ASTA LAURINKEVIČIŪTĖ

SUSTAINABLE DEVELOPMENT DECISION-MAKING MODEL FOR SMALL AND MEDIUM ENTERPRISES

SUMMARY OF DOCTORAL DISSERTATION

TECHNOLOGICAL SCIENCES, ENVIRONMENTAL ENGINEERING (04T)

Kaunas
2015

KAUNAS UNIVERSITY OF TECHNOLOGY
ALEKSANDRAS STULGINSKIS UNIVERSITY
LITHUANIAN ENERGY INSTITUTE

ASTA LAURINKEVIČIŪTĖ

SUSTAINABLE DEVELOPMENT DECISION-MAKING MODEL FOR SMALL AND MEDIUM ENTERPRISES

Summary of Doctoral Dissertation
Technological Sciences, Environmental Engineering (04T)

2015, Kaunas

The dissertation has been developed at the Institute of Environmental Engineering, Kaunas University of Technology during 2005–2015.

Dissertation was prepared extramurally.

Scientific Consultant:
Prof. Dr. Žaneta STASIŠKIENĖ (Kaunas University of Technology,Technological Sciences, Environmental Engineering – 04T);

Dissertation Defence Board of Environmental Engineering Science Field:
Prof. Dr. Habil. Jurgis Kazimieras STANIŠKIS (Kaunas University of Technology, Technological Sciences, Environmental Engineering – 04T) – **chairman**;
Prof. Dr. Gintaras DENAFAS (Kaunas University of Technology,Technological Sciences, Environmental Engineering – 04T);
Prof. Dr. Habil. Remigijus ČIEGIS (Vilnius University, Social Sciences, Economics – 04S);
Prof. Dr. Violeta MAKAREVIČIENĖ (Aleksandras Stulginskis University, Technological Sciences, Environmental Engineering – 04T);
Prof. Dr. Lars Olof ÖSTERLUND (Uppsala University (Sweden), Technological Sciences, Environmental Engineering – 04T).

The official defence of dissertation will be held at the public meeting of the Board of Environmental Engineering Science field at 11 a.m. on December 18, 2015 in the Dissertation Defence Hall at the Central Building of Kaunas University of Technology.

Address: K. Donelaičio St. 73-403, 44249 Kaunas, Lithuania
Tel. (+370) 37 300042, Fax. (+370) 37 324144; e-mail: doktorantura@ktu.lt
Summary of doctoral dissertation was sent on 18 November, 2015.
The doctoral dissertation is available on the internet http://ktu.edu and at the libraries of Kaunas University of Technology (K. Donelaičio St. 20, 44239 Kaunas, Lithuania), Aleksandras Stulginskis University (Studentų St. 11, Akademija, Kaunas dist.) and Lithuanian Energy Institute (Breslaujos St. 3, Kaunas).

KAUNO TECHNOLOGIJOS UNIVERSITETAS

ALEKSANDRO STULGINSKIO UNIVERSITETAS

LIETUVOS ENERGETIKOS INSTITUTAS

ASTA LAURINKEVIČIŪTĖ

DARNIOS PLĖTROS SPRENDIMŲ PRIĖMIMO MODELIS MAŽOMS IR VIDUTINĖMS ĮMONĖMS

Daktaro disertacijos santrauka

Technologijos mokslai, aplinkos inžinerija (04T)

2015, Kaunas

Disertacija rengta 2005 – 2015 metais Kauno technologijos universiteto Aplinkos inžinerijos institute.
Disertacija ginama eksternu.

Mokslinė konsultantė:
Prof. dr. Žaneta STASIŠKIENĖ (Kauno technologijos universitetas, technologijos mokslai, aplinkos inžinerija – 04T).

Aplinkos inžinerijos mokslo krypties disertacijos gynimo taryba:

Prof. habil. dr. Jurgis Kazimieras STANIŠKIS (Kauno technologijos universitetas, technologijos mokslai, aplinkos inžinerija – 04T) – **pirmininkas**;
Prof. dr. Gintaras DENAFAS (Kauno technologijos universitetas, technologijos mokslai, aplinkos inžinerija – 04T);
Prof. habil. dr. Remigijus ČIEGIS (Vilniaus universitetas, socialiniai mokslai, ekonomika – 04S);
Prof. dr. Violeta MAKAREVIČIENĖ (Aleksandro Stulginskio universitetas, technologijos mokslai, aplinkos inžinerija – 04T);
Prof. dr. Lars Olof ÖSTERLUND (Upsalos universitetas (Švedija), technologijos mokslai, aplinkos inžinerija – 04T).

Disertacija bus ginama viešame aplinkos inžinerijos mokslo krypties tarybos posėdyje 2015 m. gruodžio 18 d. 11 val. Kauno technologijos universiteto centrinių rūmų disertacijų gynimo salėje.

Adresas: K. Donelaičio g. 73 – 403, LT-44249 Kaunas, Lietuva.
Tel. (+370) 37 300042; faksas (+370) 37 324144; el. paštas: doktorantura@ktu.lt

Disertacijos santrauka išsiųsta 2015 m. lapkričio 18 d.
Su disertacija galima susipažinti internetinėje svetainėje http://ktu.edu, Kauno technologijos universiteto (K. Donelaičio g. 20, 44239 Kaunas), Aleksandro Stulginskio universiteto (Studentų g. 11, Akademija, Kauno r.) ir Lietuvos energetikos instituto (Breslaujos g. 3, Kaunas) bibliotekose.

INTRODUCTION

Research relevance

Small and medium-sized enterprises (SMEs) comprise the most mobile, constantly changing group of companies, the activities and status of which have a decisive impact on the overall Lithuanian economic development, social stability and sustainable development [V.Grublienė ir S. Lengvinienė (2011)]. The growing importance of small and medium-sized enterprises and their impact on the sustainable development of the countries attractexclusive attention to SMEs development processes, trends, perspectives and promoteto search for effective ways that increase SMEs sector’s efficiency and competitiveness. This is one of the priorities of the EU and Lithuanian policy.

In the twenty-first century “sustainable development” as aconcept plays an important role in business and industry.To seek fora high environmental, as well as economic and social performanceof enterprises (including SMEs) – are key objectivesof sustainable development. Sustainable development is based on the precautionary management principles; their application in small and medium-sized enterprises is becoming an important factor for increasing competitiveness.

The paradox is that while small and medium-sized enterprises have a significant impact on the overall national economic and sustainable development, most scientific works that deal with sustainable industry development and itsenvironmentalimpact are more focused on larger companies, likewise many environmental protection and sustainability management measures, sustainability assessment methodologies are oriented towardsbig businessesor are applicable at state or regional levels. Not only individual small and medium-sized enterprises, their efficiency-increasing, decision-making instruments lack the attention, the overall sustainability of the SMEs sector to the total industrial, national, regional consistency often remain forgotten as well. This is due to the fact that the individual small business impact on the environment, their resource use, social impacts are less visible, they are more difficult to identify and evaluate;moreover SMEs have less knowledge, experience and resources in this area.

It must be acknowledged that over the last five years Lithuanian scientists began to examine more actively the topic of sustainable development, sustainability evaluation methods; in the field of environmental engineering in 2013 L.Kinderytė defended dissertation "Model of the System for Enterprise Sustainability Assessment“ in the field of management and economics two doctoral dissertations were defended – R.Kareivaitė "Integrated Assessment of Sustainable Development by Using Multi-Criteria Methods" (2012) and A.Kutkaitis „Assessment of Sustainability of Seaport Logistics Activity“ (2012). Year 2014 Vilnius University issued a collective monograph "Sustainable Development: Theory and Practice“, Kaunas University of Technology issued monograph "Strategy of Sustainable Industrial Development: Theory and Practice" (2004).

Considering the problems of small and medium-sized enterprises, their flexibility, dynamics and the ability to rapidly pursue technological innovation that enhance the corporate environmental performance, economic and social efficiencyof this sector, it is getting clear thatthere is a need for integrated sustainable development decision-making tool that would helpto make right decisions inside the company, survive and compete in the market.

This thesis "*Sustainable Development Decision-making Model for Small and Medium Enterprises*" is relevant and timely.

Aim and tasks of the research

The aim of the research – to create an integrated sustainable development decision-making model for small and medium-sized enterprises.

Tasks:

1. Perform the analysis of environmental, social, economic and technological aspects of SMEs sector, identify the main effectiveness-promoting factors and obstacles.
2. Perform the decision-making methods'analysis. In pursuanceof efficient use of energy and raw materials and recycling,while ensuring economic benefits, set all strengths and weaknesses of applying them to SMEs.
3. Create a sustainable development decision-making model for small and medium-sized enterprises.
4. Apply model to SMEs, assess its effectiveness accordingto environmental and economic criteria.

Key thesis

In order to reduce the environmental impactof SMEs, to increase resource optimization and improve their effectiveness, their management system should be based on an integrated and continuously-updating engineering decision-making model.

The research object is – the performance of sustainable development inLithuanian small and medium-sized industrial enterprises.

Research methodology

The research has beencarried out on the basis of common analysis methods – the systematic analysis, comparative analysis, quantitative statistical analysis. During thesystematic analysis of Lithuanian industrial SMEs from various sectors, as well as their ongoing technological and managerial processes therewere valuable empirical dataon sustainable development aspects collected.

After applying cleaner production (CP) methodology, the SMEs database was formed consisting of systematized data on company'sphysical materials and energy flows, as well as technological and financial data of the company. Through application of sustainability management accounting (SMA) methodology (by Ch.Jasch, 2005, 2006) that integrates physical and financial information flows of the company, database information helped to identify critical aspects of sustainable SMEs development. Based on the strategic management and rational decision-making model concept, courses of action for SMEs were selected – engineering solutions for critical aspects of sustainable development were found,the search for alternative technological solutions, their technological and economical evaluation, and the sensitivity analysiswas performed.

Throughintegration of SMA and composite sustainable development index (by D.Krajnc, P.Glavič, 2005) methodologies, the sustainability performance indicator system for SMEs was developed, that provides general performancereport for bothinternal decision-making purposesof the enterprise and as information toexternal stakeholders.

Scientific novelty

- The most important scientific novelty item –the original integrated sustainable development decision-making model for small and medium-sized enterprises was created.
- The developed model integrates SMA with the instrument of composite sustainable development index and thus allowsto eliminatethe subjectivity in the interpretation of company data, ensures a systematic processof technological and managerial decision and choice-making. Scientifically and practically,such solutions are new and will allow SMEs to reasonably compete in the global market.

Practical value

Newly created sustainable development decision-making model was realized in practice in three Lithuanian manufacturing industries' small and medium-sized enterprises: one drink producing, two woodprocessing and one service offering company.

Due to model flexibility and broad applicability it can be equally successfully applied to various-sizedSMEs from various industries.

Structure and contents of the dissertation

The dissertation contains four main chapters and conclusions including supplementary materials and references. The main text of dissertation consists of 133 pages. The general structure is presented below.

CHAPTER I. Review of the recent researches

The chapter reviews the recent research and advances in the sustainability decision making methods and models at enterprise level. Firstly, it addresses the problematic of SMEs sector through environmental, social, economic and technological aspects, also identifying the main effectiveness-promoting factors and obstacles. Secondly, it reviewsthe decision-making methods and modelssetting all strengths and weaknesses of applying them to SMEs in pursuance of efficient use of resources, recycling, reuse, while ensuring economic benefits.

In comparison to large companies, SMEs are significantly less likely tostart voluntary preventive environmental protection programs, rarely adapt environmental policies, implement formal environmental management systems, perform environmental audits, provide public sustainability reports or use other sustainable development and environmental efficiency-assessment and -improvement tools [Biondi et al, 2000, Hitchens et al., 2003, Labonne, 2006]. On the one hand, this situation is determined by the fact that SMEs still have insufficient knowledge about their impact on the environment and the management of this area, as well as they feel less responsibility towards the environment as it is used to believe that SMEs impact is not significant. On the other hand, the SMEs' well known preventive measures like environmental management, quality management systems, sustainability reporting, are in many cases more applicable to larger companies, are quite complex to implant and resource-requiring.

In the end section reasons the need of sustainable development decision making instrument for SMEs.

CHAPTER II. Methodology and development of sustainable development decision-making model for small and medium-sized enterprises

This chapter presents the methodology for sustainable development decision making in SMEs sector.

On the basis of rational decision-making modelconcept, cleaner production method, the integration of sustainability management accounting and composite sustainable development index method, have been achieved the original result – created new sustainable development decision-making model for small and medium-sized enterprises (Figure 1). The model consists of calculation block, logic block and deep calculation block, which enables a systematic assessment of the main sustainable development problems in SMEs and establish alternative engineering solutions, performing the original technological, economic assessment and sensitivity analysis.

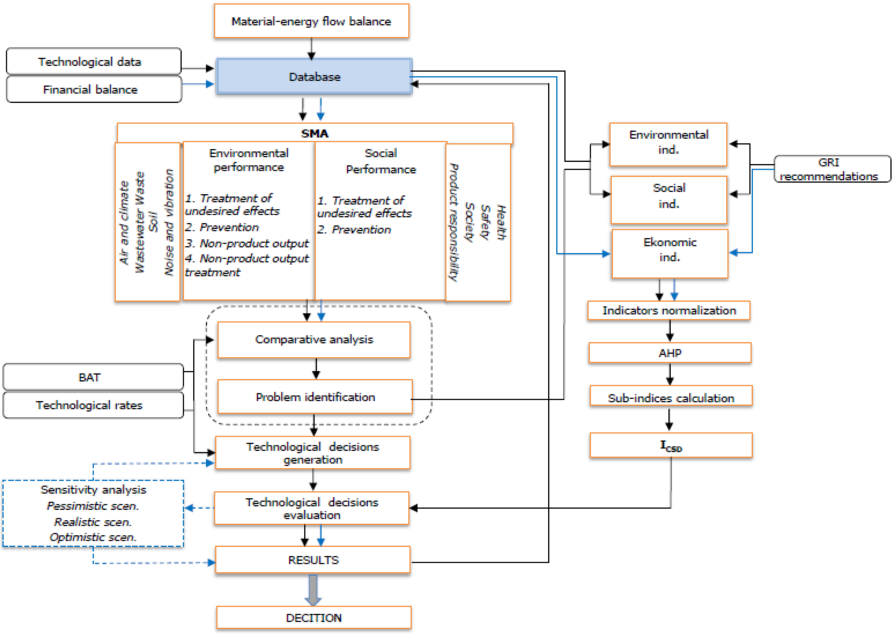

Fig. 1. Structure of sustainable development decision-making model

The chapter presents the run of each model stage.

Quantifying material flow system, the company creates a database consisting of quantities, values and costs. The crucial stage of the formation of the database is material-energy balance (Fig. 2) of the basis of cleaner production method.

The main sources of the physical information are:

- Technology profiles
- Waste records
- Environmental Reports
- Environmental management systems (EMS) data (if existent)
- ERP data (if existent).

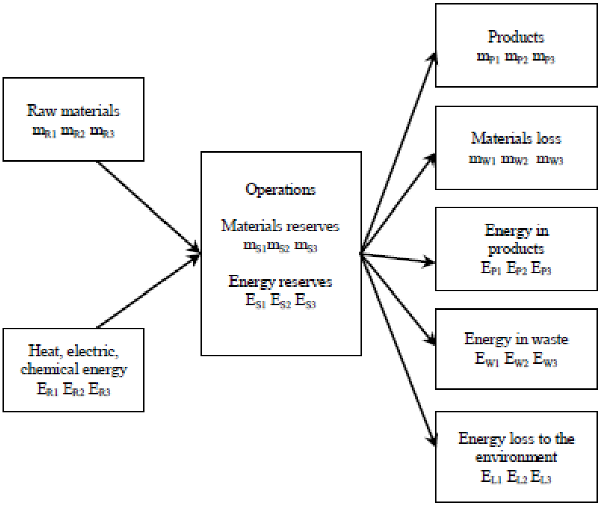

Fig 2. Material-energy flow balance

Material-energy balance is created according to the following equations:

$$\sum m_R = \sum m_P + \sum m_W + \sum m_S \; ; \qquad (1)$$

$$\sum m_R = \sum m_{R1} + \sum m_{R2} + \cdots + \sum m_{Rn}$$

$$\sum m_P = \sum m_{P1} + \sum m_{P2} + \cdots + \sum m_{Pn}$$

$$\sum m_W = \sum m_{W1} + \sum m_{W2} + \cdots + \sum m_{Wn}$$

$$\sum m_S = \sum m_{S1} + \sum m_{S2} + \cdots + \sum m_{Sn}$$

Where: m_R – the amount of raw materials, m_P – the amount of production, m_W – material loss, m_S – material reserves.

$$\sum E_R = \sum E_P + \sum E_W + \sum E_S; \qquad (2)$$

$$\sum E_R = \sum E_{R1} + \sum E_{R2} + \cdots + \sum E_{Rn}$$

$$\sum E_P = \sum E_{P1} + \sum E_{P2} + \cdots + \sum E_{Pn}$$

$$\sum E_W = \sum E_{W1} + \sum E_{W2} + \cdots + \sum E_{Wn}$$

$$\sum E_L = \sum E_{L1} + \sum E_{L2} + \cdots + \sum E_{Ln}$$

$$\sum E_S = \sum E_{S1} + \sum E_{S2} + \cdots + \sum E_{Sn}$$

Where: E_R – energy input, E_P – output energy in products, E_W – output energy in waste, E_L – energy loss to the environment, E_S – energy reserves [LR AM, 2009].

The information of created database is used in further stage of model – sustainability management accounting process. Material-energy balance gives information about non-product output (raw materials, energy, water, etc.), losses in form of emissions, waste, wastewater; linking these physical quantities with the company‘s financial balance sheet data, environmental costs due to the loss of resources, the scale of fees and/or fines for emissions, waste, etc. are determined.

Identifying key sustainability problems in the company and their reasons,the peak sustainable development costs identified, while applying SMA methodology,are directly attributed to generating activities (production, warehousing, logistics etc.) and for specific products or services. In order to assure therelevance of sustainable development issues of the technological aspect,non-product output quantitative data comparative analysis with the technological standards or best available techniques and social data comparison with the company's aims and/or Eurostat databaseis performed (Fig. 3).

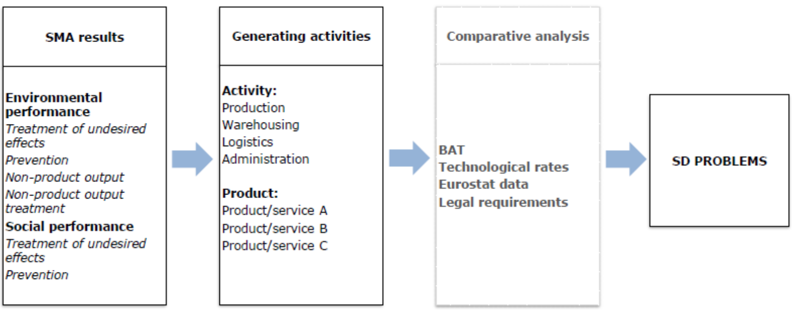

Fig. 3. Connection between SMA results and problem identification

Company's sustainable development performance indicators are chosen with respect to the identified major sustainability issues in the company. These relative indicators are the quantification of the company's existing sustainability problems, which encourages the taking of decisions and allows the company periodically to monitor changes. Since these indicators cover only the problematic aspects of sustainable development, they do not reflect the overall sustainability of the company. In order to determine the overall effectiveness of the company's sustainable development, in particular in order to provide sustainability reporting externally, requires greater set of indicators, who‘s part would be the above mentioned indicators. For this purpose, composite sustainable development index (I_{CSD}) is integrated in sustainable development decision-making model (Fig. 4).

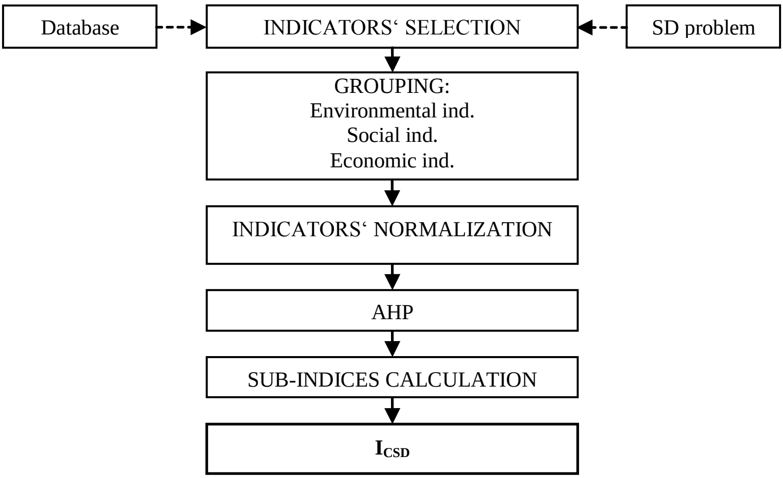

Fig. 4. The procedure of composite sustainable development index calculation (by D. Krajnc, P. Glavič, 2004)

Considering the problems identified, with a respect to the company's sustainable development goals and untapped potential, technological standards, BAT and other reference documents, the search for alternative technological decitions for each of the identified company's sustainable development problems is fullfilled, their technological and economic evaluation, also sensitivity analysis is performed (Fig. 5).

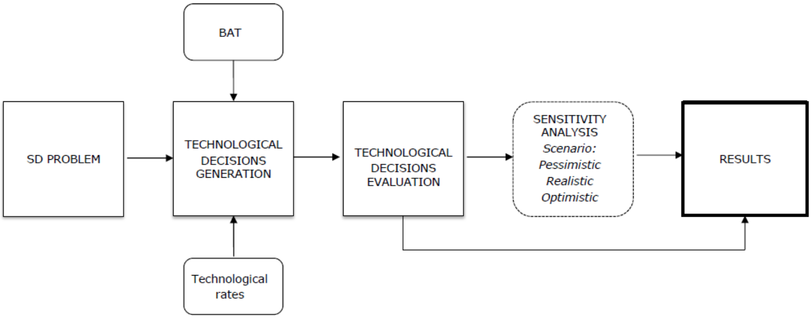

Fig. 5. The process of technological solutions generation

CHAPTER III. Application of model in small and medium-sized enterprises

Sustainable development decision-making model was applicated in practice in three Lithuanian manufacturing industries' small and medium-sized enterprises: one drink producing, two wood processing and one service offering company.This chapter presents the detail run of the model in each researched company, while performing technological, environmental and economic calculations, using original corporate data.

CHAPTER IV. Model results interpretation

Applying the sustainable development decision-making modelto the researched SMEs, systematically in environmental, technological and financial aspects major problems of sustainable development have been assessed. The sustainability management accounting conducted has allowed determining the real costs of sustainable development. Reliability of the SMA results and their soundness in the technological aspect have proved right after the comparative analysis of quantitative data of non-product output with best available techniques (BAT) and technological results.

After the technological and economical assessment and sensitivity analysis have been completed, alternative technological solutions to the identified environmental problems have been prescribed. Calculations have demonstrated that due to these solutions, the resource consumption can be reduced, and, consequently, emission and wastewater quantities as well (Table 1, 2, 3, 4).

Table 1. Technological solutions at the brewing company. Results

Problem	**Indicator**	**Indicator value before solution**	**Technological solution**	**Indicator value after solution**	**BAT**	**Change in indicator after the solution, %**
High water consumption and wastewater	Water consumption to produce one unit of production	1.55	Water reuse	1.37	1.0	-12 %
High electrical energy consumption	Electrical energy consumption to produce one unit of production	10.42	Lighting system reconstruction	9.37	9.0	-10 %
High thermal energy consumption	Thermal energy consumption to produce one unit of production	28.22	Heat recovery	24.85	22.0	-12 %

Table 2. Technological solutions at a parquet manufacturing company. Results

Problem	Indicator	Indicator value before solution	Technological solution	Indicator value after solution	BAT	Change in the indicator after solution, %
High electrical energy consumption	Electrical energy consumption to produce one unit of production	0.83	Condensing economizer	0.7	0.65	-16 %

Table 3. Technological solutions at the wooden pallet manufacturing company. Results

Problem	Indicator	Indicator value before solution	Technological solution	Indicator value after solution	BAT	Change in the indicator after solution, %
High electrical energy consumption	Electrical energy consumption to produce one unit of production	2.05	Conveyor introduction	1.85	1.7	- 10 %
High thermal energy consumption	Thermal energy consumption to produce one unit of production	0.47		0.42	0.37	- 12 %

Table 4. Technological solutions at a brokering company. Results

Problem	Indicator	Indicator value before solution	Technological solution	Indicator value after solution	BAT	Change in the indicator after solution, %
High thermal energy consumption	Thermal energy consumption to produce one unit of production	51.94	Conditioner introduction	0	26.0	- 100 %
	Electrical energy consumption to produce one unit of production	75.64		91.05	-	+ 20 %

Main conclusions

1. The analysis of environmental, social situationand statistical indicators of economic and technological aspects of SMEs showed that in the context of sustainable development SMEs have a lower environmental and social performance, as well aspoorer economic efficiency. Key limiting factors for applying measures thatimprove the sustainability performance for SMEs are: lack of information, knowledge and competence; denial of sustainable development measures that potentially increase company's value. The main driving factors – ambition for competitive advantage, environmental impact reduction, likely financial benefits,need for reporting on sustainability development.

2. The comparative analysis of methods for increasing the performance of sustainable development and improving the efficiency of decision-making showed that the application of existing tools in the SMEs sector istoo scarce. Most of the existing instruments are orientedtowards larger enterprises, are hardly adapted in SMEs level and (or) have an integration problem, meaning they are based on the assessment of individual indicators of sustainable development therefor creating the need for systematic evaluation of links between environmental and social performance and the economic benefits for the enterprise.

3. The newly developed SMEs' sustainable development decision-making model helps to evaluate key issues of sustainable development in the company and by performing an original technological, environmental and economic assessment to identify alternative solutions. Due to interaction of SMA andcomposite sustainable development index methods in this model, it helps to ensure that technological and management decision-making processes within the company and the reporting process that increases external stakeholders' awareness of sustainable development is in line with sustainable development principles.

4. Sustainable development decision-making model's efficiency was tested in four SMEs from different industries and of different sizes – in drink producing (230 employees), two wood processing (70 and 22 employees)companies and in one micro-services enterprise (9 employees). Model'sefficiency is reflected by the following aspects:

    4.1. Calculations with the original data of the investigated companies helped to define the most significant sustainable development problems of those enterprises: all tested SMEs haddominant environmental problems – loss of raw and other materials in the form of emissions, waste and (or) wastewater.

    4.2. Effective technological solutions for corporate sustainable development issues were found; calculations have shown that these solutions can reduce resource consumption, quantities of waste, emissions and wastewaters, i.e., a more efficient production process can reducethe environmental impact:

    - In beer production enterprise, the total consumption of water and wastewater generated content theoretically decreased by 12-13%, electrical and thermal energy consumption decreased by 10-12%.
    - In wood processingenterprise with 70 employeesthe potential decrease of electrical and thermal energy consumption is 10-12%.
    - In wood processingenterprise with 22 employees the potential decrease of electrical energy consumtion is 16%.
    - Brokering micro-enterprise had a 100%decrease in thermal energy consumption, whereas electricity consumption increased by 20%.

4.3. The integration of composite sustainable development index (I_{CSD}) method in the model allowed to evaluate and compare a total sustainabilityperformance between different SMEs. Through evaluated alternative technological solutions SMEs sustainable development index has reached a growth potential of:

- Wood processing company (70 employees) – from 0.502 to 0.542.
- Wood processing company (22 employees) – from 0.517 to 0.563.
- Brokering company – from 0.546 to 0.606.
- Drink producingcompany – from 0.562 to 0.618.

5. With respect to systematic approach, flexibility and integration with existing enterprise systems this newly developed sustainable development decision-making model is broadly applicable – as experimental studies with SMEs from different sectors show, it can be effectively applied not only in various manufacturing SMEs, independent of their nature, but can be successfully used in micro and small service sector's companies as well.

REFERENCES

1. Biondi, Vittorio; Frey, Marco; Iraldo, Fabio. Environmental Management Systems and SMEs // Greener Management International. ISSN 0966-9671. 2000, Vol. 2000, No. 29, p. 55-69.
2. Jasch, Christine; Lavicka Alexander. Pilot project on sustainability management accounting with the Styrian automobile cluster // Journal of Cleaner production. ISSN: 0959-6526. 2006, Vol. 14, Issue 14, p. 1214-1227.
3. Jasch, Christine; Stasiškienė, Žaneta. From Environmental Management Accounting to Sustainability Management Accounting // Environmental Research, Engineering & Management. 2005, Vol. 34, Issue 4, p.77-88.
4. Glavič, Peter; Krajnc, Damjan. A model for integrated assessment of sustainable development // Resources, Conservation and Recycling. 2005, Vol. 43, Issue 2, p. 189-208.
5. Glavič, Peter; Krajnc, Damjan. How to compare companies on relevant dimensions of sustainability // Ecological Economics. ISSN: 0921-8009. 2005, Vol. 55, Issue 4, p. 551-563.
6. Grublienė, Violeta; Lengvinienė, Sigita. Valstybės parama kaip SVV darnaus vystymosi prielaida // Management theory and studies for rural

business and infrastructure development. Klaipėda. 2011, Nr. 1 (25), ISSN 1822-6760.
7. Hitchens, David; Clausen, Jens; Trainor, Mary; Keil, Michael; Thankappan, Samarthia. Competitiveness, Environmental Performance and Management of SMEs // Greener Management International. 2003, Vol. 2003, No. 44, p. 44-57 (14).
8. Labonne, Julien. A Comparative Analysis of the Environmental Management, Performance and Innovation of SMEs and Larger Firms based on the OECD database. 2006.

LIST OF SCIENTIFIC PUBLICATIONS ON THE TOPIC OF THE DISSERTATION

Articles in the journals inscribed into the main list of Institute of ScientificInformation (ISI):

1. Laurinkevičiūtė, Asta; Stasiškienė, Žaneta. SMS for decision making of SMEs // Clean Technologies and Environmental Policy. New York : Springer. ISSN 1618-954X. 2011, Vol. 13, iss. 6, p. 797-807.

Articles referred in other International databases:

1. Laurinkevičiūtė, Asta; Stasiškienė, Žaneta. Environmental management accounting model and its feasible integration into corporate information systems of textile company // Environmental research, engineering and management = Aplinkos tyrimai, inžinerija ir vadyba. Kaunas : Technologija. ISSN 1392-1649. 2006, nr. 3(37), p. 52-63.
2. Laurinkevičiūtė, Asta; Kinderytė, Loreta; Stasiškienė, Žaneta. Corporate decision-making in furniture industry: weight of EMA and a sustainability balanced scorecard // Environmental research, engineering and management = Aplinkos tyrimai, inžinerija ir vadyba. Kaunas : Technologija. ISSN 1392-1649. 2008, nr. 1(43), p. 69-79.
3. Arbačiauskas, Valdas; Gaižiūnienė, Jurgita; Laurinkevičiūtė, Asta; Židonienė, Sigita. Sustainable production through innovation in small and medium sized enterprises in the Baltic sea region // Environmental research, engineering and management = Aplinkos tyrimai, inžinerija ir vadyba. Kaunas : Technologija. ISSN 1392-1649. 2010, nr. 1(51), p. 57-65.

4. Laurinkevičiūtė, Asta; Stasiškienė, Žaneta. Sustainable development decision-making model for small and medium enterprises // Environmental research, engineering and management = Aplinkos tyrimai, inžinerija ir vadyba. Kaunas : Technologija. ISSN 1392-1649. 2010, nr. 2(52), p. 14-24.

INFORMATION ABOUT THE AUTHOR

Name, surname:	Asta Laurinkevičiūtė
Date of birth:	5 September, 1981
Academic background:	In 1999 finished Kaunas Jesuit Gymnasium. 1999-2003 studies at Vytautas Magnus University, Faculty of Natural Science: Bachelor of Biology. 2003-2005 studies at Kaunas University of Technology, Faculty of Chemical Technology: Master of Environmental Engineering, programme “Cleaner production and Environmental management”. 2005 – 2010 Doctoral studies at Kaunas University of Technology, Institute of Environmental Engineering.
Research interest:	sustainable management systems, sustainable management accounting, integrated sustainability evaluation, sustainability of SME
For contacts:	asta.laurinkeviciute@gmail.com

REZIUMĖ

Darbo aktualumas

Mažos ir vidutinės įmonės (MVĮ) – tai mobiliausia, nuolat besikeičianti įmonių grupė, kurios veikla ir būklė turi lemiamą poveikį bendrai Lietuvos ūkio raidai, socialiniam stabilumui ir darniam vystymuisi [V.Grublienė ir S. Lengvinienė (2011)]. Vis didėjanti mažų ir vidutinių įmonių svarba bei jų įtaka darniam šalių vystymuisi lemia ypatingą dėmesį MVĮ plėtros procesams, tendencijoms, perspektyvoms bei skatina ieškoti efektyvių MVĮ sektoriaus veiksmingumo ir konkurencingumo didinimo būdų. Tai yra vienas iš prioritetinių ES ir Lietuvos politikos tikslų.

Darnios plėtros koncepcija atlieka svarbų vaidmenį XXI amžiaus versle ir pramonėje. Siekti aukšto įmonių (tame tarpe – MVĮ), aplinkos apsaugos veiksmingumo, ekonominio ir socialinio efektyvumo yra pagrindinis darnios plėtros koncepcijos tikslas. Darni plėtra remiasi prevencinės vadybos principais, jų taikymas mažų ir vidutinių įmonių veikloje tampa svarbiu konkurencingumo didinimo veiksniu.

Paradoksalu tai, kad nors smulkusis ir vidutinis verslas daro esminį poveikį bendrai šalies ūkio raidai ir darniam vystymuisi, tačiau darnią pramonės plėtrą ir poveikį aplinkai nagrinėjančiuose tiek užsienio, tiek Lietuvos tyrėjų moksliniuose darbuose daugiausia dėmesio skiriama didelėms įmonėms, taip pat dauguma aplinkos apsaugos bei darnios vadybos priemonių, darnumo vertinimo metodikų yra orientuotos į stambųjį verslą arba yra taikytinos valstybiniame ar regioniniame lygmenyje. Teikiamas nepakankamas dėmesys ne tik atskiroms mažoms ir vidutinėms įmonėms bei jų veiksmingumo didinimo, sprendimų priėmimo priemonėms, bet ir bendra MVĮ sektoriaus darnumo svarba bendram pramonės, šalies, regiono darnumui dažnai lieka užmiršta. Tam turi įtakos tai, jog atskirų mažų įmonių poveikiai aplinkai, resursų naudojimas, socialiniai poveikiai yra mažiau pastebimi, juos yra sudėtingiau identifikuoti bei įvertinti, taip pat MVĮ turi mažiau žinių, patirties šioje srityje bei išteklių.

Reikia pripažinti, kad per pastaruosius penkerius metus Lietuvos mokslininkų darbuose pradėta aktyviau nagrinėti darnios plėtros tematika, darnos vertinimo metodai; aplinkos inžinerijos srityje 2013 m. apginta L.Kinderytės disertacija „Įmonės darnios plėtros vertinimo sistemos modelis“, vadybos ir ekonomikos srityse apgintos dvi disertacijos – R.Kareivaitės „Kompleksinis darnaus vystymosi vertinimas taikant daugiakriterius metodus“ (2012) ir A.Kutkaičio „Jūrų uostų logistinės veiklos darnos vertinimas“ (2012). 2014 m. VU išleista kolektyvinė monografija „Darnus vystymasis: teorija ir praktika“, 2004 m. KTU išleista monografija „Subalansuotos pramonės plėtros strategija: teorija ir praktika“.

Atsižvelgiant į mažų ir vidutinių įmonių problematiką, jų lankstumą, dinamiką bei gebėjimą sparčiai diegti technologines inovacijas, siekiant padidinti šio sektoriaus įmonių aplinkos apsaugos veiksmingumą, ekonominį ir socialinį efektyvumą, yra reikalinga integruota darnios plėtros sprendimų priėmimo priemonė, įgalinanti priimti tinkamus sprendimus įmonių viduje, išsilaikyti bei konkuruoti rinkoje.

Šios disertacijos tema *„Darnios plėtros sprendimų priėmimo modelis mažoms ir vidutinėms įmonėms“* yra aktuali ir savalaikė.

Darbo tikslas ir uždaviniai

Darbo tikslas – sukurti integruotą darnios plėtros sprendimų priėmimo modelį mažoms ir vidutinėms įmonėms.

Uždaviniai:

1. Atlikti MVĮ sektoriaus aplinkos apsaugos, socialinių, ekonominių bei technologinių aspektų analizę, nustatyti pagrindinius veiksmingumą skatinančius veiksnius bei kliūtis.
2. Atlikti sprendimų priėmimo metodų analizę. Nustatyti jų taikymo MVĮ privalumus ir trūkumus, siekiant užtikrinti efektyvų žaliavų ir energijos vartojimą, reciklą ir antrinį panaudojimą, tuo pačiu užtikrinant ekonominį naudingumą.
3. Sukurti darnios plėtros sprendimų priėmimo modelį mažoms ir vidutinėms įmonėms.
4. Atlikti praktinį modelio taikymą MVĮ ir įvertinti jo efektyvumą pagal aplinkos apsaugos ir ekonominius kriterijus.

Ginamasis disertacijos teiginys

Siekiant MVĮ poveikio aplinkai mažinimo, išteklių naudojimo optimizavimo ir veiksmingumo didinimo, jų valdymo sistema turėtų būti paremta integruotu bei nuolatinį atnaujinimą užtikrinančiu inžinerinių sprendimų priėmimo modeliu.

Tyrimo objektas ir metodika

Tyrimo objektas – Lietuvos smulkaus ir vidutinio verslo pramonės įmonių darnios plėtros veiksmingumas.

Darbas atliktas remiantis bendraisiais tyrimų metodais – sistemine analize, lyginamąja analize, kiekybiniu statistinių duomenų analizės metodu.Sukaupti vertingi empirinių tyrimų duomenys darnios plėtros aspektu sistemiškai analizuojant įvairių Lietuvos pramonės sektorių MVĮ, jose vykstančius technologinius, vadybinius procesus.

Pritaikius švaresnės gamybos (ŠG) metodiką, MVĮ suformuotaduomenų bazė, susidedanti išsusistemintų įmonės fizikinių medžiagų bei energijos srautų, technologinių bei finansinių įmonės duomenų. Duomenų bazės informacija naudojama MVĮ kritinių darnios plėtros aspektų identifikavimui taikant darnios vadybos kaštų vertinimo (DVKV) metodiką (pagal Ch.Jasch, 2005, 2006), integruojančią įmonės fizikinius bei finansinius informacinius srautus. Remiantis strateginio valdymoir racionalaus sprendimų priėmimo modelio koncepcija, MVĮ parinktos veiksmų kryptys – kritiniams darnios plėtros aspektams rasti inžineriniai sprendimo būdai – atlikta alternatyvių technologinių sprendimų paieška, jųtechnologinis ir ekonominis vertinimas, jautrumo analizė.

DVKV ir sudėtinio darnios plėtros indekso (pagal D.Krajnc, P.Glavič, 2005) metodikų integravimo dėkaMVĮ sukurta darnios plėtros veiksmingumo indikatorių sistema, ataskaitų forma teikianti svarią įmonės bendrąją veiksmingumo informaciją tiek įmonės vidaus sprendimams, tiek išorės suinteresuotų šalių informavimui.

Darbo mokslinis naujumas

- Pagrindinis mokslinio naujumo elementas – sukurtas originalus integruotas darnios plėtros sprendimų priėmimo modelis mažoms ir vidutinėms įmonėms.
- Sukurtas modelis integruoja DVKV su sudėtinio darnios plėtros indekso išvedimo instrumentu ir tokiu būdu leidžia eliminuoti subjektyvumą interpretuojant įmonės duomenis, užtikrina sisteminę technologinių ir valdymo sprendimų paiešką ir priėmimą. Tokie sprendimai yra nauji moksliniu ir praktiniu požiūriu ir leis MVĮ pagrįstai konkuruoti pasaulinėje rinkoje.

Praktinė darbo vertė

Sukurtas naujasdarnios plėtros sprendimų priėmimo modelis praktiškai pritaikytas trijose Lietuvos apdirbamosios pramonės šakų mažose ir vidutinėse įmonėse – vienoje gėrimų gamybos ir dvejose medienos apdirbimo bei vienoje paslaugų įmonėje.

Modelio lankstumo ir plataus pritaikomumo dėka jis gali būti vienodai sėkmingai taikomas įvairaus dydžio ir įvairių pramonės šakų MVĮ.

Darbo apimtis ir struktūra

Darbą sudaro keturi pagrindiniai skyriai ir išvados, priedai ir naudotos literatūros sąrašas. Iš viso 133 puslapiai pagrindinio teksto.

Išvados

1. Atlikus MVĮ aplinkos apsaugos, socialinės situacijos, statistinių ekonominių rodiklių ir technologinių aspektų analizę, nustatyta, kad MVĮ darnios plėtros kontekste pasižymi žemesniu aplinkos apsaugos, socialiniu veiksmingumu bei ekonominiu efektyvumu. Pagrindiniai darnios plėtros veiksmingumo didinimo priemonių taikymą MVĮ ribojantys veiksniai – informacijos, žinių ir kompetencijos stoka; darnios plėtros priemonių, kaip potencialiai didinančių įmonės vertę, neigimas. Pagrindiniai skatinantys veiksniai – konkurencinio pranašumo siekis, poveikio aplinkai mažinimas, tikėtina finansinė nauda, darnumo ataskaitų teikimo poreikis.

2. Darnios pramonės plėtros veiksmingumo didinimo ir sprendimų priėmimo metodų lyginamoji analizė parodė, kad esamų instrumentų taikymas MVĮ sektoriaus įmonėms nėra plačiai išvystytas. Dauguma esamų instrumentų yra orientuoti į dideles įmones, sudėtingai pritaikomi MVĮ lygmenyje ir (arba) pasižymi integravimo problema, t.y., remiasi pavienių darnios plėtros rodiklių vertinimu – kyla aplinkos apsaugos bei socialinio veiksmingumo sąsajų su ekonomine įmonės nauda sisteminio įvertinimo poreikis.

3. Sukurtas darnios plėtros sprendimų priėmimo modelis MVĮ leidžia sistemiškai įvertinti pagrindines darnios plėtros problemas įmonėje ir nustatyti alternatyvius sprendimo būdus, atliekant originalų technologinį, poveikio aplinkai ir ekonominį vertinimą. DVKV metodikos bei sudėtinio darnios plėtros indekso išvedimo metodikos sąveikos modelyje dėka užtikrinamas darnios plėtros principus atitinkantis technologinių ir valdymo sprendimų priėmimas įmonės viduje bei išorės suinteresuotų šalių informavimas teikiant darnios plėtros ataskaitas.

4. Darnios plėtros sprendimų priėmimo modelio veikimo efektyvumasišbandytasketuriose skirtingų pramonės šakų bei skirtingų dydžių MVĮ – gėrimų gamybos (230 darbuotojų), dvejose medienos apdirbimo (70 ir 22 darbuotojai) bei mikro paslaugų įmonėje (9 darbuotojai). Modelio efektyvumą atspindi šie aspektai:

   4.1. Atliekant skaičiavimus suoriginaliaistirtų įmonių duomenimis,nustatytos reikšmingiausios darnios plėtros problemos įmonėse: visose tirtose MVĮ dominuoja su aplinkos apsaugos sritimi susiję problemos – žaliavų bei medžiagų praradimai emisijų, atliekų ir (ar) nuotekų pavidalu.

4.2. Įmonių darnios plėtros problemoms spręsti rasti efektyvūs technologiniai sprendimai;skaičiavimai parodė, kad šių sprendimų dėka galima sumažinti resursų sąnaudas, atliekų, emisijų ir nuotekų kiekius, t.y., efektyvesnio gamybos proceso dėka sumažinti poveikį aplinkai:

- alaus gamybos įmonėje bendros vandens sąnaudos ir susidarančių nuotekų kiekis teoriškaisumažėjo 12-13 %, elektros ir šiluminės energijos sąnaudos sumažėjo 10-12 %.
- 70 darbuotojų turinčioje medienos apdirbimo įmonėje elektros ir šiluminės energijos sąnaudųmažėjimo potencialas10-12 %.
- 22 darbuotojus turinčioje medienos apdirbimo įmonėje elektros energijos sąnaudųmažėjimo potencialas16 %.
- tarpininkavimo paslaugų mikro įmonėje šiluminės energijos sąnaudų sumažėjo 100 %, elektros energijos sąnaudos išaugo 20 %.

4.3. Sudėtinio darnios plėtros indekso – I_{CSD}, išvedimo metodo integravimas modelyje leido įvertinti ir palyginti tarpusavyje bendrą skirtingų MVĮ darnios plėtros veiksmingumą. Įvertintų alternatyvių technologinių sprendimo būdų dėka tirtose MVĮ darnios plėtros veiksmingumo rodiklis turi didėjimo potencialą:

- medienos apdirbimo įmonėje (70 darbuotojų) – nuo 0,502 iki 0,542.
- medienos apdirbimo įmonėje (22 darbuotojai) – nuo 0,517 iki 0,563.
- tarpininkavimo paslaugų įmonėje – nuo 0,546 iki 0,606.
- gėrimų gamybos įmonėje – nuo 0,562 iki 0,618.

5. Dėl sisteminio požiūrio, lakstumo, integralumo su esamomis įmonių sistemomis, sukurtas darnios plėtros sprendimų priėmimo modelis yra plataus pritaikymo – kaip įrodyta eksperimentiniais bandymais skirtingų sektorių MVĮ, jis gali būti efektyviai taikomas ne tik įvairiose apdirbamosios pramonės MVĮ, nepriklausomi nuo jų veiklos pobūdžio, bet ir sėkmingai veikti mikro bei mažose paslaugų sektoriaus įmonėse.

UDK 502.131.1, 658:502.131.1(043.3)

SL344. 2015-11-12, 1,75 leidyb. apsk. l. Tiražas 50 egz. Užsakymas 433 .

Išleido Kauno technologijos universitetas, K. Donelaičio g. 73, 44249 Kaunas
Spausdino leidyklos „Technologija“ spaustuvė, Studentų g. 54, 51424 Kaunas