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# Sustainable Development Decision-Making Model for Small and Medium Enterprises

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Growing importance of small and medium enterprises (SMEs) and their influence on economic development of the countries demand special attention given to processes, tendencies, perspectives in them and encourage the search for the effective SME performance improvement measures.

To pursue high environmental performance, economic and social effectiveness of SMEs is a key goal of the sustainable development concept.

Taking into consideration the importance of SMEs, their dynamics, ability to innovate rapidly, also problematic issues and the need to improve competitiveness, it can be noted that to improve their environmental performance, economic and social effectiveness, the integrated, based on financial analysis, decision-making model is needed which would be oriented to strategic sustainability goals, not requiring significant time, financial and human resources, The integration of sustainability management accounting (SMA) and composite sustainable development index ($I_{CSD}$) methodologies makes the basis of sustainable development decision-making model for SMEs.

Key words: *environmental management accounting (EMA), sustainability management accounting (SMA), composite sustainable development index ($I_{CSD}$ ).*

## 1. Introduction

Development of small and medium enterprises (SMEs) is one of the priorities of the EU and Lithuanian policy. SMEs play a key role in implementing the *Lisbon Strategy* aims of encouraging development of innovation, partnership, competitiveness and employment. It is stressed in the *Long-term Strategy for Development of Lithuanian Economy to 2015* that "small and medium enterprises are one of the key factors of economic growth, with substantial impact on the overall development of the Lithuanian economy, job creation and social stability, and therefore its development is one of Lithuania's most important economic policies" (Government of the Republic of Lithuania 2002). In Lithuania, as in the other EU countries, more than 99% of all operating companies are classified as SMEs creating about 60% of total value added (VAT), and employing more than 70% of the total workforce. Although individual SMEs impact on the environment may be minimal, but the total emissions of SMEs in the EU account for 70% of the total industrial pollution.

SMEs are the basis of socio-economic well-being and ensure continuous employment. An increased number of SMEs give impetus to the economic growth through intensified competition. Permanent change is an essential feature of SMEs. Due to the constantly changing business environment, companies wishing to survive and continue their activities must be flexible, dynamic and open. Only an adequate response to environmental changes, an anticipation of these changes may ensure the continuity of business (Lithuanian Department of Statistics 2007), therefore contesting for the market the companies are forced to seek new solutions and niches.

Under competitive conditions, in order to improve their performance and to sustain and expand the market, SMEs should inevitably follow the *sustainable and long-term development principles* (Ministry of Economy 2007) and to apply integrated measures to increase SME sustainability - economic, environmental and social performance.

## 2. Necessity of sustainability decision-making model for SMEs

At the beginning of 2008 in Lithuania there functioned 63,561 companies, 63,187 of them (99.4%) were SMEs. That number accounted for 75% of micro firms, 20% of small and only 5% of medium. Most micro-enterprises operate in the services sector. SMEs dominate the wholesale and retail trade (at the beginning of 2008 - 22,247 firms), real estate, rental activities (at the beginning of 2008 - 11,684 firms), manufacturing (at the beginning of 2008 - 7807 companies) and construction, transport and storage sectors.

The highest VAT is also created by wholesale and retail trade, manufacturing and real estate activities in the SME sector. In 2001-2005 SMEs VAT increased steadily, faster growth occurred in 2005-2006 (42% compared to the last year). The highest VAT of SMEs is created by medium-sized enterprises (50-249 employees), with a slight lag behind small businesses (9-49 employees), VAT created by micro enterprises (1-9 employees) is the lowest, although there are the largest number of micro enterprises in the SMEs sector. SMEs create about 60% of VAT of all Lithuanian companies operating.

In Lithuania in 2000-2006 about 70% of all employees were employed in SMEs, and staff costs accounted for about 60% of all Lithuanian companies staff costs.

In 2006 SMEs export accounted for almost 60% of all Lithuanian companies export, the import - 47%. The largest share of export and import is related to medium-sized businesses. In 2005-2006 SMEs export increased by 31%, while import - by 27%. In the case of large companies –by 14% and 6%, respectively.

*Manufacturing* is the most important VAT creating (22%) Lithuanian economy sector, it provides a major share (60%) of the country's export. (Ministry of Economy 2009). SMEs in the total number of manufacturing companies represent around 97%. In 2008 SMEs represented the number of 7807 enterprises out of 8137 of the total manufacturing enterprises. More than half of these enterprises were micro-sized companies, 33% - small and 12% - medium-sized enterprises. In 2006 compared to 2002, the total manufacturing businesses VAT grew more than 100%, while the manufacturing SMEs VAT grew even 1.3 times. SMEs VAT in 2000-2006 accounted for about 60% of all manufacturing enterprises created value.

In 2005-2006 manufacturing SMEs export accounted for more than a half of all manufacturing industry export, import - about 46%, manufacturing industry SMEs were employing 70% of all employees in manufacturing industries.

Manufacturing sector SMEs dominate in wood and wood and cork products, paper and paper products manufacturing industry (in 2006 – 1 641), textiles (1 158), food and beverage industry (1 105), furniture (822), and publishing industry (816). The biggest VAT is also created by food and beverage, textiles, wood, cork and their products, paper and paper products manufacturing, furniture manufacturing industry.

Most of sustainable development-related research works focus on large companies rather than SMEs, especially in the industrial sector. The importance of SMEs often remains unnoticed for several reasons. The first - environmental impacts of large firms are more visible. It is easier to see, measure, interpret and evaluate the impact of large enterprises. The second reason - nature and structure of the SME sector. Most of these enterprises are very small, as well as their impact on the environment. Their individual, for example, waste generation and energy consumption levels may be very low. In addition, many SMEs (particularly in developed countries) are operating in the service sector, and have no obvious "polluting" industrial practices. Therefore, at first sight, it seems that SMEs are causing little or no impact on the environment (Julien Labonne 2006). However, this assumption is not correct - like large enterprises, SMEs have a significant impact on the environment, but the maximum impact may be caused not by the activity of individual companies (with exceptions), but by the total number of SMEs operating in all sectors. The study performed in the UK has stated that 60% of carbon dioxide emissions of the total national economic activity are generated by SMEs and the conclusions are presented about the need to increase energy efficiency and reduce emissions from SMEs. A study in the Netherlands stresses that SMEs generate about 50% of all commercial and industrial waste. These studies confirm the fact that small and medium businesses have a significant impact on the environment (European Commission 2007).

Thus, the impact on the environment of individual SMEs may be minimal, especially if it is a service sector micro-enterprise, but it should be noted that since SMEs sector involves enterprises of different sizes, in many aspects (also related to the impact on the environment) a medium-sized enterprise is more comparable to a large company than small or micro-sized, especially in the manufacturing sector. Therefore, the biggest environmental impact is caused by SMEs of the following manufacturing sectors: metal manufacturing, textile, plastics, wood and furniture manufacturing, publishing, electronics, food and beverage industry as well as chemicals and chemical products manufacturing SMEs.

The problem lies in the fact that SMEs often have inadequate knowledge about their environmental impacts and management in this area and are not familiar with environmental legislation and obligations assigned to them (European Commission 2007). This often results in the situation when SME does not implement any practical measures to reduce an environmental impact.

Numerous scientific works concerning development of sustainable management, efficiency and innovation are also more focused on large companies and the industry level, but not on the SME sector (Julien Labonne 2006). SMEs develop preventive voluntary environmental improvement programs significantly less than large companies and they also less frequently adapt environmental policies, introduce a formal environmental management system, carry out environmental audits, or implement other sustainable development and environmental performance evaluation and improvement measures.

However, in Lithuania there is an increasing number of SMEs implementing the measures of sustainable industrial development, nevertheless most companies being limited to the Cleaner Production and Environmental Management System (EMS), "EMAS-Easy" and the Quality Management Systems tools. The application of other measures, such as product-oriented measures of sustainable industrial development, sustainability cost accounting and sustainability reporting tools, capable of increasing the company's economic efficiency, environmental and social performance is only at the initial stage (Christine Jasch, Žaneta Stasiškienė 2005)

The last decade saw an increased pressure on broadening accountability of large and also small and medium companies beyond economic performance for shareholders, on sustainability performance for all stakeholders. The concept of business or corporate sustainability has therefore grown in recognition and importance. 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’’. Business sustainability entails incorporation of the objectives of sustainable development, namely, social equity, economic efficiency and environmental performance, into the company’s operational practices. Companies that compete globally are increasingly required to commit to and report on the overall sustainability performances of operational initiatives (Carin Labuschagne, Alan C. Brent 2004). The key sustainable development decision-making promoting factors in SMEs are as follows:

- pursuit of competitive advantage,
- supply chain pressure,
- legal requirements and obligations,
- international standards,
- demand for voluntary reporting (Janet Ranganathan 1998)

Methodologies used for measuring sustainability (involving sustainability of environmental, social and economic domains, both individual and in various combinations) are still evolving: they include indicators, indices, benchmarks, audits, cost accounting, as well as assessment and reporting systems.

The profit is a key business activity driver. Regardless of what goals or ideals company executives and other employees uphold, survival of the business and positive economic indicators are fundamental principles of any profit-making enterprise (Ministry of Economy 2008). For most companies to have an interest in sustainable development there needs to be an expected financial benefit.The main task when making right decisions in the company is to ensure that all relevant costs are taken into account (United Nations Division for Sustainable Development 2001).

Economic and financial indicators are a well understood business “language” which, if expressing sustainable development aspects of the company, would let achieve promising results. Therefore, SMEs need a relatively simple, easily adapted, flexible decision-making model expressing sustainable development aspects (economic, environmental and social) through financial indicators.

## 3. Sustainable development decision-making model for SMEs. Model application to brewing company

Sustainability management accounting (SMA) and composite sustainable development index - $I_{CSD}$ (D. Krajnc, P. Glavič) methodologies were chosen as very promising tools for sustainable decision making in SMEs. The integration of these methodologies makes the basis of a sustainable development decision-making model for SMEs (see Fig. 1).

SMA is a most evolved form of environmental management accounting (EMA). EMA is a joint evaluation method, enabling companies to increase material efficiency, reduce environmental impacts and risks, and reduce environmental costs due to the financial accounting and cost accounting data transmission. The evaluation method combines both financial and physical data of a company (United Nations Division for Sustainable Development 2001) (M. Bennett, J.J. Bouma, T. Wolters 2002).

EMA information encourages the search for more efficient approaches of energy and materials use, allows effective monitoring and management of the pollutants generation. Due to EMA, environmental costs are more accurately identified, evaluated, distributed and controlled and more detailed information is provided for assessing environmental performance and preparing the report (Rikhardsson, P. M., M. Bennett 2005). In this way, the company improves the internal decision-making process and its image in the eyes of stakeholders (customers, employees, government, etc.).

The cost categories are evaluated using EMA:

- Emission and waste treatment cost;
- Prevention and environmental management cost;
- Material purchase value of non product output;
- Processing costs of non product output;
- Environmental earnings.

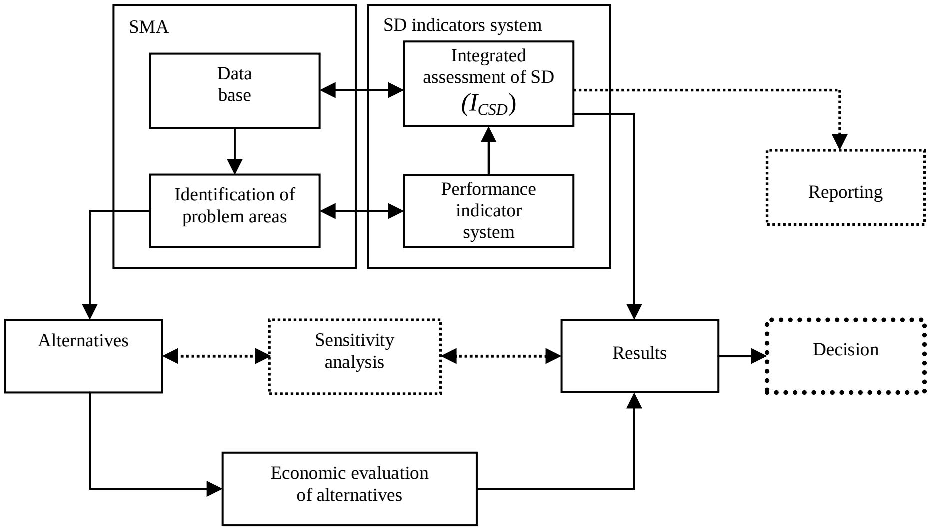


*Fig. 1. Sustainable development decision-making model structure for SMEs*

*Material purchase value of non product output* is a specific category of costs that are not evaluated by other methods. The non product output, i.e., material turned into emissions and waste, is an indicator of inefficient production. The material purchase cost of wasted materials is the most important environmental cost factor, accounting for 40 to 90 % of the total environmental costs, depending on the value of raw materials and the labour intensity of the sector (M. Bennett, P.M. Rikhardsson and S. Schaltegger 2003).

SMA is enlargement of EMA incorporating the costs of social performance – treatment of undesired effects, prevention and sustainability management cost and sustainability earnings. *Health and Safety* are two very important social cost aspects in SMEs. *Training and education* also constitute a significant social cost factor. *Human rights* and *Diversity and opportunity* do not make up any significant costs in Lithuanian SMEs, as well as *Society* and *Product Responsibility* costs (Christine Jasch, Alexander Lavicka 2005). Main benefits are more accurate data and better arguments for investment appraisal or performance indicators as well as improved consistency of information and management systems that should help them improve their environmental, social and economic performance (Christine Jasch, Alexander Lavicka 2005). The two major cost drivers are purchase costs of non-product output and costs related to lost working days because of sick leave and accidents and an overtime pay to make up for these lost working days. The cost assessment scheme makes it possible to understand better the relationships between the costs for treatment of undesired effects due to unimplemented protection measures and for lost material purchase value in comparison to the prevention costs (Christine Jasch, Žaneta Stasiškienė 2005).

SMA enables companies to identify their key sustainable development problems based on financial indicators. Depending on the available information, comparative analysis of non product output and technological norms or the Best Available Technologies (BAT) are carried out with the purpose to assure relevance and validity of the problems.

With regard to the company key issues/problems, identified when implementing SMA, sustainability performance indicators are selected.

These indicators are quantification of current company's sustainability problems to promote decision-making and enable the company the periodical monitoring of the changes in this field. However, these indicators do not reflect the overall enterprise sustainability, since they include only problematic aspects. These performance indicators might be sufficient to the internal decision-making, but to determine the effectiveness of overall sustainable development, to provide sustainability reports, a larger set of indicators is necessary. For this purpose, the composite sustainable development index ($I_{CSD}$) methodology is integrated into a sustainability decision making model.

The main purpose of $I_{CSD}$ is communication with stakeholders and raising the sustainability reporting level (Damjan Krajnc, Peter Glavič 2004). Methodology of composite sustainable development index calculation consists of several stages:

- Selection of indicators,
- Normalization of indicator,
- Weighing of indicators (using AHP),
- Calculation of sub-indices,
- Combining sub-indices into ICSD.

SMEs are suggested to use 5-15 indicators from each economic, social and environmental indicator group. Main problem of aggregating indicators into $I_{CSD}$ is the fact that indicators may be expressed in different units. One way to solve this problem could be normalization of indicators. One of the possible options for normalization of indicators could be normalization of each indicator *i* by dividing its value in time *t* with its target value determined by realistic assessment of unexploited potentials of the company (Damjan Krajnc, Peter Glavič 2004). Another step requires *pair-wise comparisons (weighing)* to be made between each pair of indicators. The comparisons are made by posing the question which of the two indicators *i* and *j* is more important with respect to SD of the company, respectively. The intensity of preference is expressed on a factor scale from 1 to 9.

Sustainability *sub-indices* are calculated using formula (1) (Damjan Krajnc, Peter Glavič 2004):

$$I_{S,j} = \sum_{ji}^{n} W_{ji} \cdot I_{N,ji} \qquad (1)$$

$$\sum_{ji}^{n} W_{ji} = 1, \; W_{ji} \geq 0,$$

where

$I_{S,j}$ - sustainability sub-index for a group of indicators (economic, *j* = 1, environmental, *j* = 2, social, *j* = 3);

$W_{ji}$ - weight of indicator *i* for the group of sustainability indicators *j* and reflects the importance of this indicator in the sustainability assessment of the company.

Sustainability sub-indices are combined into composite sustainable development index $I_{CSD}$ using formula (2) (Damjan Krajnc, Peter Glavič 2004):

$$I_{CSD} = \sum_{j}^{n} W_j \cdot I_{S,j} \qquad (2)$$

Once the fundamental issues/problems of sustainable development are defined and a comprehensive indicator system is developed, the following important step toward a sustainable development decision-making model is taken – the search for alternatives and their economic evaluation. In search for alternatives to solve the problem it is useful to rely on the BAT information.

Economic evaluation can be performed using the following profitability indicators:

- Payback period (PP),
- Net Present Value (NPV,)
- Internal rate of return (IRR).

Payback period (PP) is the simplest and most approximate investment evaluation method used mainly in small and medium-sized enterprises. It is the investment and resulting annual savings ratio. The payback period is calculated under formula:

$$n_y = K/R \qquad (3);$$

where

$n_y$ - payback period,

*K* - investment,

*R* – annual net income.

*Net Present Value (NPV)* is widely used as an economic project viability assessment method. Calculating NPV the value of money decrease is measured over time. The assessment of monetary value decline is very important when the long-term projects are evaluated. Decline in value of money over time is also called *discount* (Vytis Kopustinskas, Robertas Alzbutas 2007). Frequently the discount is considered at the time prevailing interest-rate offered by sound banks, also considering the inflation rate. NPV is calculated under formula:

$$NPV = CF_0 + CF_1/(1 + i)^1 + CF_2/(1 + i)^2 + \ldots + CF_n/(1 + i)^n \qquad (4);$$

where:

$CF_{0\ldots}CF_n$ – cash flows from the initial investment to last cash flows, i – discount rate.

On the basis of NPV, the following decision-making rule is considered:

- investment would add the value to the company and the project may be accepted, if NPV > 0,
- investment would subtract the value from the company, the project should be rejected, if NPV < 0,
- investment would neither gain nor lose the value for the company, if NPV = 0.

In some cases, the investing company finds it difficult to assess the cost of the capital for the investment, i.e. there are several credit sources, loan terms are not clear and so on. In such cases, it is impossible to calculate NPV, and instead of it the company often uses the internal rate of return (IRR). (Vytis Kopustinskas, Robertas Alzbutas 2007). The *Internal Rate of Return (IRR)* is the discount rate at which the net present value is equal to zero. IRR is calculated under formula:

$$\Sigma^n{}_{t=0} (CF_t /(1 + i)^t)) = 0 \qquad (5)$$

After economic evaluation of the alternatives of a sustainability decision-making model, sensitivity analysis may be performed. Sensitivity analysis is performed by varying the initial assumptions and observing the changes in the net present value and other criteria. The investment would be risky if the cost issue in a small change leads to significant changes in the criteria. The essence of sensitivity analysis lies in the basic variable change, when the others stay stable (M.V. Biezma and J.R. San Cristóbal 2005). *Sensitivity analysis* is needed to evaluate the risks of the investment project. Sensitivity analysis is a tool for testing robustness of findings to inherent uncertainties and the need for assumptions. The idea is to simply replace unknown or uncertain parameters with alternative values drawn from a plausible distribution (Matthew J. Kotchen 2010). Sensitivity analysis includes the following steps:

- Selection of a key indicator, i.e., the parameter which is the target of sensitivity analysis. Such indicators may be an internal rate of return and /or net present value;
- Choice of the variables whose effect on a key indicator is to clarify in particular the parameters whose values may vary in a wide range;
- Calculation of a key indicator for a given range of model parameters.

The last step of the sustainable development decision-making model is implementation of a selected alternative or alternatives, taking into ac+count the economic evaluation of alternatives, risk assessment, i.e., sensitivity analysis, and results of the composite sustainable development index ($I_{CSD}$) methodology.

Sustainable development decision-making model was applied to the medium-sized (210 employees) Lithuanian brewing company *"gate-to-gate"*, targeted year – 2008. Other specific data are shown in Table 1.

*Table 1. Data of Lithuanian brewing company*

| | |
|---|---|
| **Activity** | Beer production |
| **Industry** | Food and beverages |
| **Number of employees** | 210 (medium -sized) |
| **Targeted year** | 2008 |
| **Annual turnover, euro** | 15,9 million |
| **Environmental Management System** | implementation stage |
| **Corporate Social Responsibility** | - |
| **Sustainability Reporting** | - |

*Table 2. Total sustainability costs (%) in Lithuanian brewing company*

| **Sustainability media** | **Air and climate** | **Waste water** | **Waste** | **Other** | **Health** | **Safety** | **Society** | **Product Responsibility** | **Total** |
|---|---|---|---|---|---|---|---|---|---|
| **Sustainability cost categories** | | | | | | | | | |
| **1. Treatment of undesired effects** | **0.6** | **6.5** | **2.2** | **0.1** | **3.1** | | | | **12.5** |
| 1.1. Depreciation of related equipment | 0.0 | | | | | | | | 0.0 |
| 1.2. Maintenance, operating materials and services | 0.2 | 0.2 | 0.2 | | | | | | 0.6 |
| 1.3. Related personnel | 0.3 | 0.1 | 0.4 | | 3.1 | | | | 3.9 |
| 1.4. Fees, Taxes, charges | 0.1 | 6.2 | 1.7 | 0.1 | | | | | 8.1 |
| 1.5. Fines and Penalties | | | | | | | | | |
| 1.6. Insurance of environmental and social liabilities | | | | | | | | | |
| 1.7. Provisions of clean up costs, remediation and accidents | | | | | | | | | |
| **2. Prevention and sustainability management** | **0.9** | **0.9** | **0.8** | | **0.2** | **14.9** | | | **17.7** |
| 2.1.External services for sustainability management | 0.0 | 0.1 | | | | 2.5 | | | 2.6 |
| 2.2. Personnel for general sustainability management activities | 0.8 | 0.8 | 0.8 | | | 0.9 | | | 3.4 |
| 2.3. Research and Development | | | | | | | | | |
| 2.4. Extra expenditure for IPPC technologies, safety equipment and personal safety | | | | | | 11.5 | | | 11.5 |
| 2.5. Other sustainability management costs | | | | | 0.2 | | | | 0.2 |
| **3. Material purchase value of non product output** | **22.5** | **8.2** | **25.5** | | | | | | **56.2** |
| 3.1. Raw Materials | | 0.5 | 10.1 | | | | | | 10.6 |
| 3.2. Packaging Materials | | | 1.5 | | | | | | 1.5 |
| 3.3. Auxiliary Materials | | 1.5 | 0.7 | | | | | | 2.2 |
| 3.4. Operating Materials | 7.2 | | 13.2 | | | | | | 20.4 |
| 3.5. Energy | 15.3 | | | | | | | | 15.3 |
| 3.6. Water | | 6.3 | | | | | | | 6.3 |
| **4. Processing costs of non product output** | | **7.2** | **7.2** | | | | | | **14.4** |
| ***Total sustainability costs*** | **24.0** | **22.9** | **35.7** | **0.1** | **3.3** | **14.9** | | | **100.9** |
| **5. Sustainability earnings** | | | **-0.9** | | | | | | **-0.9** |
| 5.1. Subsidies, Awards | | | | | | | | | |
| 5.2. Insurance payments | | | | | | | | | |
| 5.3. Other earnings | | | -0.9 | | | | | | -0.9 |
| ***Total sustainability earnings*** | | | **-0.9** | | | | | | **-0.9** |
| | | | | | | | | | |
| ***Saldo Costs/Earnings*** | **24.0** | **22.9** | **34.9** | **0.1** | **3.3** | **14.9** | | | **1000** |

Results of sustainability management accounting in brewing company (see Table 2):

- Total sustainability costs of the brewing company amounted to 550 922 euro in 2008, 450 522 euro (82 %) of which were environmental costs, 100 400 euro (18 %) – social costs.
- Before the application of SMA, only environmental taxes were considered as environmental costs in the company, they amounted to 9 % of the total real environmental costs.
- For the treatment of undesired effects in 2008 the company paid 68 945 euro, for the prevention and sustainability management – 97 564 euro, material purchase value of non product output amounted to 309 808 euro, processing costs of non product output – 79 383 euro, sustainability earnings amounted to 4 779 euro.
- Distribution of environmental costs under cost categories in the brewing company:
    - treatment of undesired effects 11.5 %;
    - prevention and sustainability management – 3.2 %;
    - material purchase value of non product output – 68.8 %;
    - processing costs of non product output – 17.6 %.
    - environmental earnings – 1.1 %.
- Distribution of social costs under cost categories in the brewing company:
    - treatment of undesired effects – 17.1 %;
    - prevention and sustainability management – 82.9 %.
- In 2008 social prevention and sustainability management costs were significantly higher (83 228 euro) than the costs for the prevention of the environment (14 336 euro). Since the investment into preventive measures reduces the costs of both undesired effects treatment and material non product output abundantly, it can be concluded that sufficient attention has not been paid to the prevention of the environment in 2008 m.
- Environmental air and climate costs amounted to 132 015 euro (24 %) in 2008, waste water costs to 125 968 euro (22.9 %), waste costs to 192 105 euro (34.9 %). Social health costs amounted to 18 452 euro (3.3 %), safety costs to 81 948 euro (14.9 %).

*Table 3. Economic, environmental and social indicators in brewing company*

| | Symbol | Units | Value |
|---|---|---|---|
| **Economic indicators $I_{A,1i}$** | | | |
| Sales | S | MEUR* | 15.9 |
| Operating profit | $P_O$ | MEUR | 1.19 |
| Net earnings | $E_N$ | MEUR | 0.96 |
| Research and development costs | $C_R$ | MEUR | 0.75 |
| Number of employees | $S_D$ | 1 | 210 |
| **Environmental indicators $I_{A,2i}$** | | | |
| Electric energy consumption per UP** | $E_E$ | kWh/hl | 10.44 |
| Gas consumption per UP | $E_{gas}$ | $m^3$/ hl | 2.83 |
| Fuel consumption per UP | $E_{fuel}$ | ltr/ hl | 1.89 |
| Water consumption per UP | $V_{water}$ | $m^3$/ hl | 0.16 |
| Production mass | $m_{prod}$ | hl | 344 800 |
| $CO_2$ emissions per UP | $m_{CO2}$ | kg/ hl | 0.024 |
| $NO_X$ emissions per UP | $m_{NOx}$ | kg/ hl | 0.007 |
| $SO_2$ emissions per UP | $m_{SO2}$ | kg/ hl | 0.0002 |
| Dust emissions per UP | $m_{dust}$ | kg/ hl | 0.001 |
| Heavy metals emissions per UP | $m_{hm,tot}$ | kg/hl | 0.00004 |
| Wastewater per UP | $V_{wstwater}$ | $m^3$/hl | 0.055 |
| Waste per UP | $m_{wst,tot}$ | kg/hl | 1.26 |
| Hazardous waste per UP | $m_{wst,hazard}$ | kg/hl | 0.0002 |
| **Social indicators $I_{A,3i}$** | | | |
| Number of serious occupational accidents*** | $N_{ac,ser}$ | 1 | - |
| Number of accidents during typical production activities | $N_{ac,act}$ | 1 | 2 |
| Number of sick leave days /number of employees | $N_{sick\ d}$ | days num./ employees num. | 3.5 |
| Number of non-profit projects | $N_{proj}$ | 1 | - |
| Number of complaints due to odour | $N_{c,odor}$ | 1 | 1 |
| Number of complaints due to noise | $N_{c,noise}$ | 1 | 2 |
| Number of complaints due to dust | $N_{c,dust}$ | 1 | - |
| Number of improvement measures initiated | $N_{impr}$ | 1 | 2 |

* MEUR – million euro
** UP – unit of production (hl)
*** More than 50 days absence from work

With reference to SMA results and comparison with BAT, the key sustainable development problems of the company are identified:

Problem 1: high water consumption and waste water (BAT - 4 - 10hl/1 hl beer, in our case – 15.5 hl/1 hl beer). High water consumption and waste water during the washing process of the plant.

Problem 2: high electrical energy consumption (BAT – 8.1 – 10.6 kWh/hl beer, in our case – 10.4 kWh/hl beer). It can be stated that electrical energy consumption satisfies BAT norms, though it was noticed that the lighting system in production departments is insufficiently effective.

Problem 3: high heat energy consumption (BAT – 22.44 – 67.50 kWh/hl beer, in our case – 22.33 kWh/hl beer). Therefore heat energy consumption satisfies BAT norms, though from the technological point of view a heat energy saving potential has been noticed, provided waste water heat were used.

When calculating a composite sustainable index in the brewing company, to avoid time and cost consuming for collecting a huge amount of data, a limit of 5-15 sustainability indicators was set in each sustainable development perspective. In our case, 5 key economic, 13 environmental and 8 social indicators were chosen. (see Table 3).

Indicators were weighted (using AHP) and normalized to calculate economic, environmental, social sub-indices and finally - composite sustainable index ($I_{CSD}$). The results are presented in Table 4.

*Table 4. Economic, environmental, social sub-indices and composite sustainable index ($I_{CSD}$) in the brewing company*

| **Indices** | **Symbol** | **Value** |
|---|---|---|
| Economic | $I_{S,1}$ | 0.644 |
| Environmental | $I_{S,2}$ | 0.483 |
| Social | $I_{S,3}$ | 0.559 |
| **Sustainability** | $\mathbf{I_{CSD}}$ | **0.562** |

When the index value is closer to 1, efficiency of the company in sustainable development is higher. It should be also noted that there should be the balance among three sustainable development indices – economic, environmental and social for making correct conclusions of sustainability performance in the company. In our case, composite sustainable index value is **0.562**. It could be stated that the company is in the midway of implementing the sustainable development goals. It should be noted, however that the value of environmental sub-index is lower compared to the economic and social sub-indices. SMA has also proved that the situation of social performance is better if compared to the environmental performance.

Once the key issues of sustainable development are identified and the comprehensive indicator system developed, the other important step towards a sustainable development decision-making model is identification of alternatives and their economic evaluation. In our case, by means of economic evaluation and sensitivity analysis three main alternatives to be implemented are selected:

1) water reuse,
2) reconstruction of the lighting system,
3) heat energy recovery.

A detailed process of economic evaluation and sensitivity analysis of one of the selected alternatives - reconstruction of the lighting system is presented below.

In Table 5 the investment (the amount of items and related market prices) is presented for implementing the alternative. Reconstruction of a lighting system requires 17 642 EUR investment. Its biggest part is taken by fixture costs - 11 550 euro

*Table 5. Investment for reconstruction of the lighting system in the brewing company*

| **Investment** | | | |
|---|---|---|---|
| **Item** | **Amount** | **Price, EUR** | **Sum, EUR** |
| Fixtures | 700 | 16.50 | 11 550 |
| Lamps | 1400 (40W) | 0.87 | 1 218 |
| Throttles | 1400 | 3.16 | 4 419 |
| Wires | 700 | 0.65 | 455 |
| **Total:** | | | **17 642** |

*Table 6. Annual savings after reconstruction of the lighting system in the brewing company*

| | Input before project implementation | | | Input after project implementation | | | Savings | |
|---|---|---|---|---|---|---|---|---|
| | unit/year | Lt/unit | Lt/year | unit/year | Lt/unit | Lt/year | unit/year | Lt/year |
| Number of fixtures | 750 | - | - | 700 | - | - | - | - |
| Number of fluorescent lamps | 1 500 (58W) | - | - | 1 400 (40W) | - | - | - | - |
| Number of lamp replacement | 300 | 1.19 | 357 | 140 | 0.87 | 121.80 | 160 | 235.20 |
| Disposal of used fluorescent lamps | 300 | 0.26 | 78 | 140 | 0.26 | 36.40 | 160 | 41.60 |
| El. E consumption | 343 824 kWh | 0.05 | 17 191.20 | 221 312 kWh | 0.05 | 11 065.60 | 122 512 | 6 125.60 |
| **Total:** | | | 17 626.20 | | | 11 223.80 | | **6 402.40** |

Table 6 presents annual savings in the case of alternative implementation. Having introduced the reconstruction project of the lighting system in the brewing company, electrical energy consumption compared to the other inputs would be significantly reduced (36 % or 22 052 LT per year).

Calculation of Payback period (PP):

$n_y = K/R$
$n_y = 17642,00/6402.40 = 2.75$ year

Since the payback period is almost 3 years, it is advisable to calculate Net Present Value (NPV):

$$NPV = CF_0 + CF_1/(1 + i)^1 + CF_2/(1 + i)^2 +\ldots + CF_n/(1 + i)^n ;$$

where
$CF_{0\ldots}CF_n$ – cash flows from the initial investment to the last cash flows, i – discount rate.

In the case of 10 % discount rate, *Net Present Value* is relatively high (see Table 7) considering the investment choice.

*Table 7. NPV calculation (with the discount rate of 10 %) in the brewing company*

| Year | Cash flow, EUR | Discount rate (10 %) | Discounted cash flow, EUR |
|---|---|---|---|
| 1 | -60 921 | 1.0000 | -17 644 |
| 2 | 6 663.45 | 0.9091 | 6 058 |
| 3 | 6 663.45 | 0.8265 | 5 507 |
| 4 | 6 663.45 | 0.7513 | 5 006 |
| 5 | 6 663.45 | 0.6830 | 4 551 |
| | | **NPV** | **3 478** |

Internal Rate of Return (IRR) is calculated under formula:

$$\Sigma^n_{\ t=0} (CF_t /(1 + i)^t)) = 0$$

At that point, where Net Present Value is equal to zero, the discount rate is equal to Internal Rate of Return. In our case IRR is equal to 0.188 or 18.8 %.

In sensitivity analysis, NPV is chosen as a key indicator and electrical energy costs are chosen as key variables, while the other variables stay stable, since electrical energy consumption has the major impact on the project (alternative) payback period and also electrical energy costs tend to vary (to grow).

Three variations for the evaluation were chosen: pessimistic (15 % growth), realistic (10 % growth) and optimistic (5 % growth).

*Table 8. Impact of the variable on the key indicator - NPV (when discount rate is 10%)*

| **Variation** | **Pessimistic** | **Realistic** | **Optimistic** |
|---|---|---|---|
| Annual growth in electricity prices | 15 % | 10 % | 5 % |
| Net present value - NPV (EUR) | -2 150 | -321 | 773 |

Table 8 presents the influence of the variable (electricity prices) to the key indicator – *Net Present Value*. In our case, before sensitivity analysis, *NPV* amounted to 3 478 euro. After sensitivity analysis, in the case of pessimistic and realistic variations, NPV was negative, and optimistic variantion amounted to *NPV* of 773 euro.

## 4. Conclusions

1. SMEs are seeking a relatively simple, easily adapted, flexible decision-making model, expressing sustainable development aspects through financial indicators. Sustainability management accounting (SMA) and composite sustainable development index ($I_{CSD}$) methodologies being very promising tools for sustainable decision making in SMEs fill this gap.
2. Applying SMA to the medium-sized brewing company, it is identified that total sustainability costs amount to 550 922 EUR, 450 522 EUR (82 %) of which are environmental costs, 100 400 EUR (18 %) – social costs. Therefore, social prevention and sustainability management costs are significantly higher (83 228 EUR) than the costs for the environment prevention (14 336 EUR). Since investment into preventive measures reduces the costs of both treatment of undesired effects and material non product output abundantly, it can be concluded that the company has not paid sufficient attention to the environment prevention in 2008.
3. Main sustainability problems based on financial indicators identified in the brewing company are related to the environmental perspective of sustainable development i.e. big water, electrical energy, heat energy consumption and large quantities of waste water,
4. Composite sustainable development index ($I_{CSD}$) of the brewing company is 0.562, consisting of 0.644 economic sub-index, 0.483 environmental sub-index and 0.559 social sub-index values. It shows that the company is in the midway of sustainable development goals implementation. The key issue and problematic area is environmental performance with the sub-index value of 48 %. It supports the results of SMA and it may be also used for reporting purposes.
5. Application of a sustainable development decision-making model enables companies to identify key sustainability problems and to find the solutions of improving their sustainability performance. In the brewing company, to solve three key problems of sustainability three alternatives: water reuse, reconstruction of the lighting system and heat energy recovery have been selected to improve its environmental performance.

## References

European Commission. Small, clean and competitive. Executive summary of the impact assessment, 2007.

Carin Labuschagne, Alan C. Brent, Ron P.G. van Erck. Assessing the sustainability performances of industrines. Journal of Cleaner Production, 2004

Christine Jasch , Alexander Lavicka. Pilot project on sustainability management accounting with the Styrian automobile cluster, 2005

Christine Jasch, Žaneta Stasiškienė. From Environmental Management Accounting to Sustainability Management Accounting, 2005.

Damjan Krajnc, Peter Glavič. A model for integrated assessment of sustainable development, 2004.

Government of the Republic of Lithuania (2002). Long-term Strategy for Development of Lithuanian Economy to 2015, Vilnius.

Janet Ranganathan. Sustainability Rulers: Measuring Corporate Environmental and Social Performance, 1998.

Julien Labonne. A Comparative Analysis of the Environmental Management, Performance and Innovation of SMEs and Larger Firms based on the OECD database, 2006.

Lithuanian Department of Statistics (2007). SME Business Success Factors, 2007.

Matthew J. Kotchen. Cost-Benefit Analysis, 2010

Ministry of Economy of the Republic of Lithuania (2007). Business social initiatives analysis: benefits, costs, impact on business and society. Report of applied scientific research, Vilnius.

Ministry of Economy of the Republic of Lithuania (2008). Corporate sustainable industrial development (including the assessment of greenhouse gas emissions) effectiveness system and methodology development. Report of applied scientific research, Vilnius.

M. Bennett, J.J. Bouma, T. Wolters. Environmental management accounting: Informational and Institutional Developments. Dordrecht/Boston/London, 2002.

M. Bennett, P.M. Rikhardsson and S. Schaltegger Environmental Management Accounting – Purpose and Progress, 2003.

Ministry of Economy of the Republic of Lithuania (2009). Plan for Stimulation of Economy, Vilnius.

M.V. Biezma and J.R. San Cristóbal. Investment criteria for the selection of cogeneration plants—a state of the art review, 2005.

Rikhardsson, P. M., M. Bennett, J. J. Bouma and S. Schaltegger, Eds.Implementing Environmental Management Accounting: Status and Challenges. Springer, NY, 2005.

United Nations Division for Sustainable Development. Environmental Management Accounting Procedures and Principles, 2001.

Vytis Kopustinskas, Robertas Alzbutas, Juozas Augutis. Statistical Methods of Uncertainty and Sensitivity Analysis for Mathematical Model Output, 2007.

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# Mažų ir vidutinių įmonių darnios plėtros sprendimų priėmimo modelis

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Vis didėjanti mažų ir vidutinių įmonių (MVĮ) svarba ir jų įtaka ekonominiam šalių vystymuisi lemia ypatingą dėmesį MVĮ plėtros procesams, tendencijoms, perspektyvoms ir skatina ieškoti efektyvių MVĮ sektoriaus veiksmingumo didinimo būdų. Siekti didelio įmonių (ir MVĮ), aplinkos apsaugos veiksmingumo, ekonominio ir socialinio efektyvumo yra pagrindinis darnios plėtros koncepcijos tikslas. Darni plėtra remiasi prevencinės vadybos principais, jų taikymas pramonės MVĮ veikloje tampa svarbiu konkurencingumo didinimo veiksniu.

Siekiant padidinti įmonių aplinkos apsaugos veiksmingumą, ekonominį ir socialinį efektyvumą, yra reikalingos integruotos darnios pramonės plėtros priemonės, leidžiančios priimti tinkamus sprendimus įmonėse, išsilaikyti ir konkuruoti rinkoje. Atsižvelgiant į MVĮ svarbą, lankstumą, dinamiką, gebėjimą sparčiai diegti inovacijas, jų problematiką ir konkurencingumo didinimo poreikį, galima teigti, jog šių įmonių aplinkos apsaugos veiksmingumo, ekonominio ir socialinio efektyvumo didinimui siekti yra reikalingas integruotas finansine analize paremtas darnios plėtros sprendimų priėmimo modelis, orientuotas į MVĮ strateginius darnumo tikslus, užtikrinantis nuolatinį gerinimą ir nereikalaujantis didelių laiko, finansinių resursų bei žmogiškųjų išteklių. Darnios vadybos kaštų vertinimo (DVKV) ir sudėtinio darnios plėtros indekso ($I_{CSD}$) metodikų integravimas sudaro darnios plėtros sprendimų priėmimo modelio pagrindą.