enterprises.

2. Methods

The system of selected qualitative and quantitative sustainability indicators can be used for identification of indicators important to SMEs under Lithuanian conditions. Participatory methods are needed to adjust indicators and to evaluate their significance.

Experts' survey is specific inquiry where a selected group of people possessing knowledge in the field of research are interviewed. The questionnaire should be developed for experts' survey. Questions can be closed, opened, direct, indirect **(**Kardelis 2007).

Participatory methods that incorporate experts are the most suitable way to assign weights for sustainability indicators. Weighting techniques derived from participatory methods are budget allocation processes, analytic hierarchy processes and conjoint analysis (Nardo et al. 2005). In choosing an appropriate weighting method it is important to highlight advantages and disadvantages of each method. Budget allocation processes can be characterized as simple, clear and consuming little experts' time (Šaparauskas 2004). Analytic hierarchy processes (Saaty 1980) is mathematically precise. The main disadvantage to be mentioned is a big amount of pair comparison to be made and it consumes much experts' time (Šaparauskas 2004). Conjoint analysis requires a lot of respondents. The most suitable weighting method for research is a budget allocation process. To evaluate the significance of sustainability indicators a 5 points scale is defined:

1 – not significant indicator,
2 – little significant indicator,
3 – moderate significant indicator,
4 – significant indicator,
5 – very significant indicator.

After experts'survey the data are statistically processed. Average significance value of indicators $\overline{t_j}$ is calculated according to formula (Zavadskas, Kaklauskas 1996; Завадскас 1987):

$$\overline{t_j} = \frac{\sum_{k=1}^{r} t_{jk}}{r} \quad (1);$$

where:

t_{jk} - by expert *k* evaluated indicator *j*,

r - a number of experts.

Weighting coefficient of every indicator q_j is calculated according to formula:

$$q_j = \frac{\overline{t_j}}{\sum_{j=1}^{n} \overline{t_j}} \quad (2).$$

3. Development of methodology for sustainability indicators determination

To select important qualitative and quantitative indicators for sustainability assessment, a set of qualitative and quantitative indicators were compiled. To distinguish a final set of indicators the experts' survey was arranged. Seven experts participated in the survey, they were representatives from universities and business consultancies: Kaunas University of Technology, Klaipėda University, Vytautas Magnus University, Public Enterprise "Minds' sector" (Lith. *VšĮ "Idėjų sektorius"*) and one Lithuanian scientist from Lund University, Sweden.

As a background of the research into the qualitative indicators system the Sustainability Controlling System (SuCoS) (Institut...2007) was chosen. Sustainability Controlling System (SuCoS) was developed in 2006 in Lippe and Höxter University of Applied Sciences, Germany. It consists of sustainability assessment at enterprise and product levels. This qualitative sustainability assessment methodology is developed on the basis of Dow Jones Sustainability Index's indicators adjusted to SMEs (Chmiel 2006). Structure of this assessment is similar to the product environmental assessment questionnaire based on life cycle approach (Sietz et al. 2001, Behrendt et al. 1997). At an enterprise level SuCoS was applied to two enterprises and four reports on sustainability evaluation were received in 2007 and 2008 (Fig. 1). SuCoS at an enterprise level encompasses 39 environmental, 32 economical and 38 social qualitative indicators. Because of a large number of indicators they were at first aggregated then experts' survey was organized.

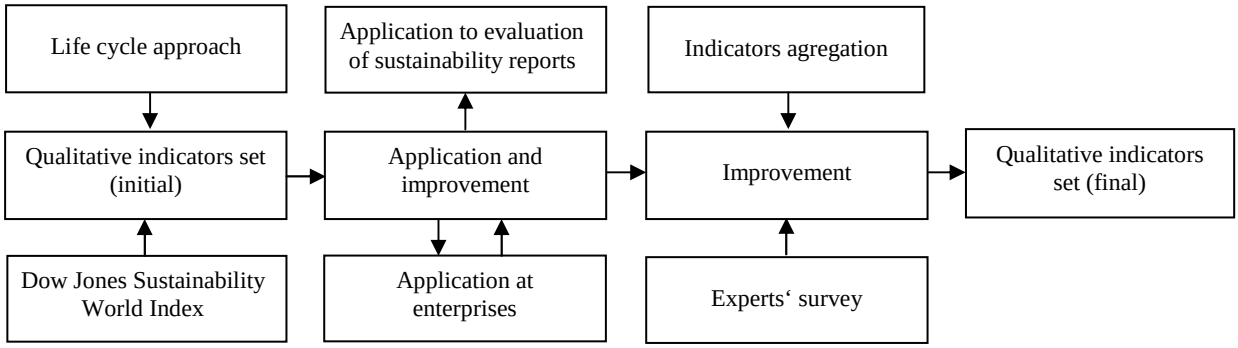

Fig. 1. Methodology of qualitative sustainability indicators determination

Experts' survey was organized in April of 2010 to select qualitative sustainability indicators and to evaluate their significance under Lithuanian conditions. Out of 31 qualitative indicators experts selected 20 for evaluation of sustainability (Tables 2–4). If at least one expert excluded an indicator, then that indicator was eliminated from the indicators set. Average significance of each indicator was calculated according to formula (1) and weighting coefficient was calculated according to formula (2).

To evaluate sustainability of an eneterprise according to qualitative indicators, the scale of assessment should be defined. It is suggested to build assessment on a three levels scale (Table 1). The results can be aggregated into percentage of each level.

Table 1. Example of qualitative assessment

Indicator	Values of an indicator	Assessment
Use of renewable energy	Renewable energy is not considered	
	Renewable energy is considered partly	
	Enterprise produces or buys all required energy from regenerative sources	

To select sustainability indicators, an initial set of quantitative indicators was compiled from both sustainability indicators and separate environmental indicators systems (Fig. 2). Sustainability indicators systems used for an initial set of indicators were: Global Reporting Initiative (GRI 2006), the sustainability metrics (Institution of Chemical Engineers 2003), standard ISO 14031 (2000), Corporate Environmental Indicators (Federal Environment Ministry 1997), Framework of Lowell Center for Sustainable Production (Veleva and Ellenbecker 2000), Dow Jones Sustainability World Index (2006), EMAS regulation (2009), indicators for enterprise social responsibility(Kovaliov 2009). Dow Jones sustainability subcriteria for big enterprises (corporate governance) were excluded from an initial quantitative indicators set. A set was compiled of most often used and all indicators from the most developed indicators system Global Reporting Initiative (GRI).

Experts' survey was organized in April of 2010 to select quantitative sustainability indicators and to evaluate their significance and importance under Lithuanian conditions. If at least on expert excluded an indicator then this indicator was eliminated from an indicators set. Out of 43 quantitative indicators experts selected 24 for sustainability evaluation (Tables 2–4). If at least one expert excluded an indicator, then this indicator was eliminated from an indicators set. Average significance of each indicator was calculated according to formula (1) and weighting coefficient was calculated according to formula (2). Determined quantitative indicators should be adjusted to a particular sector or directly to the company. When adopted to a particular sector or company it is recommended to carry out an experts' survey on compilation of a quantitative indicators set.

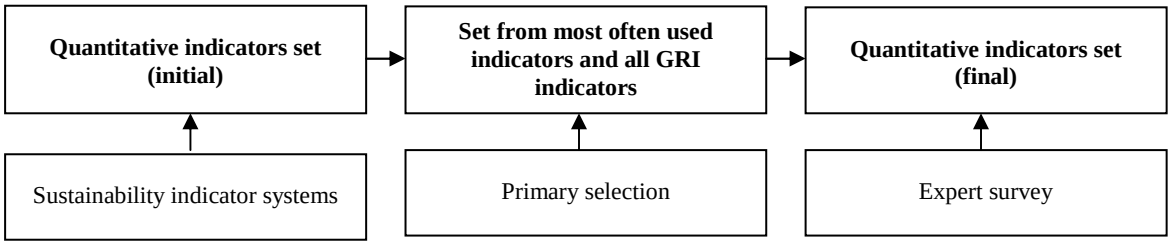

Fig. 2. Methodology of quantitative sustainability indicators determination

Qualitative economical indicators (Table 2) concentrate on the level of stability of position in the market, collaboration with local suppliers and work force, codex of social responsibilities introduced. Out

of quantitative indicators experts selected those related to indirect economic impact of the enterprise social responsible activity. Among excluded indicators the quality management system is found because according to experts' opinion it is not important to have a certified management system, it is important to have an efficient one. The same exclusion criteria were mentioned for the environmental management system, occupational health and safety management system. Penalties because of non-compliance to environmental, work safety and other legal requirements were excluded by experts. SMEs are very rarely inspected, therefore penalties expressed in financial indicators cannot indicate the severity of legal violation. As to local suppliers and local employees, it is difficult to quantify and to define what local means. Thus these indicators are excluded from the set. This can be generally evaluated by a qualitative indicator at the level of collaboration (indicator X.1.2, Table 2).

Table 2. Economical indicators selected by experts ($\overline{t_j}$ – significance of indicator, q_j – weighting coefficient)

Qualitative indicators	$\overline{t_j}$	q_j	Quantitative indicators	$\overline{t_j}$	q_j
X.1. General economical indicators			**Y.1. Indirect Economic Impacts**		
X.1.1. Stability of position in the market	4	0.32	Y.1.1. Charitable gifts as percentage of profit (%)	4	0.47
X.1.2. Collaboration with local business and local work force	4	0.36	Y.1.2. Development and impact of infrastructure investments and services provided for public benefit (in national currency)	4	0.53
X.1.3. Ethics of social responsible business	4	0.32			

Qualitative as quantitative indicators are split into occupational health and safety, human capital development, communication with stakeholders (Table 3). Percentage of employees trained in organization anti-corruption policies and procedures (S03 core indicator, GRI 2006) is not a practical indicator because there is no practice to formalize and very small risk of corruption at an enterprise level in Lithuania. Percentage of significant suppliers and contractors that have undergone screening on human rights and action (HR2 core indicator, GRI 2006) is a too complicated indicator and there is no practice to follow it through the supply chain.

Table 3 Social indicators determined by experts ($\overline{t_j}$ – significance of indicator, q_j – weighting coefficient)

Qualitative indicators	$\overline{t_j}$	q_j	Quantitative indicators	$\overline{t_j}$	q_j
X.2. Occupational health and safety			**Y.2. Occupational health and safety**		
X.2.1. Assurance of work safety	4	0.12	Y.2.1. Work safety incidents (in number)	4	0.18
			Y.2.2. Professional illnesses (in number)	4	0.18
			Y.2.3. Working hours lost through absence (number/ employee)	4	0.17
X.3. Human capital development			**Y.3. Human capital development**		
X.3.1. Encouragement of employees	4	0.11	Y.3.1. Employee turnover (%)	4	0.16
X.3.2. Development of employees qualification	4	0.12	Y.3.2. Average hours of training per year per employee (hour/ employee)	3	0.14
X.3.3. Employees' involvement into decision making	4	0.11	-		
X.3.4. Employees health care	3	0.08	-		
X.4. Communication with stakeholders			**Y.4. Communication with stakeholders**		
X.4.1. Response to clients environmental, social and economical requirements	5	0.12	Y.4.1. Number of complaints regarding environmental protection, work safety and other (number)	4	0.15
X.4.2. Response to interests of local community	5	0.14			
X.4.3. Socially responsible collaboration with international suppliers	4	0.11			
X.4.4. Communication with stakeholders	3	0.08			

Employee turnover is calculated as a number of resigned and redundant employees divided by a number employed in total. Working hours lost through absence means all unplanned reasons, such as sickness, strikes, absenteeism, etc. but not holiday or training (Institution of Chemical Engineers 2003).

Qualitative indicators are split into Ecodesign and Pollution prevention, whereas quantitative indicators groups are product responsibility and more detailed parts related to pollution prevention: use of resources, use of energy, emissions, effluents and waste and environmental costs (Table 4). Environmental costs cover pollution treatment costs (waste, wastewater, air pollutants, packaging). GRI indicator "financial implications due to climate change" (EC2 core indicator, GRI 2006) was excluded as a separate indicator because SMEs usually do not participate in the greenhouse gas trading systems. Choice of a transportation mode was removed from qualitative indicators as it can be covered under other quantitative indicators for transportation enterprises and the influence to mitigate an impact is not so big and it depends on a financial situation (if new vehicles are used).

All environmental quantitative indicators are included into the Global Reporting Initiative guidelines, except an indicator of energy sources from renewable, hazardous waste to be mentioned separately as required by EMAS (2009).

Table 4. Environmental indicators determined by experts ($\overline{t_j}$ – significance of indicator, q_j – weighting coefficient)

Qualitative indicators	$\overline{t_j}$	q_j	**Quantitative indicators**	$\overline{t_j}$	q_j
X.5. Ecodesign			**Y.5. Product Responsibility**		
X.5.1. Ecodesign issues	5	0.15	Y.5.1. Extent of impact on environment mitigation by products and services (%)	4	0.07
			Y.5.2. Share of products and services labelled or with environmental protection information provided (%)	3	0.05
			Y.5.3. Share of products and services whose health and safety impacts are assessed for improvement (%)	4	0.06
			Y.5.4. Percentage of products sold and their packaging materials that are reclaimed by category (%)	4	0.07
X.6. Pollution prevention			**Y.6. Use of Resources**		
X.6.1. Non-renewable materials substitution by renewable materials	4	0.13	Y.6.1. Materials used by weight or volume (t/ t of production)	4	0.06
			Y.6.2. Total water used (m^3/ t of production)	4	0.06
			Y.7. Use of Energy		
			Y.7.1. Direct energy consumption (kWh/ t of production)	4	0.06
X.6.2. Use of renewable energy	4	0.12	Y.7.2. Percentage energy sourced from renewables (%)	4	0.07
			Y.8. Emissions, Effluents, and Waste		
X.6.3. Waste prevention	3	0.10	Y.8.1. Total weight of waste by type and disposal method (t/ t of production)	5	0.07
X.6.4. Waste management	4	0.13	Y.8.2. Total weight of hazardous waste (t/ t of production)	4	0.06
X.6.5. Air pollution management	5	0.14	Y.8.3. Total greenhouse gas emissions by weight (t/ t of production)	4	0.07
			Y.8.4. NO_x, SO_2, and other significant air emissions by type and weight (t/ t of production)	4	0.07
			Y.8.5. Emissions of ozone-depleting substances by weight (t/ t of production)	5	0.07
X.6.6. Management of wastewater pollution	4	0.13	Y.8.6. Total wastewater discharge (m^3/ t of production)	4	0.06
			Y.8.7. Damage of environmental accidents (in national currency)	5	0.07
X.6.7. Environmental protection issues in office	4	0.11	**Y.9. Environmental costs**		
-			Y.9.1. Total environmental protection expenditures (in national currency)	3	0.05

Significance of sustainability indicators ranges from 3 (moderate significant) to 5 (very significant). The experts evaluated indicators quite significantly because they chose only important indicators and those of less importance were excluded at the beginning. Some experts suggested involving into sustainability assessment the following indicators: use of hazardous chemicals to production unit, debt and turnover ratio, etc.

Assessment according to standardized methodology can indicate only essential problems and it is the first step toward the improvement process (Gimžauskienė 2007).

5. Conclusions

1. Methodology of determining sustainability indicators of evaluating enterprises consists of systemic analysis of existing sustainability indicators systems, determination of sustainability indicators and their significance by the experts.
2. The most important 20 qualitative and 24 quantitative sustainability indicators were determined by the experts. The determined quantitative indicators should be adjusted to a particular sector or directly to an enterprise. Qualitative indicators can be used directly in any enterprise.
3. Determined indicators and their weights assigned by the experts are relevant under Lithuanian or similar economical, social and environmental conditions. To adjust indicators and weights for enterprises of developing or developed countries determination and weighting procedure by the national experts should be repeated.
4. The experts' survey has revealed that is not important to assign weights to indicators. The experts evaluated indicators quite significantly. The most important step is to determine right indicators for evaluation. If the set of essential indicators is compiled, the weighting procedure can be skipped and equal weights to indicators can be appointed.

Acknowledgements

Author of this article would like to acknowledge all experts who participated in answering questionnaires with sincere comments.

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Darnaus vystymosi rodiklių nustatymo metodika įmonėms vertinti

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(gauta 2010 m. gegužės mėn., atiduota spaudai 2010 m. birželio mėn.)

Lietuvos mažoms ir vidutinėms įmonėms reikalinga rodiklių sistema, kuri įvertintų darnų vystymąsi. Svarbu sukurti darnaus vystymosi vertinimo sistemą, kuri apimtų kokybinę (dėl sunkiai kvantifikuojamų kai kurių darnaus vystymosi aspektų) ir kiekybinę informaciją. Kadangi yra pakankamai užsienio institucijų sukurtų kokybinių ir kiekybinių rodiklių sistemų, tai svarbu išskirti, kokie darnaus vystymosi rodikliai svarbūs įmonėms Lietuvos sąlygomis. Darnaus vystymosi kiekybinių rodiklių sąrašas sudarytas išrinkus rodiklius iš darnaus vystymosi vertinimo rodiklių sistemų. Kokybinių rodiklių sąrašas sudarytas remiantis išplėtota kokybinių rodiklių sistema. Organizuota ekspertų apklausa, kurios metu iš kiekybinių ir kokybinių rodiklių rinkinių atrinkti rodikliai ir suteikti jiems svoriniai koeficientai. Norint sudarytą kokybinių ir kiekybinių rodiklių sistemą, pritaikomą įmonėms iš labai išsivysčiusių ar besivystančių šalių, turėtų būti pakartota ekspertų apklausa, kad rodikliai ir svoriniai koeficientai būtų adaptuoti šalies specifikai.