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KEY SUSTAINABILITY PERFORMANCE INDICATOR ANALYSIS FOR CZECH BREWERIES

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Abstract

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Sustainability performance can be said to be an ability of an organization to remain productive over time and hold on to its potential for maintaining long-term profitability. Since the brewery sector is one of the most important and leading markets in the foodstuff industry of the Czech Republic, this study depicts the Czech breweries' formal entry into sustainability reporting and performance.
The purpose of this paper is to provide an efficiency level evaluation which would represent the level of corporate performance of Czech breweries. For this reason, Data Envelopment Analysis (DEA) is introduced. In order to apply it, we utilize a set of key performance indicators (KPIs) based on two international standard frameworks: the Global Reporting Initiative (GRI) and its GRI 4 guidelines, and the guideline KPIs for ESG 3.0, which was published by the DVFA Society. Four sustainability dimensions (economic, environmental, social and governance) are covered, making it thus possible to adequately evaluate sustainability performance in Czech breweries. The main output is not only the efficiency score of the company but also the input weights. These weights are used to determine the contribution of particular criteria to the breweries' achieved score. According to the achieved efficiency results for Czech breweries, the percentage of women supervising the company does not affect the sustainability performance.

Keywords: brewery, DEA, DVFA, EFFAS, GRI, key performance indicators, sustainability performance

INTRODUCTION

The brewery sector is one of the most important and leading markets in the foodstuff industry of the Czech Republic (CBMA, 2014). Czech beer-brewing has a long history and tradition. Beer has always been one of the most significant parts of Czech culture, owing to it having a special position among other commodities. In addition to the above, the Czech Republic has the highest beer consumption per capita in the world (Walle, 2014). Moreover, beer is the country's second most important allure for foreigners, the first being historical sites (Vacl, 2014). It follows that Czech breweries play a major role in the economic and social dimensions, generating very significant economic value and contributing considerably to the country's employment rate. At the same time, Czech breweries are highly sensitive to the quality of the general business environment.

In order to help the breweries in understanding, measuring and communicating their main four performance pillars (economic, environmental, social and governance), sustainability assessment (Epstein *et al.*, 2014) should be applied. Corporate sustainability focuses on both minimizing risks arising from environmental, social and corporate governance (ESG) aspects (Grant *et al.*, 2013) as well as proactively seeking to gain advantages from "translating" ESG issues into a company's product and service portfolio. It can provide early warning, in time to prevent economic, social and environmental damage (Singh *et al.*, 2012). Measuring corporate performance is difficult and challenging. In different decision-making contexts, stakeholders tend to use different criteria and methodologies, thus arriving at different and contrasting assessments of the sustainability of corporate performance in practice.

In our research, we have considered a methodology which depends on optimization algorithms and used sustainability assessment. It consists of many different models like eco-efficiency models, multi-attribute, multi-criteria decision-making models (Jablonský, 2007) and Data Envelopment Analysis (DEA) models. DEA is a very powerful tool used for decision-making and we propose that it can be used to evaluate the enterprises' efficiency (Wang and Chin, 2010). It can be also described as a non-parametric methodology aimed at evaluating the relative efficiencies of comparable decision-making units (DMUs) by means of a variety of mathematical programming models (Charnes *et al.*, 1978; Lee and Saen, 2012). In our case, the efficiency is represented as the level of sustainability performance and depicted as a share of output in a weighted sum of inputs.

The main goal of this paper is to determine the efficiency score of the Czech breweries under scrutiny. For this reason, Global Reporting Initiative (GRI) methodology (G4 Guidelines, 2013a, 2013b) and the guidelines (ESG 3.0, 2010) for Key Performance Indicators (KPIs) published by the DVFA Society of Investment Professionals in Germany are presented in Section 2. The DEA model, which is used for our sustainability assessment, is described in Section 3. Section 4 depicts the relation between the companies' score and simple ESG factors with development and computation of pressure-specific composite indicators of corporate performance. Finally, Section 5 concludes the paper.

MATERIALS AND METHODS

There are many standards available for companies interested in reporting on sustainability and environmental, social and governance performance. From the ISO standards (divided into ISO 9000 for quality, ISO 14000 for environment, ISO 18000 for occupational health and safety and ISO 26000 for social responsibility) (ISOHelpline, 2014; ISO, 2014), Eco-Management and Audit Scheme (EMAS) (EMAS, 2014), the GRI Guidelines (G4 Guidelines, 2013a, 2013b), to the guideline of KPIs for ESG 3.0 (ESG 3.0, 2010) which was published by the DVFA Society of Investment Professionals in Germany in conjunction with the European Federation of Financial Analysts Societies (EFFAS). In this section, the last two mentioned frameworks which are the most suitable ones for breweries are shortly introduced.

Global Reporting Initiative

Nowadays, the GRI (G3.1 Guidelines, 2011; G4 Guidelines, 2013a, 2013b) is the most common non-profit organization that focuses its efforts on developing a comprehensive sustainability reporting framework that is widely used across the world. Its mission is to provide a credible and transparent framework for sustainability reporting that could be used in organizations regardless of their size, sector or location. The GRI framework enables all organizations to measure corporate performance and report it in four key areas of corporate sustainability (i.e., taking into consideration the companies' ESG and economic impacts). The GRI is a multi-stakeholder, network-based organization. Their vision is a sustainable global economy where organizations manage their ESG and economic performance impacts responsibly, and report transparently. To achieve these goals, they have developed a sustainability reporting standard practice by providing guidance and support to organizations.

The last version of this framework is the GRI G4 Guidelines (G4 Guidelines, 2013a, 2013b). The G3.1 Guidelines (G3.1 Guidelines, 2011) were a starting point of the G4 Guidelines, where some important changes were made to generalize sustainable reporting. The G4 Guidelines are presented in two parts: the Reporting Principles and the Standard Disclosures (G4 Guidelines, 2013a), and the Implementation Manual (G4 Guidelines, 2013b). The Reporting Principles and the Standard Disclosures guidance explain the reporting requirements of reporting against the framework, "what" must be reported. The Implementation Manual provides further guidance on "how" organizations can report against G4 Guidelines criteria. The improvement of the technical quality of the guidelines content was focused on the elimination of ambiguities and differing interpretations. Furthermore, this improvement was focused on the harmonization of guidelines with other internationally accepted standards, and on offering guidance related to linking the sustainability reporting process to the preparation of an Integrated Report (Hřebíček *et al.*, 2011; Kocmanová *et al.*, 2013).

Key Performance Indicators for Environment, Social and Governance Issues 3.0

The DVFA framework (ESG 3.0, 2010) is a free-of-charge publically available reporting framework which was published by the DVFA Society of Investment Professionals in Germany in conjunction with EFFAS. DVFA and EFFAS are periodically reviewing the accuracy of the framework and implement modifications wherever deemed necessary. The objective of KPIs for ESG 3.0 guidelines is to propose the basis for the integration of ESG indicators into corporate performance reporting. It provides a credible and transparent framework for sustainability reporting suitable for all entities regardless of size, scope and legal form it has been specifically designed for stock-listed companies and issuers of bonds.

In order to ensure high-quality reporting of ESG-KPIs, the company should follow the DVFA Principles. These principles are relating to relevance, transparency, continuity and recentness.

The information, data, processes and assigned competencies required for the preparation of ESG reports should be recorded, analyzed, documented and disclosed in such a way that they stand up to an internal and external audit or review.

This framework consists of 114 subsectors (ESG 3.0, 2010) following the Dow Jones Industry Classification Benchmark (ICB) lists of KPIs. ICB is an instrument which is typically used for structuring industries into clusters with the aim of compiling peer groups or portfolios of companies. According to these lists, companies choose the most suitable subsector. The KPIs in this framework are presented according to the structure depicted in Tab. I.

The scope describes the level of disclosure of the mentioned KPI. The consecutive levels of ESG disclosure are classified into three levels; Entry Level (Scope I), Midlevel (Scope II) and High Level (Scope III). The last two levels are not available for some subsectors. Entry Level presents the minimum number of KPIs which should be disclosed by companies. Midlevel and High Level differ in terms of granularity and details of reporting. Both levels were modelled based on the observation that mainstream ESG disclosure often already exceeds the Entry Level. In our case, we are dealing with Czech breweries. Therefore, Tab. II which presents the KPIs of breweries subsector is taken into consideration.

Data Envelopment Analysis Model

Data Envelopment Analysis (DEA) is a relatively new "data oriented" approach for evaluating the efficiency of number of producers. In DEA the producers are usually referred to as a Decision Making Units (DMUs) which convert multiple inputs into multiple outputs. Relative efficiency is defined as the ratio of total weighted output to total weighted input. DEA can be used as a very powerful service management and benchmarking technique to evaluate nonprofit and public sector organizations (Charnes *et al.*, 1978).

In the case of evaluation n number of DMUsj (j = 1, …, n). Each DMU consists of m inputs and s outputs with x_{ij} (i = 1, …, m) and y_{rj} (r = 1, …, s) values, respectively. Assume that a particular factor is held by each DMU in the amount w_j, and this serves as both an input and output weight. Let us consider dual-role factors DEA model Cisneros *et al.* (2011) in Equation 1.

$$Max\,\theta_k = \sum_{r=1}^{s} u_r y_{kr} + \gamma w_k - \beta w_k. \quad (1)$$

Subject to

$$\sum_{i=1}^{m} v_i x_{ik} = 1, \quad (2)$$

$$\sum_{r=1}^{s} u_r y_{kr} + \gamma w_k - \beta w_k - \sum_{i=1}^{m} v_i x_{ij} \le 0,\ j = 1, 2, \ldots n, \quad (3)$$

$u_r, v_i, \gamma, \beta \ge 0.$

where u_r, v_i are the weight given to the output r and the input i, respectively. γ and β are the weights given to the dual-role factor. DMU_k consumes x_{ik}(i = 1, …, m), the amount of input i, to produce y_{rk}(r = 1, …, s), the amount of output r. Let us consider the cross-efficiency evaluation, each DMU determines a set of input and output weights individually, leading to n sets of weights for n DMUs. The n sets of weights are used to assess the efficiencies of the n DMUs, resulting in n efficiency values for every DMU. Then efficiency values for each DMU are finally averaged as an overall efficiency value of the DMU (Adler *et al.*, 2002). Denote by u_r^* (r = 1, …, s) and v_i^* (i = 1, …, m) the optimal solution of Equation 1. Then the dual-role efficiency of DMU_k is computed according to:

$$\theta_k^* = \sum_{r=1}^{s} u_r^* y_{kr} + \gamma^* w_k - \beta^* w_k, \quad (4)$$

which is the best relative efficiency that DMU_k can achieve. Therefore a cross-efficiency value of DMU_j which reflects the peer evaluation of DMU_k to DMU_j (j = 1, …, n; $j \ne k$) is calculated according to Equation 5.

$$\theta_j = \frac{\sum_{r=1}^{s} u_r^* y_{rj}}{\sum_{i=1}^{m} v_i^* x_{ij}}. \quad (5)$$

Wang and Chin (2010) referred to DMU_k as the target DMU. The above mentioned model is solved n times for each target DMU using Maple program. As a result, there will be n sets of input and output weights for n DMUs and each DMU will have one dual-role efficiency value and (n – 1) cross-efficiency values. The n efficiency values are then averaged as the overall performance of the DMU. Based on their average cross-efficiency values, then DMUs can be compared or ranked.

In order to solve this problem the Optimization Package (Maple Online Help, 2014) in Maple program is used. In order to achieve good results, Optimization [LPSolve] for solving linear programming problems is chosen. We used LPSolve (obj, constr, bd, opts) command for finding the optimum of various types of multivariable functions with various types of constraints, where parameters: obj is algebraic or linear objective function; constris (optional) set of relations or list of relations of linear constraints; bd is (optional) sequence of name = range (bounds for one or more variables); opts is (optional) equation(s) of the form option = value where option is one of assume, binaryvariables, depthlimit, feasibilitytolerance, infinitebound, initialpoint, integertolerance, integervariables, I: *ESG 3.0 KPIs' structure (ESG 3.0, 2010)*

KPI	Spez.-ID	Scope	Specification
Energy Efficiency	E01-01	I	Energy consumption, total.

Note that "KPI" refers to the name of the presented indicator. "Spez.-ID" indicates to the KPI identifier

II: *KPIs for breweries subsector (ESG 3.0, 2010)*

KPI	Spez.-ID	Scope	Specification
Energy Efficiency	E01-01	I	Energy consumption, total.
GHG Emissions	E02-01	I	GHG emissions, total.
Staff turnover	S01-01	I	Percentage of FTE leaving p.a./total FTE.
Training & Qualification	S02-02	I	Average expenses on training per FTE p.a.
Maturity of workforce	S03-01	I	Age structure/distribution.
Remuneration	S08-01 S08-02 S08-03	I I I	Total amount of bonuses. Total number of FTEs who receive 90% of total amount of bonuses. Key Performance Narrative.
Litigation risks	V01-01	I	Expenses and fines related to anti-competitive.
Corruption	V02-01	I	Revenues in regions with Transparency International corruption below 6.0 [%].
Revenues from new products	V03-02	I	New products or modified products introduced less than 12 months ago [%].
Innovation	V04-01 V04-012 V04-013	I I I	Total R & D expenses. Total investments in research on ESG. Products or services [%].
Emissions to Air	E03-01	II	Total CO^2, NOx, SOx, VOC emissions [mil.t].
Waste Scope I	E04-01	II	Total waste [t].
Waste Scope II	E05-01	II	Total waste which is recycled [%].
Packaging	E010-01 E010-02	II II	Total amount of packaging material [t]. Packaging material per [t] of output.
Gene Modified Organisms	E15-01	II	Share of products containing genetically modified organisms or ingredients containing genetically modified organisms in [%].
Water Consumption	E28-01	II	Water consumption in m^3.
Sustainable, Organic & Fair Trade Products	E31-01	II	Total revenue from products with organic origin [%].
Certification of Facilities	S07-04	II	Total facilities certificated according to ISO 9001, SA 8000 or OHSAS18001 standards [%].
Customer Satisfaction	V06-01	II	Total customers surveyed comprising satisfied customers [t].
Utilization	V13-01	II	Capacity utilization as a percentage of total available facilities.
Brand Value	V24-01	II	Value of brand as measured by third-party or external consultancy.
Supply Chain	V28-01 V28-02 V28-03	II II II	Total number of suppliers. Percentage of sourcing from 3 biggest external suppliers. Turnover of suppliers [%].
Packaging	E10-03 E10-04 E10-05	III III III	Breakdown of packaging materials [t]. Total cost of packaging in $, €. Cost of packaging per revenue in percent.
Water Consumption	E28-02 E28-03	III III	Water (m^3) used per product manufactured amount (t). Groundwater consumption in m^3.
Environmental Compatibility	E33-01	III	Number of sites with ISO 14001 certification.
Customer Retention	V05-03	III	Share of market by product, product line, segment, region or total.
Supply Chain	V28-04	III	KPN (max. 500 words) How do you ensure that your suppliers adhere to a standard of ESG compliance similar to that of your company?
	E28-05	III	KPN (max. 500 words) When assessing the performance of your procurement and purchasing functions: Do you incentivize your procurement management for the selection of ESG performing suppliers even if you might have to carry a premium over less expensive suppliers?

iterationlimit, maximize, method, nodelimit or output; specify options for the LPSolve command (Maple Online Help, 2014). It solves a linear programming problem, which involves computing the minimum (or maximum) of a linear objective function subject to linear constraints.

RESULTS AND DISCUSSION

The two previously described frameworks, i.e., GRI (G4 Guidelines, 2013a, 2013b) and DVFA (ESG 3.0, 2010), present a lot of indicators related to the economic, environmental, social, and governance pillars (Piotrowicz and Cuthbertso, 2009). Reporting on all these indicators is a big challenge, because collecting and managing data is a very difficult and expensive process. Due to this, we tried to determine the optimal set of these indicators by doing quantitative research about the most frequently used indicators in each pillar (dimension). This research includes publications research which determine the key performance indicators of manufacturing sector (Fan *et al.*, 2010). In additional, 32 small and medium brewery companies in the Czech Republic have been tested in a survey. This paper concentrates on determining the weight of indicators on the sustainability assessment. There is a lot of research which depends on a sustainability dimension for weight determination. For example: Dong *et al.* (2014) paper also evaluates a method for constructing a composite sustainability indicator that individually scores and ranks the sustainability performance. It uses principal component analysis to reduce the number of key performance indicator. Then common-weight data envelope analysis was applied to individually score each farm.

In Vinodh *et al.* (2014), the sustainability assessment for manufacturing organization was done using fuzzy logic. A computer based decision support system was developed designated as fuzzy-logic-based sustainability evaluation decision support system. The system calculates the fuzzy logic sustainability index, Euclidean distance, and fuzzy performance importance index.

Whereas in our research, we tried to cover all sustainability dimensions by depending on the available GRI and DVFA frameworks to achieve a set of suitable indicators of economic, social, and environmental dimensions, we then chose the available ones, comparing with other research (Fan *et al.*, 2010) which investigates the current application status of sustainable indicators within U.S. manufacturing companies, and takes into consideration only environment, social and economic factors. After that, without any loss of generality, in order to make a performance assessment, we chose a few KPIs which are summarized in Tab. III. This assessment is realized by applying DEA model on the previous mentioned KPIs.

We consider KPIs; ENV2, SO1, SO2 and GOV1 as organizations' inputs. The organizations' outputs are EC1 and EC2 indicators. In addition, a dual-role factor is considered as indicator ENV1. These core indicators relate to ESG and economic activities in measurement. In terms of the model's outputs, two types of output data EC1 and EC2, from the 14 Czech breweries' selected organizations A, B, C, …, N (Amadeus Database) has been used. Principally, for the input and output, environmental, financial and sustainability report data sets were used.

We applied the previously described model and computed efficiency score of selected organizations (DMUs) using the linear programing in Maple (Hřebíček *et al.*, 2014), where score and parameters are computed for the first company A:

```
restart; with(Optimization);
c := Vector(8, [−783.1, 362314, 0, 0, 0, 0, 36.397, −36.397]);
A := Matrix(14, 8,[[−783.1, 362314, −265.625, −134, −37286, −100,
        36.397, −36.397],
    [−14524.78, 246934, −111.92, −131, −53681, 0, .3, −.3],
    [192358.85, 9635, −1474.85, −113, −71230, 0, .95, −.95],
    [−1974.2, −6086, −35.72, −12, −2918, 0, 1.21, −1.21],
    [−3657, 333159, −26.88, −47, −20020, 0, 0, 0],
    [24351, 3903753, −89.83, −140, −71344, −67, 0, 0],
    [−25977.55, 270751, −33.63, −58, −22691, −33, 1.55, −1.55],
    [−75690.93, −1008306, −137.03, −65, −31349, −33, 2.19, −2.19],
    [994.77, 90193, −71.17, −32, −5982, 0, .85, −.85],
    [−27269.89, 277075, −108.74, −89, −28882, −33, 1.18, −1.18],
    [7959.8, 1007815, −73.44, −150, −72533, −33, 0, 0],
    [−3452.37, 113280, −154.69, −58, −12731, −100, .22, −.22],
    [122.79, 570883, −99.22, −81, −34719, 0, .26, −.26],
    [226103.5, −176006, −64.58, −51, −17458, 0, 0, 0]]);
b := Vector(14, [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]);
Aeq := Matrix(1, 8, [[0, 0, 265.625, 134, 37286, 100, 0, 0]]);
beq := Vector(1, [1]);
c, [A, b, Aeq, beq];
sol := LPSolve(c, [A, b, Aeq, beq], assume = nonnegative, output =
= solutionmodule, maximize); sol:-Results()
```

III: *Core indicators*

Indicator	Description	Unit
EC1	Economic Value Added (EVA)	CZK
EC2	Cash flow	CZK
ENV1	The amount of hazardous waste	Tons
ENV2	The amount of other waste	Tons
SO1	The number of employees	Num
SO2	The average employees salary and bonus	CZK
GOV1	Percentage of women in supervising the company	%

The above written program can be modified for the other 13th organizations. Tab. IV identifies the set of organizations as A, C, …, N with the values of related KPIs.

According to Tab. V we can distinguish between efficient and non-efficient companies. Two types of curves are depicted in Fig. 1. The dashed one describes the threshold of sustainability performance for these breweries, whereas the continued curve presents the efficiency score of each studied brewery in the Czech Republic. The set of organizations F, I, N and M represents the most efficient companies with relative efficiency scores equal to 1.

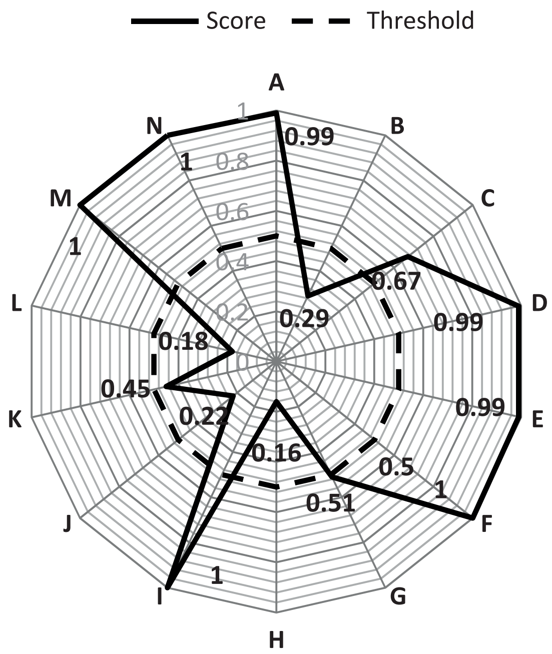
However, the less efficient organizations, B, H, J, K and L, with a very low score of less than 0.5, are considered to be inefficient. Depending on our detailed results, we can conclude that company N is the most efficient organization with the best corporate performance. According to the above applied model, we can conclude that the percentage of women in supervising the brewery does not have any effective role in sustainability performance. In additional, taking into consideration the achieved results in the last two columns of Tab. V, the dual-role factor of "amount of hazardous waste" behaved in the same way as output. All other parameters that appear in Tab. V can help us in determining the weight of each input or output KPI which affects the sustainability performance. Our final result shows different weights for each KPI depending on the company number. For future work these weights can be combined using a suitable method to produce a unique weight of each indicator which will help all the brewery companies in Czech Republic to assess their sustainability performance.

IV: *Core indicators of companies A, B, C, …, N*

Company	EC1	EC2	ENV1	ENV2	SO1	SO2	GOV1
A	−783.1	362314	36.397	265.625	134	37286	100
B	−14524.78	246934	0.3	111.92	131	53681	0
C	192358.85	9635	0.95	1474.85	113	71230	0
D	−1974.2	−6086	1.21	35.72	12	2918	0
E	−3657	333159	0	26.88	47	20020	0
F	24351	3903753	0	89.83	140	71344	67
G	−25977.55	270751	1.55	33.63	58	22691	33
H	−75690.93	−1008306	2.19	137.03	65	31349	33
I	994.77	90193	0.85	71.17	32	5982	0
J	−27269.89	277075	1.18	108.74	89	28882	33
K	7959.8	1007815	0	73.44	150	72533	33
L	−3452.37	113280	0.22	154.69	58	12731	100
M	122.79	570883	0.26	99.22	81	34719	0
N	226103.5	−176006	0	64.58	51	17458	0

V: *Score and weights*

Company	Score	v_{ENV2}	v_{SO1}	v_{GOV}	v_{SO2}	γ_{ENV1}	β_{ENV1}
A	0.99	0	0	0	0	0.023	0
B	0.29	0	0.002	0	0.45	0.062	0
C	0.67	0	0.01	0	0.053	0.099	0
D	0.99	0	0	0	0.17	0.826	0
E	0.99	0	0	0	0.122	0	0
F	1	0	0	0	0	0	0
G	0.51	0.03	0	0	0	0.21	0
H	0.16	0.002	0	0	0.02	0.07	0
I	1	0	0	0	0.42	0.078	0
J	0.22	0	0	0	0.013	0.05	0
K	0.45	0.005	0	0	0.02	0	0
L	0.18	0	0	0	0	0.066	0
M	1	0	0	0	0.08	0	0.26
N	1	0	0	0	0	0	0



1: *The level of efficiency of the studied Czech brewery companies*

CONCLUSION

Corporate sustainability assessment should be a comprehensive process directed to achieve the best performance and to determine the weak points of the studied organization. There are many barriers causing the SMB of different organizations in business sectors not to support sustainability reporting. These barriers are presented as: the high costs of data-collection and data-management; the difficulty of determining the appropriate sustainability indicators and capturing reliable data-information; the business risk and difficulty in determining the sphere of influence of each organization. In order to minimize these barriers, many steps should be taken.

In this paper, some important contributions about the sustainability assessment of Czech breweries are provided. First, the breweries may establish key criteria for sustainability management following GRI and DVFA frameworks in order to measure any progress towards sustainable performance development. Subsequently, the DEA model for measuring breweries' sustainability management and performance considered a dual-role factor and cross-efficiency technique simultaneously is implemented. This model also can be integrated into the ICT tool and used by the organization as a powerful technology for monitoring its efficiency scores, which provide an indication of the levels of corporate performance. Applying this technology helps the organization in improving its sustainability in both short and long terms.

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