Environmental, Social, Governance and Economics Model of a Company's Sustainable Development as a Base for Investment Decision Making

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ABSTRACT

The paper presents the *SEESG Model* for sustainability assessment of companies using the composite indicator ***Corporate Sustainability Index*** (***ICS***), and their comparison in a case study. The composite indicator ***ICS*** is one of the options for constructing a benchmarking tool for comparing sustainability of companies in a given sector. The aim of this article is to compare manufacturing companies from different EU countries using the Sustainable Environmental, Social, Governance and Economics Model (SEESG Model) and a proposed composite indicator *Index of Corporate Sustainability* (***ICS***). The ***ICS*** integrates 16 economic and non-financial (environmental, social and corporate governance) performance indicators I_{ji}, and is comprised of 5 sub-indices (economic sub-index I_{SEko1} Profitability; environmental sub-index I_{SEn1} Waste and Emissions and sub-index I_{SEn2} Resources consumption; social sub-index I_{SSoc2} *Labour practices and Decent Work* and corporate governance sub-index I_{SCg} *Monitoring and reporting corporate governance*. Weights were determined by the PCA method. In the case study, six companies from the manufacturing industry from different countries were compared and the effectiveness of the composite indicator ***ICS*** in assessing sustainability was evaluated. Conclusions from the case study proved the suitability of the composite indicator ***ICS*** for comparing companies within the same industry, and for assessing corporate sustainability. For this reason, the *SEESG Model* for corporate sustainability assessment can be offered as a consistent and flexible model for investors. The use of the composite indicator ***ICS*** will make it possible for investors to integrate sustainability into their decision-making processes, achieve economic growth and help protect the environment as well as social values.

Keywords: sustainability, composite indicator, sub-indexes, model, Principal Component Analysis, PCA, company.

1. INTRODUCTION

Corporate sustainability cannot be measured or evaluated by any simple model based solely on economic indicators, because simple models lack sufficient information value for both investors and owners. Corporate sustainability can only be measured and evaluated by a well-designed model integrating economic as well as non-financial environmental, social and corporate governance (ESG) indicators. The result of such a model should be a composite corporate sustainability indicator that would not only measure and evaluate the company's sustainability, but, first and foremost, would provide investors with relevant economic and non-financial (environmental, social and corporate governance) information. Investors are interested in obtaining comprehensive information on corporate sustainability because such information helps them make better investment decisions. An incorporation of an integrated composite indicator into their decision-making will allow investors to more comprehensively assess whether the company in question is heading towards sustainability or not, and, at the same time, it can help the company make the world a little better place.

Composite indicators are mostly associated with macroeconomic assessments of countries, but they have also been developed for various sectors of economy (knowledge economy, innovation, technology, human development, economic prosperity, trade, environment, social progress, quality of life, etc.). Frequently used composite indicators include, for example: Sustainability Performance Index (SPI), Compass of Sustainability, Eco-efficiency Indices, Index for Sustainable Economic Welfare (ISEW); the Environmental Sustainability Index (ESI) was compiled by the World Economic Forum for 142 countries [1]; the Wellbeing Index - WI - aggregates 36 indicators [2]; Internal Market Index, Summary Innovation Index [3]; Human Development Index (HDI), Environmental Policy Performance Indicator (EPPI), World Competitiveness Index (WCI), Environmental

Performance Index (EPI), Corruption Perceptions Index (CPI), OECD'S Composite Leading Indicators (CLI) [4]; The Index of Economic Well-Being (IEWB) [5]; and for the social area FTSE4Good Index, Natur-Aktien-Index or Dow Jones Sustainability Indexes (DJSI), etc. Currently, mainly because of the JRC, revision is taking place of existing composite indicators.

Various advanced quantitative approaches (multidimensional statistical methods) are used to construct such composite indicators. Some of the key methods of aggregation used in the construction of the composite indicator include the principal components analysis, factor analysis, distance to targets, expert's opinion (budget allocation) and an analytic hierarchy process.

The research department of the Faculty of Business and Management at Brno University of Technology has studied sustainability at the corporate level since 2010 as part of grant projects of the Grant Agency of the Czech Republic [12], [13], [14], [15] and is currently working on a grant project from the GA CR called "Modelling and simulation of sustainable investment decision-making".

2. MATERIALS AND METHODS

Composite indicators of sustainable development at the corporate level were studied by [6], who constructed the Combined Sustainable Development Index (CSDI) using the concept of the Analytical Hierarchy Process (AHP) model. Author [7], used the AHP model for steel companies. Authors [8], - similar to [9], [10], - note that the most important thing is to establish a conceptual framework consisting of four steps: (1) the selection, (2) the scaling, (3) the weighting and (4) the aggregation of the variables. Based on the theoretical knowledge of the construction of composite indicators at both the macro and the micro levels, the Sustainable Environmental, Social, Governance and Economics Model (SEESG Model) including the composite Index of Corporate Sustainability (I_{CS}) was designed within the framework of the project "Measuring Corporate Sustainability in Selected Sectors" [11], The SEESG Model is based on the concept used for the computation of the Composite Sustainable Development Index presented by [6], and [7].

The *SEESG Model* structure consists of several steps: 1.*the basic conceptual framework for economic, environmental, social and corporate governance groups* $j = \{Eco, En, Soc, Cg\}$; *2. the determination of economic and non-financial (environmental, social and corporate governance) performance indicators* I_{ji}; *3. the classification of indicators according to their positive or negative impact* (I_{ji}^{+}; I_{ji}^{-}); *4. the standardization of* I_{Nj} *indicators; 5. the assignment of weights* w_{ir} *to sub-indices* I_{Nji}; *6. the determination of sustainability sub-indices* I_{Sj}; *7. the assignment of weights* w_{ji} *to sub-indices* I_{Sj}; *8. the determination of the composite "Index of corporate sustainability (*I_{CS}*)",* see Fig.1.

The composite Index of corporate sustainability (I_{CS}) is based on data for the period 2013-2015 from manufacturing companies (211 Czech, 12 Polish, 4 Latvian and 15 Slovak companies) with EMS certification according to ČSN EN ISO 14001.

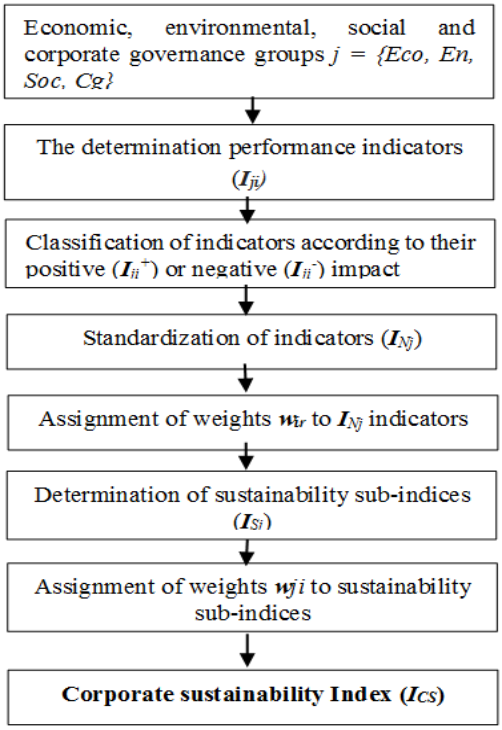

Fig.1 Structure of the composite indicator I_{CS}

The composite indicator I_{CS} the *SEESG Model* is constructed from sub-indices of sustainability I_{Sj} (economic sub-index I_{SEcoi}; environmental sub-index I_{SEnvi}; social sub-index I_{SSoci}; and corporate governance sub-index I_{SCgi}). Determination sub-indices of sustainability I_{Sj} the *SEESG Model*, see Eq.1:

$$I_{Sj} = \sum_{j=1}^{p} w_{ir} I_{Nji};$$

$$\sum_{ji}^{n} w_{ir} = 1,\ w_{ji} \geq 0 \qquad (1)$$

where I_{Nji} ... standardized value of the indicator for the *j-th* group $j = \{Eco, En, Soc, Cg\}$ and the *i-th* indicator, $i = 1,\ldots. p$; p ... number of indicators in the group j, w_{ir} ... the component score to the *i-th* indicator is calculated from standardized variables, I_{Sj} ... are the sustainability sub-indices.

The resulting composite indicator I_{CS} to the Eq.2 [11]:

$$I_{CS} = I_{SEco} + w_{En1} I_{SEn1} + w_{En2} I_{En2} + I_{SSoc} + I_{SCg} \qquad (2)$$

where I_{Sj} ..... sustainability sub-indices of the group $j = \{Eco, En, Soc, Cg\}$; I_{SEco} – *Profitability*; I_{SEn1} – *Waste and Emissions*; I_{SEn2} – *Resource consumption*; I_{SSoc}–*Labour practices and Decent Work*; I_{SCg}–*Monitoring and reporting corporate governance*; w_{ji} - sub-index weight.

The composite indicator I_{CS} is a benchmarking tool. In the *SEESG Model*, this composite indicator gives companies an opportunity to identify areas for improvement, and can also be used for further comparative analyses.

3. CASE STUDY

The companies selected for the case study were two companies from the manufacturing sector according to classification CZ_NACE 24-Manufacture of basic metals, i.e. a Czech foundry SLÉVÁRNY TŘINEC and SIA DILERS LATVIA. Their data come from the period 2013-2015. Data on economic indicators were obtained from the AMADEUS database and annual company reports, data on non-financial indicators were obtained from the Czech Statistical Office and experts of foreign companies. SLÉVÁRNY TŘINEC is one of the most important foundries in the Czech Republic and manufactures mainly high-alloyed steel castings and grey and ductile iron castings. Almost 60 % of its production is exported to Europe and even overseas. SIA DILERS LATVIA specializes in the production of aluminium alloys and currently is one of the leading companies in this sector on the Latvian market. As a player on the European market over several years, the company has proved to be a reliable cooperation partner to the consumers of secondary aluminium alloys who highly appreciate the quality of the products and the accurate delivery terms. Other companies selected for our comparative analysis were from CZ_NACE 28-Manufacture of machinery and equipment. Two companies were from the Czech Republic (IMI INTERNATIONAL and MINERVA BOSKOVICE), one from Poland (BUMAR-HYDROMA POLAND) and one from Slovakia (NISSENS SLOVAKIA). The data were for the period 2013-2015. IMI INTERNATIONAL offers a wide range of high-quality products for pneumatic and hydraulic control, such as drives, air preparation devices, fittings and valves. MINERVA BOSKOVICE manufactures, installs and repairs industrial electric sewing machines and shoe, leather, fabric and haberdashery sewing machines, which make up 93 % of the company's revenue. Cylinders and hydraulic pumps manufactured by BUMAR-HYDROMA POLAND are characterized by modern solutions, construction and production technology, which ensures reliability and durability. NISSENS SLOVAKIA manufactures and supplies refrigerator units for machinery and equipment. These were the companies selected for the application of the *SEESG Model* and the composite indicator I_{CS} in our case study. The selected companies were compared with respect to sustainability using economic, environmental, social and corporate governance sub-indices, which are composed of several indicators. The aim was to find out which company was heading towards sustainability in the years 2013-2015, and which was achieving better results from the sustainability point of view.

3.1 Calculation of the composite indicator of selected companies

In the first phase of the construction of the *SEESG Model* in the case study, economic and non-financial (i.e. environmental, social and corporate governance) performance indicators were determined using empirical analyses:

- economic indicators were obtained from documents from international organizations involved in sustainability, classical financial indicators and from the analysis of bankruptcy and creditworthiness prediction models,
- non-financial indicators are based on information and guidelines of international organizations involved in sustainability issues.

A measure (unit) was assigned to each indicator, see Tab. 1. Using the principal components method and factor analysis, four indicators were set up for economic performance, five for environmental performance, three for social performance, and four for corporate governance. The initial value of I_{ji} indicators was adjusted to reflect their positive or negative impact (performance indicators were divided into I_{ji}^{+} and I_{ji}^{-} indicators according to whether they had a positive or negative impact on corporate sustainability, respectively). The indicators were then standardized using the Z-score method. Each standardized I_{Nji} indicator was assigned a weight w_{ir} reflecting its significance. The weight w_{ir} was determined using the principal component analysis (PCA) method, and the weight w_{ir} of the I_{nji} indicator was determined on the basis of the component score.

In the second phase of the construction of the *SEESG Model*, PCA and factor analysis were used to compute sustainability sub-indices I_{Sj} for the companies in the case study (economic sub-index I_{SEcoi}; environmental sub-index I_{SEnvi}; social sub-index I_{SSoci}; and corporate governance sub-index I_{SCgi}), see Tab. 1.

Sustainability sub-indices I_{Sj} are assigned weights w_{ji} (the importance of the sub-index). The weight of a sub-index is determined based on % of variability, and the sum of all sub-indices is equal to one (a proportion of variability explained by the sub-index in total explained variance (by all sub-indices)). The weights were determined using the PCA method.

In the last phase of the SEESG Model, the composite indicator for enterprises in the case study is calculated, which is given by the sum of calculated sustainability sub-indices (economic sub-index I_{SEcoi}; environmental sub-index I_{SEnvi}; social sub-index I_{SSoci}; and corporate governance sub-index I_{SCgi}) for the period 2013-2015 (Eq.2).

Tab. 1 Performance indicators I_{ji} and sustainability sub-indices I_{Sj}

Sustainability sub-indices I_{Sj}	**Performance indicators I_{ji}**
sub-index I_{SEko1} *Profitability*	I_{NEko1} – ROE
	I_{NEko2} – ROA
	I_{NEko3} – ROS
	I_{NEko4} – ROCE
sub-index I_{SEn1} *Waste and Emissions*	I_{SEn1} – Total annual production of waste / Added value. [t/CZK]
	I_{SEn2} – Total annual production of hazardous waste / Added value. [t/CZK]
	I_{NEn3} – Total emissions to air / Added value [t/CZK]
sub-index I_{SEn2} *Resource consumption*	I_{NEn4} – Non-investment expenditures for the protection of the Environment /Added value,
	I_{NEn5} – Total consumption of renewable energy /Added value. [GJ/CZK]
sub-index I_{SSoc2} *Labour practices and Decent Work*	I_{NSoc1} - Number of terminated employments / Total number of employees in given to period
	I_{NSoc2} - Education and training expenditures / Turnover and I_{NSoc3} - Added value / Wage costs.
	I_{NSoc3} - Added value / Wage costs
sub-index I_{SCg} *Monitoring and reporting corporate governance*	I_{NCg1} - Inform about financial results
	I_{NCg2} - Collective agreement
	I_{NCg3} - Reports from environmental and social areas
	I_{NCg4} - Code of ethics

3.2 Interpretation of results

Sustainability sub-indices (economic sub-index I_{SEcoi}; environmental sub-index I_{SEnvi}; social sub-index I_{SSoci}; and corporate governance sub-index I_{SCgi}) and the composite indicator I_{CS} for companies in the case study are shown graphically in Figs 2-4 for the period 2013-2015.

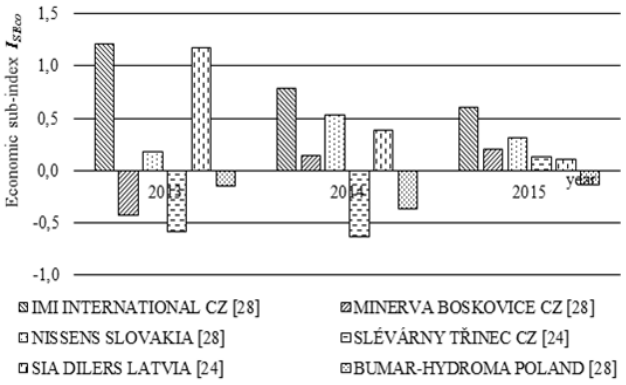

Fig. 2 Economic sub-index for 2013-2015

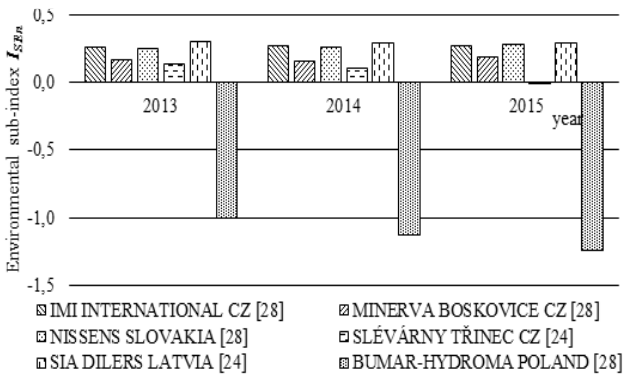

Fig. 3 Environmental sub-index for 2013-2015

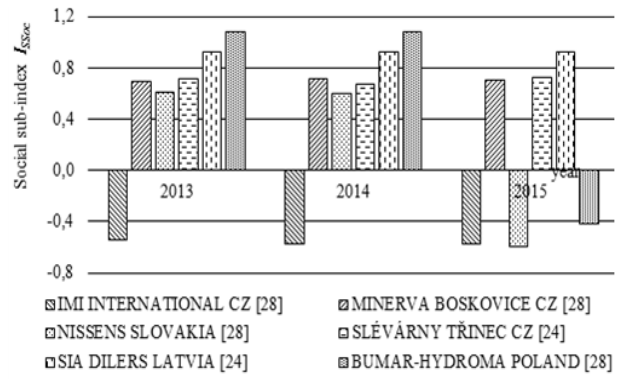

Fig. 4 Social sub-index for 2013-2015

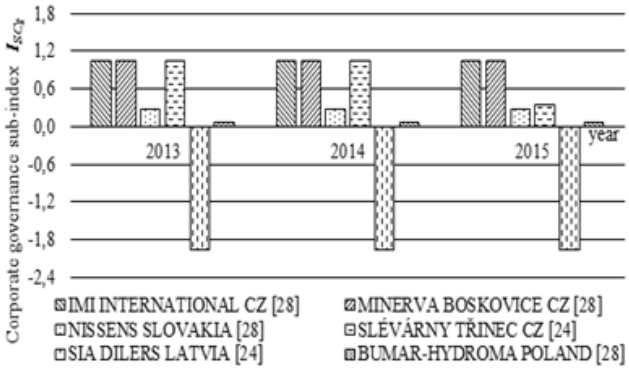

Fig. 5 Corporate governance sub-index for 2013-2015

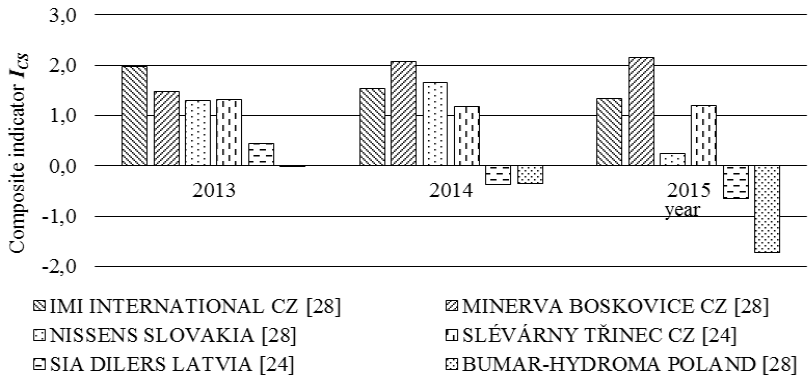

Fig. 6 Composite indicator *Corporate Sustainability Index* I_{CS} for 2013-2015

Evaluation of companies in a case study is based on an assumption that the higher the values of the composite indicator $\boldsymbol{I_{CS}}$, the higher the company's chances of achieving sustainability. A relatively high value of the composite indicator $\boldsymbol{I_{CS}}$ can also be interpreted as a degree of probability that the company will be able to retain its favourable conditions for sustainability. The same also applies to sustainability sub-indices $\boldsymbol{I_{Sj}}$. In each sub-index, there were evident differences in performance between companies in the years 2013-2015.

The environmental sub-index of the companies remained at the same level in the reference period, with the exception of SIA DILERS LATVIA, which not only failed to achieve positive results, but showed negative trends, see Fig. 3. Although the economic sub-index of the companies varied, it nevertheless showed a positive development, BUMAR-HYDROMA POLAND recorded negative values in the period 2013-2015, see Fig. 2. The companies' social sub-index showed a steady increase, with only IMI INTERNATIONAL recording negative values, see Fig. 4. Corporate governance sub-index, see Fig.5.

Results of the case study show differences in the composite indicator $\boldsymbol{I_{CS}}$ in the years 2013-2015, Fig. 6. A comparison between SLÉVÁRNY TŘINEC and SIA DILERS LATVIA shows that the former achieved better results. The value of its composite $\boldsymbol{I_{CS}}$ indicator exceeds 1, i.e. the company is heading towards sustainability, see Tab.2.

Tab.2 Composite indicator Corporate sustainability Index ($\boldsymbol{I_{CS}}$)

Company	CZ_NACE	2013	2014	2015
IMI INTERNATIONAL CZ	28	1.976	1.533	1.347
MINERVA BOSKOVICE CZ	28	1.485	2.073	2.152
NISSENS SLOVAKIA	28	1.309	1.652	0.255
BUMAR-HYDROMA POLAND	28	0.000	-0.343	-1.721
SLÉVÁRNY TŘINEC CZ	24	1.320	1.187	1.202
SIA DILERS LATVIA	24	0.438	-0.371	-0.648

A comparison between IMI INTERNATIONAL, MINERVA BOSKOVICE, BUMAR-HYDROMA POLAND and NISSENS SLOVAKIA identified best result of the composite indicator $\boldsymbol{I_{CS}}$ in MINERVA BOSKOVICE, with IMI INTERNATIONAL as the runner-up. The $\boldsymbol{I_{CS}}$ value of both companies exceeds 1, i.e. they are heading towards sustainability. The worst result was found in BUMAR-HYDROMA POLAND, where the $\boldsymbol{I_{CS}}$ value was negative, i.e. the company is not heading towards sustainability. A graphical decomposition of individual performance indicators would help identify indicators affecting corporate sustainability and the demonstrability of the company's position with respect to sustainability.

4. CONCLUSIONS

The *SEESG Model* offers a comprehensive view of sustainability issues at the corporate level. The *SEESG Model* defines the basic conceptual framework of financial and non-financial indicators, clarifies the appropriate method of model implementation, discusses the selection of appropriate indicators for the subsequent corporate sustainability assessment using the composite indicator ***Corporate Sustainability Index*** ($\boldsymbol{I_{CS}}$) that allows for comparisons between companies.

The $\boldsymbol{I_{CS}}$ was constructed using the principal component analysis (PCA) method, which has a number of advantages and disadvantages. One of the limitations of the method is that it is always calculated on data from a particular year, and weights derived from the PCA may

change every year if recalculated for each new year. This makes it impossible to compare composite indicators with annually recalculated weights. The weights used in the I_{CS} were computed for the years 2013-2015.

The main advantage of the I_{CS} composite indicator is that it summarizes multidimensional phenomena and allows for a quick and clear comparison of the phenomenon analyzed. A drawback of a composite indicator is that it may temp to oversimplify reality and then to oversimplified conclusions. This can be prevented by creating partial sub-indices for individual groups and decomposing individual financial and non-financial indicators. Another possible disadvantage can be the method of determining weights for indicators and sub-indices, and the selection of indicators. In the case study, indicators were selected based on the availability of reliable data.

An important feature of the I_{CS} is that companies within a specific industry can be compared and classified according to whether they are heading towards sustainability or not, as the case study shows. The I_{CS} offered a consistent and flexible benchmark for investors, especially for their investment decisions.

The results achieved with the proposed *SEESG Model* in the case study showed that the composite indicator I_{CS} is useful and can be utilized to compare progress companies make in sustainability issues. Given that the credibility of the aggregation methodology is crucial for the quality of sustainability indicators, the *SEESG Model* can be one of the tools to help assess sustainability.

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