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Assessment of Overall SCP State of Company: Results of Application of New Integrated Sustainability Index I_{SCP} in 2 Enterprises

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The challenge for every company on the way to sustainable consumption and production (SCP) is not only to use appropriate methods and measures to solve their specific sustainability problems, but first of all to select appropriate performance indicators and implement an effective sustainability performance evaluation system. It may be useful to use an integrated indicator as a single comparable index, reducing the number of sustainability decision-making criteria that need to be considered.

Since there is still no comprehensive framework for integrated sustainability assessment of the overall company state on the basis of manufacturing processes, products/services as well as relationship with various stakeholders, the algorithm for integrated sustainability assessment of the overall company state that can help to solve the most significant problems in 3 levels - manufacturing processes/company's activities, products/services and relationship with various stakeholders - was presented in an earlier author's publication. This framework proposes the assessment of current sustainability conditions of a company on the basis of sub-indices of the composite index I_{SCP} for sustainability evaluation and, according to them, can help to select and introduce the most suitable sustainable development tools for a particular enterprise to achieve its environmental and social performance goals.

As the subjected algorithm was still theoretical, there was an urgent necessity to verify its real potential in particular enterprises. Therefore, the results of its verification procedure performed in 2 large, well-known Lithuanian joint-stock companies (JSC) from different business sectors are presented.

The preliminary results of algorithm verification, despite all the limitations, are enough to propose that it is universal enough to be adapted for companies from various sectors of activities. Calculated values of the I_{SCP} indicated an average level of the sustainability state in both companies. As the results of the sub-indices showed similar moderate results, both enterprises are strongly recommended to reconsider all 3 levels of their performance by applying some of the recommended measures and tools or at least by correcting the management and operation of already implemented ones.

Keywords: *sustainable consumption and production (SCP), companies, sustainability performance indicators, integrated index, analytic hierarchy process (AHP).*

1 Introduction

During the last decades, initiatives in sustainable production have successfully focused on improving resource efficiency in manufacturing systems (Jackson, 2005; Sikdar, 2011). However, despite the improvement in results of environmental practices of many individual producers, an increase in the amount of general consumption often exceeds the achieved progress (the so-called 'rebound' effect) (Staniškis and Stoškus, 2008; Staniškis *et al.*, 2012; Sto *et al.*, 2006). It is becoming obvious that technological approaches are not enough to realise the goal of sustainable development (SD) without the critical assessment of human choices (Hertwich, 2005; Jackson, 2005; Dahl, 2012). Thus, in order to determine the most suitable direction for the actions towards sustainable consumption and production (SCP), it is essential to analyse the relation between consumption and production systematically, considering not only producers and consumers, but also all the other interested groups in the SCP system, such as government, non-governmental organisations (NGOs), shareholders, suppliers, academic community and media, etc. (Gold *et al.*, 2010).

Integrating sustainability thinking and practice into an organisational structure requires a system approach with an appropriate management framework. However, there is no generic 'off-the-shelf' management scheme for every organisation that could enable a systematic and structured approach to manage their corporate sustainability (Azapagic, 2003). Thus, the challenge for every company on the way to SCP is to use appropriate methods and measures to solve their specific sustainability problems (Carson, 2007). To manage integration of the tools and to ensure effective information flows for decision making, there is a need to select appropriate performance indicators and to implement an effective sustainability performance evaluation system (Staniškis and Arbačiauskas, 2009). It may be useful to apply an integrated indicator as a single comparable index, linking many sustainability issues and so reducing the number of decision-making criteria that need to be considered (Azapagic, 2003; Krajnc and Glavič, 2005a; Singh *et al.*, 2007, 2009, 2012).

Currently, there are various approaches to create frameworks and methodologies for the development of integrated sustainability indicators that measure, monitor and assess the progress of an enterprise towards sustainability. Significant examples are presented in the publications by Azapagic (2003), Krajnc and Glavič (2005, 2005a); Singh *et al.* (2007, 2009, 2012), Kang *et al.* (2010); Kinderytė *et al.* (2010) and Kinderytė (2010, 2011, 2013) as well as Laurinkevičiūtė and Stasiškienė (2010). However, despite these attempts, there is still no comprehensive framework for integrated sustainability assessment of the overall company state on the basis of manufacturing processes, products/services and relationship with various stakeholders.

In respect of this demand, the algorithm that offers methodical suggestions to assess the customers' opinion about the presence of company's environmental and social sustainability activities and initiatives; to identify and select most appropriate sustainability indicators; to determine their significance according to analytic hierarchy process (AHP); and to solve the most important sustainability problems in 3 levels − manufacturing processes/company's activities, products/services and stakeholders by adapting most suitable SD tools − was developed and presented in an earlier publication of Jonkutė (2015). This framework proposes the assessment of current sustainability conditions of a company on the basis of sub-indices of the composite index I_{SCP} for sustainability evaluation and, according to them, can help to select and introduce the most suitable SD tools for a particular enterprise to achieve its environmental and social performance goals.

The aim of this article was to introduce some preliminary results of the implementation of this algorithm in 2 large, well-known Lithuanian joint-stock companies (JSC) from different business sectors in order to disclose all its application opportunities.

The results of the algorithm implementation were divided in 10 essential steps, and the limitations of the verification procedure are comprehensively presented in the following section.

2 Methodology and results of the algorithm implementation

The previously developed algorithm (Jonkutė, 2015) (see Figure 1) for integrated sustainability assessment of the overall company state can help to solve the most significant problems in 3 levels, i.e. manufacturing processes/company's activities, products/services and relationship with various stakeholders. The algorithm consists of 10 essential steps, namely survey of permanent customers of the company; assessment of the presence of company's sustainability actions; organisation of the board of experts; identification and selection of sustainability indicators; weighting of indicators by the AHP method; collection of data for selected indicators; normalisation of the indicators; calculation of the sub-indices for I_{SCP} and suggestion of the most suitable SD tools; combination of the sub-indices into I_{SCP}; as well as interpretation of results and determination of the overall sustainability state of a company, which are in detail described by Jonkutė (2015).

The preliminary verification of the algorithm was implemented in 2 large, well-known Lithuanian enterprises from different business sectors following all the aforementioned steps with some minor modifications that are comprehensively described further. One of the companies represents the sector of telecommunications (service sector, company No. 1), the other – sector of construction and real estate (manufacturing sector, company No. 2).

2.1 *Survey of permanent customers/clientele of the company*

The aim of the survey is to assess the opinion of company's customers about the presence of environmental and social sustainability activities and initiatives of the enterprise in every of 3 levels as well as to express their overall satisfaction regarding company's performance. On purpose to perform easier and time efficient preliminary evaluation, the public opinion surveys with the respondents that do not essentially belong to the clientele group of particular enterprises, were introduced. However, as both companies are well-known, the results of these surveys reflected the general public opinion. The study was conducted from March to May in 2015 by applying 2 surveying methods, i.e. a questionnaire distributed on the web (online) and a survey in .doc format distributed as an attachment on e-mail, ensuring the possibility for respondents to decide personally which form is most suitable for them. The sample size was 77 respondents for company No. 1 and 59 respondents in the case of company No. 2. More than half of the interviewees (54%) from the first group stated that they were the clientele of company No. 1 and 21% of the respondents from the second group belonged to the clientele of company No. 2.

The major part of the respondents that assessed both companies were women (84% in both cases) aged from 20 to 29 (51% for company No.1 and 53% for company No. 2) who lived in one of 5 biggest Lithuanian cities (60% and 79%) and had university education (51% and 63%). The biggest part of the interviewed subjects were single (46% and 58%), worked as specialists of a particular field or as officers (41% and 53%) and lived with one more family member (51% and 68%). The household incomes of the interviewees reached from EUR 501 to 700 (27%) in the case of company No. 1 or from EUR 1101 to 1500 (32%) in the case of company No. 2 respondents. While investigating their attitude towards sustainability issues, even 49% and 58% of the interviewees stated that environmental and social sustainability of the products they consumed and the services they chose were 'very important' or 'important' to them. Unfortunately, even 38% and 37% respondents rarely considered these criteria in real life circumstances.

During the surveying, the respondents were asked to evaluate each of the 25 presented statements, related to manufacturing processes/company's activities, products/services and collaboration with stakeholders as well as their general satisfaction regarding company's sustainability activities (Jonkutė, 2015). They were requested to rate these statements on a 5-point Likert scale, assessing the level of their acceptance of each item (where 1 = strongly disagree, 5 = strongly agree). The results of the surveys were compiled and the mean values of each set of statements were determined (see Table 1).

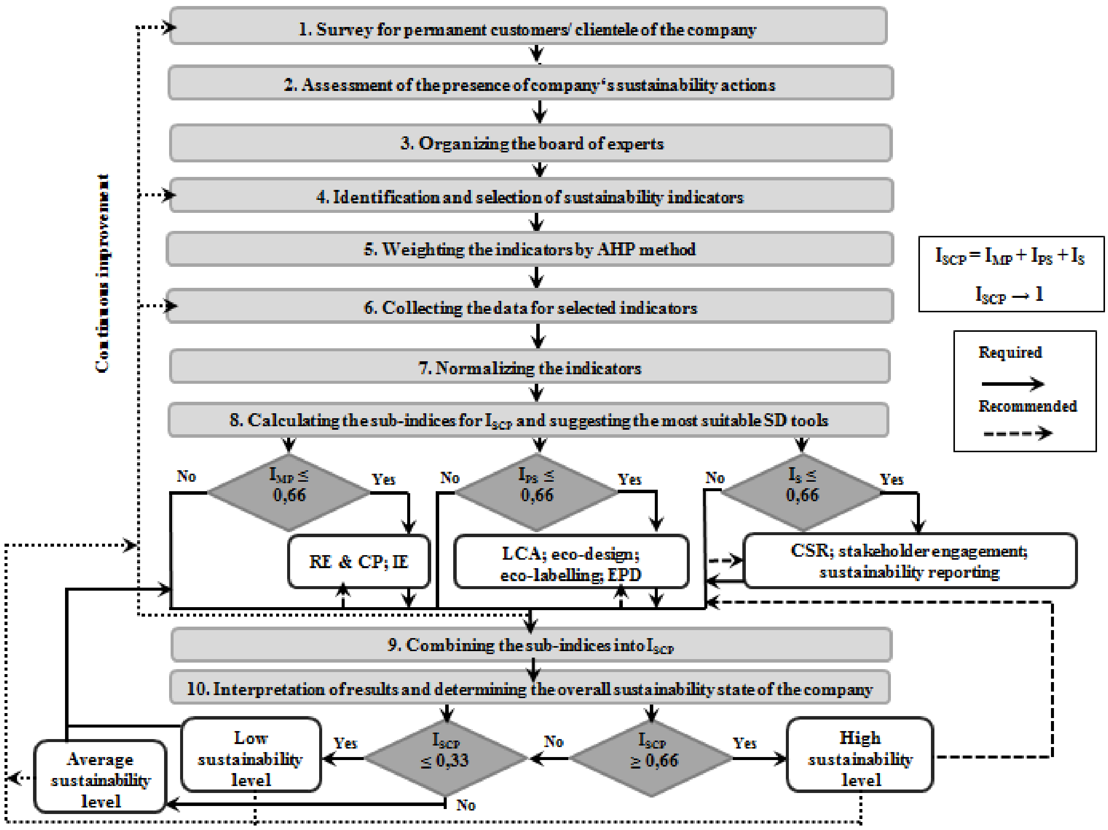

Figure 1. The algorithm for integrated sustainability assessment of the overall company state (Jonkutė, 2015).

2.2 Assessment of the presence of company's sustainability actions

The presence of company's sustainability actions related to manufacturing processes/ company's activities, products/ services and stakeholders is based on the values of the coefficients K_j (K_{MP}, K_{PS} and K_S) that were evaluated recalculating the mean values of the respondents' answers to the parts of percentage (where 1 → 0; 2

→ 0.25; 3 → 0.5; 4 → 0.75 and 5 → 1) (Table 1). The index of general green customers' satisfaction I_{GCS} was calculated similarly to the coefficients K_j, assessing the average results of the respondents' answers from the fourth set of statements.

2.3 Organising the board of experts

As different stakeholders of the company have different priorities, needs and expectations, they could share decision-making power with corporate management (Madsen and Ulhøi, 2001) in the following steps of identification, selection and weighting of sustainability indicators. Ideally, the board of experts should include representatives from all the internal and external stakeholder groups of a company.

However, in order to simplify the testing procedure, the step of the organisation of the board of experts was excluded and replaced by the communication with one representative from each company.

Table 1. The average evaluation results of the sustainability state of the companies according to respondents' answers.

Company	The average evaluation results of the sustainability state of the company according to respondents' answers						Respondents' overall satisfaction regarding company's performance	
	Manufacturing processes/company's activities		Products/services		Relationship with stakeholders			
	Likert scale value	Parts of percentage	Likert scale value	Parts of percentage	Likert scale value	Parts of percentage	Likert scale value	Parts of percentage
No. 1	3.27	0.65	3.28	0.66	3.25	0.65	3.20	0.64
No. 2	3.41	0.68	3.46	0.69	3.41	0.68	3.26	0.65

2.4 Identification and selection of sustainability indicators

To make sustainability performance evaluation meaningful in terms of better enterprise management, a company has to develop its own individual set of indicators that reflect its profile and needs (Labuschagne *et al.*, 2005; Staniškis and Arbačiauskas, 2009). Azapagic (2003) advises that indicators should be quantitative whenever possible; however, for societal aspects of sustainability, qualitative descriptions may be more appropriate (Krajnc and Glavič, 2005a).

In this step, the quantitative and qualitative sustainability indicators related to manufacturing processes, products/services and collaboration with stakeholders were identified. It is recommended to use the list of performance indicators from Global Reporting Initiative (GRI) guidelines as a primary set of indicators to perform this identification. In order to ascertain the most relevant indicators for a particular company, every individual from the aforementioned board of experts should be asked to rate each of them on a 5-point Likert scale. The results should be compiled and the mean value of each indicator should be determined. The best rated indicators for each level should be selected for further weighting procedure in step 6.

Since both enterprises are already more or less engaged in the sustainability reporting based on GRI, the indicators were selected without the additional assessment procedure of companies' representatives. Sustainability indicators (52 in the case of company No. 1 and 40 in the case of company No. 2) that were already measured and reported by the enterprises were chosen according to the recommendations from GRI checklists for particular business sectors. These indicators were classified to the 3 levels related to manufacturing processes (or company's activities in the case of service company), products/ services and relations with stakeholders. Thus, 9 (company No. 1) and 5 (company No. 2) indicators were included in the group of manufacturing processes/company's activities; 13 and 8 indicators at the products/services level; and 30 and 27 indicators in the group of cooperation with stakeholders. All the selected indicators for all the 3 levels in both enterprises are listed in Tables 2−7.

Table 2. Selected indicators related to manufacturing processes/company's activities of company No. 1.

No. by GRI	Indicator related to manufacturing processes/company's activities of company No. 1	Mea-sure	Annual value of indicator $I_{A,ijt}$ during the period of 2011-2013	W_{ji}	K_j
EN1	Savings in consumption of paper invoices/bills	%	1.25 - 8.10	0.034	0.65
	Savings in energy consumption for administrative purposes	%	9.69 - 5.60	0.095	
EN7	Initiatives to reduce indirect energy use	*	1	0.111	
EN8	Savings in total water consumption	%	3.20 - 0.95	0.059	
EN18	Initiatives to reduce greenhouse gas emissions	*	1	0.206	
EN22	Total amount of paper waste	kg	1608.80 - 4470.00	0.089	
	Percentage of sorted office waste	%	16.40 - 19.30	0.135	
EN23	Total number of significant spills	1	0	0.015	
EN28	Total number of monetary and non-monetary sanctions for non-compliance with environmental laws and regulations	1	0	0.256	

** - Numerical evaluation of company's qualitative indicators*

Table 3. Selected indicators related to manufacturing processes/company's activities of company No. 2.

No. by GRI	Indicator related to manufacturing processes/ company's activities of company No. 2	Mea-sure	Annual value of indicator $I_{A,ijt}$ during the period of 2011-2013	W_{ji}	K_j
EN3	Total amount of direct energy consumption by non-renewable primary energy sources	MWh	2257.42 - 2843.40	0.306	0.68
EN7	Initiatives to reduce indirect energy use	*	0.5	0.367	
EN8	Total water consumption	m^3	6248 - 6748	0.063	
EN18	Initiatives to reduce greenhouse gas emissions	*	0.5	0.164	
EN22	Total amount of composite municipal waste	t	44.74 - 72.18	0.100	

* - *Numerical evaluation of company's qualitative indicators*

Table 4. Selected indicators related to products/services of company No. 1.

No. by GRI	Indicator related to products/services of company No. 1	Mea-sure	Annual value of indicator $I_{A,ijt}$ during the period of 2011-2013	W_{ji}	K_j
EN1	Savings in automobile fuel consumption	%	0.50 - 11.40	0.016	0.66
EN5	Energy saved due to conservation and efficiency improvements	kWh	750800 - 90900	0.090	
EN6	Energy efficiency initiatives in place to reduce the energy requirements of major products/product groups and services	*	1	0.098	
EN18	Initiatives to reduce greenhouse gas emissions arising from products and services delivery	*	1	0.097	
PR2	Total number of incidents of non-compliance with regulations and voluntary codes concerning health and safety impacts of products and services	1	0	0.061	
PR3	Procedures for information provision of products and services	*	1	0.077	
PR9	Total monetary value of significant fines for non-compliance with laws and regulations concerning the provision and use of products and services	mln, EUR	0	0.094	
IO1	Capital investment in infrastructure of telecommunications network	mln, EUR	43.73 - 45.18	0.100	
PA3	Strategies and actions to ensure the availability and reliability of products and services	*	1	0.118	
PA6	Programs and actions to provide and maintain services in emergency situations	*	1	0.112	
PA11	Initiatives to inform customers about responsible, efficient and environmentally preferable product use	*	1	0.049	
TA1	Efficient consumption of resources related with telecommunications products and services	*	1	0.062	
TA2	Telecommunications products and services replacing physical objects	*	1	0.026	

* - *Numerical evaluation of company's qualitative indicators*

2.5 Weighting the indicators by the AHP method

To determine the weights of indicators, the evaluators are often confronted with a lack of data. Therefore, the pair-wise comparison technique is used in order to derive relative weights of each indicator practically. The pair-wise comparison technique is based on the method developed by the operation research pioneer Saaty (1980) and is called the AHP (Krajnc and Glavič, 2005a).

The representatives of both companies were asked to weight the indicators in each of the 3 levels by applying the AHP pair-wise comparison technique. These pair-wise comparisons between each pair of the indicators were made by posing the question which of them was more important with respect to the ultimate SCP goals of the company, namely resources and energy savings as well as increasing in consumers' acceptance and satisfaction. The intensity of preference was expressed on a factor scale from 1 to 9 (where 1 = equal indicators, 9 = one indicator is nine times the importance of the other). The same process of comparison was repeated for each column of the matrix, making independent judgments over each pair of indicators (Krajnc and Glavič, 2005. 2005a; Singh *et al.*, 2007). Saaty (1996) has shown that solving the right eigenvector of the matrix will provide an excellent estimate of the relative weights W_{ji} of the indicators evaluating their priority level (Singh *et al.*, 2007). The examples of the matrices for the estimation of these relative weights of the indicators for manufacturing processes/company's activities in both enterprises are presented in Tables 8 and 9.

Table 5. Selected indicators related to products/services of company No. 2.

No. by GRI	Indicator related to products/services of company No. 2	Mea-sure	Annual value of indicator $I_{A,ijt}$ during the period of 2011-2013	W_{ji}	K_j
EN4	Total amount of indirect energy consumption by non-renewable primary energy sources	MWh	1966 - 3172	0.164	0.69
EN6	Energy efficiency initiatives in place to design new buildings and infrastructure and redevelop existing buildings	*	1	0.100	
EN22	Total amount of composite construction and demolition waste	t	1607.57-2760.11	0.091	
	Total amount of forestry waste	t	45.22 - 61.16	0.021	
	Total amount of hazardous waste	t	0.74 - 2.68	0.109	
EN26	Environmental management initiatives to manage existing buildings and construction sites efficiently	*	1	0.168	
EN29	Mitigation measures of environmental impacts of transporting products, materials and members of the organization's workforce	*	0.5	0.120	
PR1	Assessment of health and safety impacts of real estate and infrastructure assets	*	1	0.228	

** - Numerical evaluation of company's qualitative indicators*

2.6 Collecting the data for selected indicators

This step of the algorithm involves the collection of the reliable, high quality quantitative and qualitative data for the previously selected indicators, reflecting the performance of a company for the period of 1 year or 3 years. As Kinderytė (2010, 2011, 2013) suggested, the evaluation of the company's sustainability according to qualitative indicators is built on a 3-level scale: worst evaluation - 0; medium evaluation - 0.5 and best evaluation - 1. All the collected quantitative and qualitative data for all the selected indicators reflecting the performance of both companies for the period from 2011 to 2013 are presented in Tables 2−7.

2.7 Normalizing the indicators

The main problem of aggregating a set of indicators into an integrated one is the fact that they may be expressed in different units. One way to solve this problem could be to normalise each indicator (Kinderytė, 2010, 2011; Krajnc and Glavič, 2005. 2005a). The normalisation of all the indicators was made by applying the Min-Max (Kinderytė, 2010, 2011, 2013; Krajnc and Glavič, 2005, 2005a) method. In order to minimise sensitivity of this normalisation, particular normalisation conditions, suggested by Kinderytė (2013), were defined (Jonkutė, 2015).

2.8 Calculating the sub-indices for I_{SCP} and suggesting the most suitable SD tools

The sub-indices $I_{S,jt}$ for all the 3 levels − manufacturing processes/company's activities (I_{MP}), products/services (I_{PS}) and stakeholders (I_S) − were evaluated, considering the weights of every indicator W_{ji} from the AHP weighting procedure as well as coefficients K_j generated from the public survey.

Each of these sub-indices shows the tendency of company's sustainability development regarding the SCP in one of the corresponding levels. The minimal value of a particular sub-index demonstrates that the related level is the weakest in the whole system and, thus, the condition of it should be improved by applying suitable tools and measures. If the lowest value is recorded at the level of manufacturing processes/company's activities ($I_{MP} \leq 0.66$), the model suggests realising resource efficiency and cleaner production (RE and CP) as well as industrial ecology (IE) opportunities. Poorest conditions regarding the characteristics of products and services ($I_{PS} \leq 0.66$) can be fixed by applying life cycle assessment (LCA) based measures, such as eco-design, eco-labelling and environmental product declarations (EPD). If the weakest area of an enterprise seems to be relations with stakeholders ($I_S \leq 0.66$), the corporate social responsibility (CSR) according to an international standard ISO 26000, various stakeholder engagement initiatives as well as improvements in sustainability reporting should be reconsidered.

As the results of the sub-indices showed the similar moderate results in the case of both companies (0.5 - 0.6 in company No. 1 and 0.4 - 0.5 in company No. 2) (Table 10), the enterprises are strongly recommended to reconsider all the 3 levels of their performance by applying some of the recommended measures and tools or at least by correcting the management and operation of already implemented ones.

Table 6. Selected indicators related to various stakeholders of company No. 1.

No. by GRI	Indicator related to various stakeholders of company No. 1	Mea-sure	Annual value of indicator $I_{A,ijt}$ during the period of 2011-2013	W_{ji}	K_j
EC1	Revenues	mln. EUR	0.210 - 0.220	0.089	0.65
	Employee wages and benefits	mln. EUR	0.046 - 0.049	0.021	
	Social investments	mln. EUR	0.347×10^{-3} - 0.377×10^{-3}	0.018	
EC4	Total financial assistance received from government	mln. EUR	0 - 0.015	0.014	
EN26	Initiatives to mitigate environmental impacts of products and services between suppliers	*	1	0.027	
LA1	Total workforce	1	3034 - 3303	0.009	
LA4	Percentage of total employees covered by collective bargaining agreements	%	100	0.037	
LA7	Total number of accidents	1	2 - 26	0.100	
LA8	Education/ training programs in place to assist workforce members, their families or community members regarding serious diseases	*	0.5	0.016	
LA10	Average number of hours of training per year per employee	h	17.10 - 36.80	0.014	
LA11	Programs for skills management and lifelong learning that support the continued employability of employees and assist them in managing career	*	0.5	0.007	
LA12	Percentage of employees receiving regular official performance and career development reviews	%	100	0.008	
	Percentage of employees that developed career	%	4.00 - 9.20	0.010	
HR3	Percentage of employees trained in policies and procedures concerning aspects of human rights	%	0 - 98.70	0.010	
HR4	Total number of incidents of discrimination	1	0	0.015	
HR5	Measures taken to support rights to freedom of association and collective bargaining	*	0	0.020	
HR6	Operations considered to have significant risk for incidents of child labour	*	1	0.015	
SO2	Total number of business units analysed for risks related to corruption	1	0	0.042	
SO3	Percentage of employees trained in organization's anti-corruption policies and procedures	%	0 - 98.7	0.012	
SO5	Participation in public policy development	*	0	0.004	
SO7	Total number of legal actions for anti-competitive behaviour, anti-trust and monopoly practices	1	0	0.059	
SO8	Monetary value of fines for anti-competitive behaviour, anti-trust and monopoly practices	mln. EUR	0	0.056	
PR5	Practices in place to assess and maintain customer satisfaction	*	1	0.062	
PR6	Programs for adherence to laws, standards and voluntary codes related to marketing communications, including advertising, promotion and sponsorship	*	1	0.043	
PR7	Total number of incidents of non-compliance with regulations and voluntary codes concerning marketing communications	1	0	0.062	
	Monetary value of fines of incidents of non-compliance with regulations concerning marketing communications	mln. EUR	0	0.065	
PR8	Total number of substantiated complaints regarding breaches of customer privacy and losses of customer data	1	0 - 4	0.070	
PA1	Strategies and actions to implement telecommunications infrastructure and ensure access of services in low population density areas	*	1	0.035	
PA2	Strategies and actions to overcoming barriers for telecommunications services access and use	*	0.5 - 1	0.024	
PA10	Initiatives to ensure clarity of telecommunications services charges and rates	*	1	0.034	

** - Numerical evaluation of company's qualitative indicators*

Table 7. Selected indicators related to various stakeholders of company No. 2.

No. by GRI	Indicator related to various stakeholders of company No. 2	Mea-sure	Annual value of indicator $I_{A,ijt}$ during the period of 2011-2013	W_{ji}	K_j
EC1	Revenues	mln. EUR	36.49 - 40.55	0.059	0.68
EC5	Standard average monthly wage for women employees	EUR	430.95 - 480.19	0.047	
	Standard average monthly wage for men employees	EUR	543.04 - 606.17	0.038	
EC8	Significant investments and support on communities and local economies	*	1	0.068	
LA1	Total workforce	1	394 - 399	0.033	
	Total number of women employees	1	56 - 69	0.051	
	Total number of men employees	1	328 - 341	0.028	
LA2	Total number of new employee hires	1	77 - 330	0.048	
	Total number of employees leaving employment	1	103 - 280	0.027	
LA4	Percentage of total employees covered by collective bargaining agreements	%	100	0.024	
LA7	Total number of accidents	1	0 - 3	0.048	
LA8	Education/ training programs in place to assist workforce members, their families or community members regarding serious diseases	*	1	0.035	
	Preventive measures in place where there is high incidence or high risk of specific diseases	*	1	0.032	
LA9	Formal agreements with trade unions covering health and safety aspects	*	1	0.046	
LA10	Average number of hours of training per year per employee	h	3117 - 7568	0.038	
LA12	Number of employees receiving regular official performance and career development reviews	1	116 - 125	0.031	
LA13	Number of employees within the organization‘s governance bodies	1	68 - 75	0.042	
LA15	Number of employees that took parental leave	1	2 - 8	0.039	
HR4	Total number of incidents of discrimination	1	0	0.034	
HR5	Operations and significant suppliers identified in which employee rights to exercise freedom of association or collective bargaining may be at risk	*	0	0.020	
HR6	Operations and significant suppliers considered to have significant risk for incidents of child labour	*	0	0.038	
HR7	Operations and significant suppliers considered to have significant risk for incidents for compulsory labour	*	0	0.029	
SO2	Total number of business units analysed for risks related to corruption	1	0	0.025	
SO7	Total number of legal actions for anti-competitive behaviour, anti-trust and monopoly practices	1	0	0.035	
PR5	Practices in place to assess and maintain customer satisfaction	*	1	0.036	
PR6	Codes or voluntary standards related with marketing communications	*	1	0.024	
CRE6	Percentage of employees (labour) internally verified to be operating in compliance with the health and safety management systems	%	1.71 - 2.09	0.026	

* - *Numerical evaluation of company‘s qualitative indicators*

2.9 Combining the sub-indices into I_{SCP}

Finally, the calculated sustainability sub-indices $I_{S,jt}$ were combined into the integrated index for the assessment of the overall SCP state of the company I_{SCP}. The equal weights for all the sub-indices were used (Kinderytė, 2011, 2013; Krajnc and Glavič, 2005, 2005a).

2.10 Interpretation of results and determination of the overall sustainability state of the company

In general, the integrated index helps to make decisions about the overall level of enterprise’s sustainability (Azapagic, 2003; Kinderytė *et al.*, 2010) and highlight the achieved progress (Azapagic, 2003; Krajnc and Glavič, 2005a; Singh *et al.*, 2007). The higher the value of the index, the greater the improvement of the company towards sustainability. Moreover, if analogous methodology and similar indicators for index calculation were applied to different companies, it would be possible to compare and rank them according to the current sustainability state (Krajnc and Glavič, 2005, 2005a). However, as the preliminary verification of this algorithm was made in 2 very different enterprises which consider and assess diverse indices, this comparison was not possible.

Table 8. Pair-wise comparisons and relative weights of the indicators related to manufacturing processes/company's activities of company No. 1.

Pair-wise comparisons of the indicator related to manufacturing processes/company's activities of company No. 1										**Relative weights W_{ij} (average value of each row)**
No. by GRI	**EN1-1**	**EN1-2**	**EN7**	**EN8**	**EN18**	**EN22-1**	**EN22-2**	**EN23**	**EN28**	
EN1-1	1.00	0.33	0.25	0.50	0.14	0.33	0.17	5.00	0.14	
EN1-2	3.00	1.00	0.33	3.00	0.20	2.00	1.00	7.00	0.25	
EN7	4.00	3.00	1.00	1.00	0.50	1.00	1.00	8.00	0.33	
EN8	2.00	0.33	1.00	1.00	0.33	0.33	0.25	6.00	0.25	
EN18	7.00	5.00	2.00	3.00	1.00	3.00	2.00	8.00	0.50	
EN22-1	3.00	0.50	1.00	3.00	0.33	1.00	0.50	7.00	0.33	
EN22-2	6.00	1.00	1.00	4.00	0.50	2.00	1.00	8.00	0.50	
EN23	0.20	0.14	0.13	0.17	0.13	0.14	0.13	1.00	0.11	
EN28	7.00	4.00	3.00	4.00	2.00	3.00	2.00	9.00	1.00	
∑	33.20	15.31	9.71	19.67	5.13	12.81	8.04	59.00	3.42	
Ratio between each pair-wise comparison and the sum of each column of comparisons										
EN1-1	0.030	0.022	0.026	0.025	0.028	0.026	0.021	0.085	0.042	0.034
EN1-2	0.090	0.065	0.034	0.153	0.039	0.156	0.124	0.119	0.073	0.095
EN7	0.120	0.196	0.103	0.051	0.097	0.078	0.124	0.136	0.097	0.111
EN8	0.060	0.022	0.103	0.051	0.065	0.026	0.031	0.102	0.073	0.059
EN18	0.211	0.327	0.206	0.153	0.195	0.234	0.249	0.136	0.146	0.206
EN22-1	0.090	0.033	0.103	0.153	0.065	0.078	0.062	0.119	0.097	0.089
EN22-2	0.181	0.065	0.103	0.203	0.097	0.156	0.124	0.136	0.146	0.135
EN23	0.006	0.009	0.013	0.008	0.024	0.011	0.016	0.017	0.032	0.015
EN28	0.211	0.261	0.309	0.203	0.390	0.234	0.249	0.153	0.292	0.256

Table 9. Pair-wise comparisons and relative weights of the indicators related to manufacturing processes/company's activities of company No. 2.

Pair-wise comparisons of the indicator related to manufacturing processes/company's activities of company No. 2						**Relative weights W_{ij} (average value of each row)**
No. by GRI	**EN3**	**EN7**	**EN8**	**EN18**	**EN22**	
EN3	1.00	1.00	4.00	2.00	3.00	
EN7	1.00	1.00	5.00	3.00	4.00	
EN8	0.25	0.20	1.00	0.33	0.50	
EN18	0.50	0.33	3.00	1.00	2.00	
EN22	0.33	0.25	2.00	0.50	1.00	
∑	3.08	2.78	15.00	6.83	10.50	
Ratio between each pair-wise comparison and the sum of each column of comparisons						
EN3	0.324	0.359	0.267	0.293	0.286	0.306
EN7	0.324	0.359	0.333	0.439	0.381	0.367
EN8	0.081	0.072	0.067	0.049	0.048	0.063
EN18	0.162	0.120	0.200	0.146	0.190	0.164
EN22	0.108	0.090	0.133	0.073	0.095	0.100

Table 10. Values of the integrated index for the assessment of overall SCP state of the company I_{SCP} and its 3 sub-indices as well as index of general green customers' satisfaction I_{GCS} in both companies.

Value of sub-indices and integrated index	**Company No. 1**	**Company No. 2**
I_{MP}	0.45	0.38
I_{PS}	0.57	0.54
I_S	0.45	0.47
I_{SCP}	0.49	0.46
I_{GCS}	0.64	0.65

The integrated index I_{SCP} that is proposed in the algorithm can help to disclose the overall SCP state of a company. If this index is less than the value 0.33, a particular company can be named as unsustainable and should urgently rethink the whole business strategy, implementing all the possible actions and measures in all the system levels with the purpose to improve its overall sustainability condition. If the calculated value lies between 0.33 and 0.66, an enterprise shows an average level of the sustainability state regarding the implementation of SCP practices. In this case, it is strongly recommended to implement suitable measures and tools, especially in those particular levels which show the worst results according to the values of sub-indices. And finally, if I_{SCP} exceeds the critical value of 0.66, it can be stated that an enterprise is on the right way to become comprehensively sustainable and its overall sustainability is high, as the value of I_{SCP} is closer to 1. However, even on a high level of sustainability, a company can still improve its current sustainability state by implementing additional measures and tools and, thus, exploiting all its sustainability potential.

Calculated values of the composite index I_{SCP} indicated an average level of the sustainability state regarding the implementation of overall SCP practices in both companies (I_{SCP} = 0.46 - 0.49; 0.33 ≤

$I_{SCP} \leq 0.66$) (see Table 8). As it was stated earlier, all the sub-indices also showed moderate results ($I_{S,jt} \leq 0.66$) in the case of both companies; therefore, the enterprises are strongly recommended to reconsider all their performance by applying some of the recommended measures and tools for each of the 3 levels.

Furthermore, the value of the green customers' satisfaction index I_{GCS}, which was determined from the average results of the respondents' answers in step 2, can also be helpful as an additional parameter to appreciate purchasers' general satisfaction regarding environmental and social sustainability of company's activities and products/services. Analogous to the integrated index I_{SCP}, the general satisfaction of sustainably engaged customers is high, as the value of I_{GCS} is closer to 1.

The results of the public survey disclosed that consumers were more than moderately satisfied towards the enterprises' sustainability initiatives ($I_{GCS} = 0.64$ for company No. 1 and $I_{GCS} = 0.65$ for company No. 2).

Periodical review of the customers' opinion and periodical assessment of the company's sustainability state

Periodical review of the customers' opinion and periodical assessment of the company's sustainability state constitute a very important part of the algorithm that guarantees continuous improvement of the enterprise's sustainability state. These assessments could help to estimate the results of sustainability enhancement concerning newly implemented measures and to observe changes in the customers' opinion. Periodical review and assessment can be realised in 3 levels – by applying the algorithm from the very beginning or by performing the inner evaluation selecting new sustainability indicators or barely collecting data for indicators that were already chosen to estimate the changes in 3 levels of company's activities. However, it is clear that during preliminary verification of the algorithm this step is not required.

It should be noted that this preliminary verification definitely has some limitations. First of all, the public surveying cannot guarantee that the respondents are enough familiar with companies' activities and the real situation regarding the presence of sustainability initiatives in the enterprises. Moreover, the simplified weighting procedure including only one representative from each company could produce possibly subjective evaluation results. In order to sufficiently assess the application of the model, it is necessary to proceed with similar verification procedures covering a larger number of enterprises from different business sectors, while trying to ensure that surveying is allocated to the companies' clientele and the AHP weighting is performed by at least several companies' representatives or preferably by a team of members from different stakeholder groups.

Nevertheless, despite the above discussed limitations, the results obtained are sufficient to propose that the algorithm is universal enough to be adapted for companies from various sectors of activities involving different manufacturing enterprises as well as service companies and organisations. Since the algorithm was created as a guidance to apply theretofore designed SURESCOM (SUstainable and RESponsible COMpany) model based on an integrated management system (Jonkutė and Staniškis, in press), this framework can be easily incorporated into the common management system of any enterprise.

3 Conclusions and recommendations

The suggested algorithm offers methodical suggestions to assess the customers' opinion about the presence of company's environmental and social sustainability activities and initiatives; to identify and select most appropriate sustainability indicators; to determine their significance according to the analytic hierarchy process; and to solve the most important sustainability problems in 3 levels – manufacturing processes/company's activities, products/services and stakeholders by adapting the most suitable tools. The final suggestions were based on the values of the 3 sub-indices of an integrated index for the overall assessment of the SCP state in the company I_{SCP}. Moreover, the simple additional parameter to appreciate customers' general satisfaction regarding environmental and social sustainability of company's activities and products/services – the green customers' satisfaction index I_{GCS} – was also introduced.

The algorithm ensures an appropriate systematic relation between consumption and production. It incorporates the feedback of customers as well as the decision power of other main company's stakeholders and guarantees the promotion of SCP through more sustainable design, production and distribution of products and services as well as other company's activities, simultaneously stimulating the demand for more sustainable products/services.

In respect of the demand to examine the real potential of this theoretical algorithm, the verification procedure was performed in 2 large, well-known Lithuanian enterprises from different business sectors. The calculated values of the composite index I_{SCP} indicated an average level of the sustainability state regarding the implementation of overall SCP practices in both companies. As the results of the sub-indices were moderate in the case of both companies, the enterprises are strongly recommended to reconsider all 3 levels of their performance by applying some of the recommended measures and tools or at least by correcting the management and operation of already implemented ones. The results of the public survey disclosed that consumers were more than moderately satisfied towards the sustainability initiatives of both enterprises.

The preliminary results of algorithm verification, despite all the discussed limitations, are sufficient to propose that it is universal enough to be adapted for companies from various sectors of activities involving different manufacturing enterprises as well as service companies and organisations by applying particular modifications.

References

Azapagic, A. (2003). Systems approach to corporate sustainability. A general management framework. *Chemical Engineering Research and Design*, 81. 303-316. http://dx.doi.org/10.1205/095758203770224342.

Carson, N. (2007). *A business primer. Sustainable consumption and production*, pp. 4-23. Cambridge, UK: University of Cambridge programme for industry.

Dahl, A. L. (2012). Achievements and gaps in indicators for sustainability. *Ecological Indicators*, 17. 14-19. http://dx.doi.org/10.1016/j.ecolind.2011.04.032.

Gold, S., Seuring, S., & Beske, P. (2010). Sustainable supply chain management and inter-organizational resources: a literature review. *Corporate Social Responsibility and Environmental Management*, 17. 230-245.

Hertwich, E. G. (2005). Life cycle approaches to sustainable consumption: a critical review. *Environmental Science & Technology*, 39(13), 4673-4684. http://dx.doi.org/10.1021/es0497375.

Jackson, T. (2005). Live better by consuming less? Is there a "double dividend" in sustainable consumption? *Journal of Industrial Ecology* 9(1-2), 19-36. http://dx.doi.org/10.1162/1088198054084734.

Jonkutė, G. (2015). The assessment of overall SCP state of the company: new integrated sustainability index ISCP. *Environmental Research, Engineering and Management*, 71(3), [unpublished results].

Jonkutė, G. & Staniškis, J. K. (in press). Realizing SCP in the companies: the SURESCOM model. *Journal of Cleaner Production*. Preprint, submitted March 30. 2015.

Kang, Y., Ryu, M.-H., & Kim, S. (2010). Exploring sustainability management for telecommunications services: A case study of two Korean companies. *Journal of World Business*, 45. 415-421. http://dx.doi.org/10.1016/j.jwb.2009.08.003.

Kinderytė, L. (2010). Methodology of sustainability indicators determination for enterprise assessment. *Environmental Research, Engineering and Management*, 2(52), 25-31.

Kinderytė, L., Čiegis, R., & Staniškis, J. K. (2010). Assessment of enterprise performance for efficient sustainability. *Transformations in Business & Economics* 9(3), 104-118.

Kinderytė, L. (2011). Sustainability assessment of enterprises in printing industry. *Environmental Research, Engineering and Management*, 4(58), 59-64. http://dx.doi.org/10.5755/j01.erem.58.4.674.

Kinderytė, L. (2013). *Model of the system for enterprise sustainability assessment* [Summary of doctoral dissertation], pp. 5-25. Kaunas, Lithuania: Technologija.

Krajnc, D. & Glavič, P. (2005). A model for integrated assessment of sustainable development. *Resources, Conservation and Recycling*, 43. 189-208. http://dx.doi.org/10.1016/S0921-3449(04)00120-X.

Krajnc, D. & Glavič, P. (2005a). How to compare companies on relevant dimensions of sustainability. *Ecological Economics*, 55. 551-563. http://dx.doi.org/10.1016/j.ecolecon.2004.12.011.

Labuschagne, C., Brent, A. C., & van Erck R.P.G. (2005). Assessing the sustainability performances of industries. *Journal of Cleaner Production*, 13. 373-385. http://dx.doi.org/10.1016/j.jclepro.2003.10.007.

Laurinkevičiūtė, A. & Stasiškienė, Ž. (2010). Sustainable development decision-making model for small and medium enterprises. *Environmental Research, Engineering and Management*, 2(52), 14-24.

Madsen, H. & Ulhøi, J. P. (2001). Integrating environmental and stakeholder management. *Business Strategy and the Environment*, 10. 77-88. http://dx.doi.org/10.1002/bse.279.

Saaty, T. L. (1980). *The Analytic Hierarchy Process: planning, priority setting, resource allocation*, New York, USA: McGraw-Hill.

Saaty, T. L. (1996). *Multi-criteria decision making. The Analytic Hierarchy Process*. Pittsburgh, USA: University of Pittsburgh Press.

Sikdar, S. K. (2011). Analysis of systems for sustainability and decision making. In: *Sustainable Consumption and Production: how to make it possible. Book of abstracts of the 2nd international conference*, Kaunas, Lithuania, 29-30 September 2011. p. 18.

Singh, R.K., Murty, H. R., Gupta, S. K., & Dikshit, A. K. (2007). Development of composite sustainability performance index for steel industry. *Ecological Indicators*, 7. 565-588. http://dx.doi.org/10.1016/j.ecolind.2006.06.004.

Singh, R. K., Murty, H. R., Gupta, S. K., & Dikshit, A. K. (2009). An overview of sustainability assessment methodologies. *Ecological Indicators*, 9. 189-212. http://dx.doi.org/10.1016/j.ecolind.2008.05.011.

Singh, R. K., Murty, H. R., Gupta, S. K., & Dikshit, A. K. (2012). An overview of sustainability assessment methodologies. *Ecological Indicators*, 15. 281-299. http://dx.doi.org/10.1016/j.ecolind.2011.01.007.

Staniškis, J. K. & Stoškus, L. (2008). Recommendations for putting sustainable consumption and production into practice in Lithuania. Results of the conference "Time for Action - Towards Sustainable Consumption and Production in Europe". *Environmental Research, Engineering and Management*, 3(45).

Staniškis, J. K. & Arbačiauskas, V. (2009). Modelling sustainable management process on enterprise level. In: *EURO Mini Conference KORSD-2009. Proceedings of the 5th International Vilnius Conference*, Vilnius Gediminas Technical University, Vilnius, Lithuania.

Staniškis, J. K., Arbačiauskas, V., & Varžinskas, V. (2012). Sustainable consumption and production as a system: experience in Lithuania. *Clean Technologies and Environmental Policy*, 14. 1095-1105. http://dx.doi.org/10.1007/s10098-012-0509-y.

Stø, E., Throne-Holst, H., Strandbakken, P., & Vittersø, G. (2006). A multi-dimensional approach to the study of consumption in modern societies and the potentials for radical sustainable changes. In *Changes to Sustainable Consumption. Proceedings: of the Workshop of the SCORE! Network*, Copenhagen, Denmark, 20-21 April 2006. pp. 13-20.

Įmonės bendros darnumo būklės įvertinimas tausojančio vartojimo ir darnios gamybos atžvilgiu: naujo sudėtinio darnumo rodiklio I_{SCP} taikymo dviejose įmonėse rezultatai

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Kiekviena įmonė, norėdama įgyvendinti tausojančio vartojimo ir darnios gamybos tikslus, susiduria su iššūkiu ne tik naudoti tinkamus metodus ir priemones, siekiant išspręsti konkrečias darnumo problemas, bet, visų pirma, pasirinkti tinkamiausius darnumo vertinimo rodiklius ir diegti efektyvią veiklos darnumo vertinimo sistemą. Įmonėms gali būti naudinga turėti vieną palyginamąjį sudėtinį rodiklį, sumažinantį darnumo vertinimo kriterijų, į kuriuos reikia atsižvelgti, kiekį.

Atsižvelgiant į išsamių metodinių rekomendacijų įmonės bendros darnumo būklės įvertinimui trūkumą, nagrinėjant jos gamybos procesus, gaminius (paslaugas) ir santykius su suinteresuotomis šalimis, ankstesniame autorės straipsnyje buvo pristatytas algoritmas įmonės bendrai darnumo būklei įvertinti, galintis padėti spręsti svarbiausias problemas, susijusias su gamybos procesais, gaminiais (paslaugomis) ir santykiais su suinteresuotomis šalimis. Minėtose gairėse siūloma įvertinti esamą įmonės darnumo būklę, pagrindžiant ją trijų naujo sudėtinio rodiklio įmonės bendrai darnumo būklei įvertinti tausojančio vartojimo ir darnios gamybos atžvilgiu I_{SCP} subrodiklių skaitinėmis vertėmis. Jomis kuriomis remiantis pasirenkamos bei diegiamos konkrečiai įmonei tinkamiausios darnaus vystymosi priemonės, padėsiančios siekti aplinkosauginio ir socialinio veiksmingumo.

Kadangi pasiūlytas algoritmas buvo tik teoretinio pobūdžio, jo pritaikomumui ir veiksmingumui įvertinti būtinas verifikavimo procesas realiose įmonėse. Dėl šios priežasties straipsnyje apžvelgiami šio algoritmo preliminarios verifikavimo procedūros dviejose didelėse, plačiai žinomose, skirtingų verslo sektorių Lietuvos įmonėse, rezultatai.

Preliminarūs algoritmo verifikavimo rezultatai, nepaisant jo trūkumų, yra pakankami teigti, kad šis algoritmas yra universalus taikyti jį įvairių veiklos sričių įmonėms. Apskaičiuotos I_{SCP} vertės atskleidė vidutinio darnumo lygmens būklę abiejose įmonėse. Remiantis abiem atvejais nustatytomis vidutinėmis subrodiklių vertėmis, organizacijoms ypač rekomenduojama atsižvelgti į visus tris savo veiklos lygmenis, taikant nurodytas priemones ir įrankius arba bent jau koreguojant jau įdiegtų priemonių valdymą ir eksploatavimą.

Raktiniai žodžiai: *tausojantis vartojimas ir darni gamyba, įmonės, darnumo vertinimo rodikliai, sudėtinis rodiklis, analitinis hierarchijos procesas.*