

## COMPARISON OF ENVIRONMENTAL COSTS IN DIVISIONS WITH DIFFERENT GEOGRAPHICAL ACTION AND THEIR SIGNIFICANCE IN ENVIRONMENTAL MANAGEMENT

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### Abstract:

The relevance of the decision of this scientific research is related to the requirements of Industry 4.0. orientated to environmental sustainability. This article summarizes the scientific discussion on the issue of the comparison of environmental costs in various divisions such as Slovakia, Italy, Brazil, Mexico, China. The main goal of this article is to compare costs in divisions of the parent company with different geographical working. The object of the research was the parent company EMBRACO. Methods of research were focused on using economic analysis with indicators of the cost function, chain index, and cost structure. The results of the research show environmental costs of the divisions are at the level of €1.9–€3.1 million. The total state of the environmental costs by individual country represents the lowest value in Italy and Slovakia. The lowest environmental costs are for the category of air costs for all divisions and the second category of costs with low values are other environmental costs, while Brazil and Mexico do not record this category of costs in the accounting. The key category for minimizing environmental costs is water costs for Slovakia and China and other waste costs for Italy, Brazil, and Mexico. The hazardous waste category represents (0.9–32%). Based on these results, the parent company can decide on the possibilities of positioning its divisions in terms of strategic business.

**Key words:** *environmental costs; profit, efficiency, minimalization, sustainability*

### INTRODUCTION

The importance of environmental costs is constantly growing because it is the motivation for the protection and creation of the environment. In companies, environmental costs represent an economic quantity focused on the environment, which significantly affects the creation of the company's profit and affects the state of the environment. The main goal of this article is to compare environmental costs in divisions of the parent company with different geographical working. Environmental costs in various divisions at the world are differential because each country has a own laws, environmental law, conditions of the business and environmental taxes and fees. Environmental costs must be orientated to minimalization the financial sources and within is connected reducing of environmental burdens in all countries. The green economy solves environmental costs with an orientation on various factors such as STTEEPLI factors (social, technical,

technological, environmental, economic, political, law, and investment). Those factors influence positive and negative the trends of environmental costs in various divisions at the world. Parent company can those differences in environmental costs doing better by elimination emissions in one country by environmental quota of the other country with division with the same production programme. Social factors are presented in the level of unemployment and healthiness of people, technical and technological factors introduce using the environmental machines and equipment's in divisions, environmental factors must to decrease negative effects to environment, economic factors are presented in environmental costs such as fees, taxes, political factors express the government's stance on environmental protection, law factors define the implemented laws in environment area, investigation factors are significant in the area of environmental investigation to environmental technologies,

machines, recycling and other. As part of the research, we want to find out the differences in the amount of environmental costs in the individual countries of the world where the divisions of the parent company are located, due to the overall assessment of the performance of the parent company, under which the individual divisions belong. Environmental costs in individual countries are influenced by the mentioned STTEPLI factors, which we presented in the introduction.

#### LITERATURE REVIEW

The green economy solves environmental costs with an orientation on various factors such as STTEPLI factors (social, technical, technological, environmental, economic, political, law, and investment). In companies, environmental costs represent an economic quantity focused on the environment, which significantly affects the creation of the company's profit and affects the state of the environment. Arslan, Khan, Latif, Komal comment that close relationship between natural resources and production in many sectors, and production and consumption can also have an important environmental impact [1].

Environmental protection and economic growth cannot be maximized simultaneously. Natural resources improve environmental sustainability at the expense of economic growth. In contrast, financial development, merchandise trade, and urban population growth promote environmental degradation [2]. It is vital to understand governance mechanisms to sustain natural resource policies, considering environmental, social, and governance concerns to benefit society. Sütőová et. al. [3] comments that the internationally recognized CSR (Corporate Social Responsibility) standard aims to identify problems related to CSR compliance demonstration from the point of view of supplier organizations. Implementation of the principles of socially responsible business is manifested by the fact in their business on transparency, the fight against corruption and bribery, innovativeness and sustainability of their growth, minimization of environmental impacts on the environment and responsible waste management.

The sustainable development strategy creates a circular economy in which man cooperates with nature, not against it. It is a model where waste as such does not actually exist. All raw materials, products, and packaging are closed in long-lasting cycles. The entire cycle must be sustainable [4]. Achieving sustainable environmental development, while avoiding environmental degradation is the base of environmental sustainability. Zhironkin, & Cehlár comment that the modern theories that make up the paradigm of sustainable development, and the best practices derived from them, are based on the consistency of individual and public needs, factors of economic growth, and ecosystem conservation. The trend of green economy expansion is moving from a challenge facing modern society to the dominant area of scientific thinking, which is increasingly focused on solving the problems of reducing the anthropogenic impact on the environment, primarily on the climate [5]. The importance of environmental costs is constantly growing because it is the motivation for the

protection and creation of the environment. The social factor is presented in Green intellectual capital (green human capital, green structural capital, and green relational capital) and environmental management accounting (environmental costs) stimulates environmental performance (environmental debt, sanctions). Environmental management accounting appears to play a role in translating green intellectual capital into enhanced environmental performance [6]. The social factor creates customers, suppliers, state institutions, and other subjects that create a market. Socially sustainable and resilient supply chains are critical for organizations to succeed in business and economic growth. The performance framework integrates the environmental goods valuation to evaluate social sustainability and digitalization using blockchain technology to enhance supply chain process sustainability and resilience [7].

The methodology of the life cycle assessment (an environmental impact analysis technique) allows evaluation of regulatory impacts on several aspects like the distributed generation business itself, market surpluses and welfare, regulated tariffs, social inequality, and the environment [8]. Tiwari et. al. comment that the economic literature has extensively reviewed the relationship between environmental quality, environmental regulations, and economic growth within the context of the environmental Kuznets Curve [9]. Sohail et.al. comment that political stability lessens environmental damage by reducing emissions. Political instability not only reduces the consumption of clean energy but also leads to damage to environmental quality in the long run [10]. Ramzan et. al. in their study said that the environment needs to enhance the investment volume in cleaner and renewable energy sources and innovative environmental reforms for the industrial sector. Currently is important to present environmental information about the industry enterprises because all the environmental costs influence the profit and financial health of the firms [11]. Environmental costs are costs associated with business activities that have an impact on the environment.

The costs of environmental protection include the costs of prevention, elimination of negative impacts on the environment, planning, and control of the state of the environment, and repair of damages that occur in the enterprise and have negative effects on the environment. Ding et. al. in their research they investigate the items which violate environmental rules and regulations, and they are recording of as environmental costs [12]. These penalties impact the debt of the firms and the environmental disclosure quality. Nagyová et. al. [13] comment that risk management is a very important part too of environmental investment projects. Risk management can also focus on positive risk (or opportunity) management, which is used to identify potential benefits to the current environmental investment project with an orientation on the environment [13]. Kádárová et. al. comment that various scientific methods are used to support productivity growth in companies, aimed too at reducing waste [14]. Elimination of waste and a balance of work at individual

workplaces is achieved by applying methods of measuring time consumption, balancing workplaces, and introducing automation of welding and sealing operations using robots. All those factors minimize environmental waste in the companies. A very important factor is political and law factors, which are part of the macroeconomic policies of several countries all over the world. Macroeconomic policies to promote expansion in clean energy consumption directly stimulate green economic growth and environmental quality [15].

**METHODOLOGY OF RESEARCH**

The object of the investigation is the divisions of the parent company EMBRACO focused on the production of compressors for commercial refrigeration and condensing units. The company started production of the global EMBRACO Mini platform for home cooling. In the research, we used data from the managerial information system EMBRACO and financial accounting in Slovakia. All environmental costs are presented in Table 1.

**Table 1**  
*Environmental costs in divisions in countries (€)*

Country/year Environmental costs (€)	Atmosphere	Water	Dangerous waste	Other waste	Other environmental costs
Slovakia/2020	63814	128623	119347	75474	20465
Slovakia/2021	55349	160693	114976	72273	18641
Slovakia/2022	28392	176519	124818	70237	21974
Italy/2020	2360	16520	40858	55434	7198
Italy/2021	528	22953	26049	66055	2240
Italy/2022	4572	29913	39135	54640	3781
Brazil/2020	11313	56837	117756	504195	-
Brazil/2021	9329	160693	120094	80893	-
Brazil/2022	63266	153596	153804	511237	-
Mexico/2020	2830	150200	42516	4285	-
Mexico/2021	7077	25974	12450	15050	-
Mexico/2022	67299	3571	23934	27414	-
China/2020	8543	363721	51141	11046	12501
China/2021	22588	329635	126135	17767	10320
China/2022	2173	939920	85859	32041	10092

Source: internal documents of divisions from financial accounting.

Environmental costs we evaluated from the view of possibilities of all countries of the parent company in Brazil. We have created the chain of environmental costs as followed: environmental costs in the atmosphere, in water, dangerous waste – is a part of the waste, which is dangerous for people and the environment, this waste is determined by an important law in all countries, for example: muds, varnishes, paints, chemicals, halogens, cutting emulsions, solvents, batteries, oils, and others. The other items of environmental costs are other waste – this waste is waste that, based on its properties, does not belong to hazardous waste. Other waste consists of activities

related to operation and maintenance and activities related to disposal and transport of waste, handling of waste and machines, costs associated with procurement of containers, presses, separate collection, and export of waste. These items are examples: scrapped equipment, iron, copper, steel, aluminium, cardboard, sawdust from ferrous metals, wood and plastic packaging, and others. The other items of environmental costs are other environmental costs – sanctions, penalties, external costs, training, courses, salaries of the environmental department, environmental taxes, licenses, cost for environmental management system, and others.

We evaluate environmental costs based on economic methods from the obtained cost items. In the comparison, we use the cost function by formula 1, the chain index of costs by formula 2, and the cost structure by formula 3.

**Cost function (€):**

$$N_T = N_A + N_W + N_{DW} + N_{OW} + N_{OEC}, \tag{1}$$

where:

- (N) type of environmental costs (€),
- (N<sub>T</sub>) total costs,
- (N<sub>A</sub>) cost for atmosphere,
- (N<sub>W</sub>) cost for water,
- (N<sub>DW</sub>) cost for dangerous waste,
- (N<sub>OW</sub>) other waste,
- (N<sub>OEC</sub>) other environmental costs.

**Chain index (coefficient):**

$$I = \frac{N_1}{N_0}, \tag{2}$$

where:

- (N) type of environmental costs (€),
- (1) ordinary period,
- (0) basic period.

**Cost structure (%):**

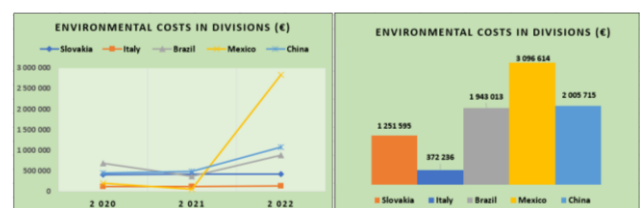
$$S = \frac{N_U}{N_T} \cdot 100\%, \tag{3}$$

where:

- (N) type of environmental costs (€),
- (N<sub>U</sub>) unit costs,
- (N<sub>T</sub>) total costs.

**RESULTS AND DISCUSSION**

EMBRACO is a global company that has production plants in Brazil, Italy, Mexico, China, and Slovakia. In this research, we focused on the number of environmental costs in terms of geographical impact and the influence of STTEPLI factors. In the first step, we monitored the total environmental costs by formula1 (Figure1) in individual divisions according to the years 2020-2022, which we had available from the financial accounting of individual divisions.



**Fig. 1** Environmental costs in divisions (€) in year 2020-2022 and total costs

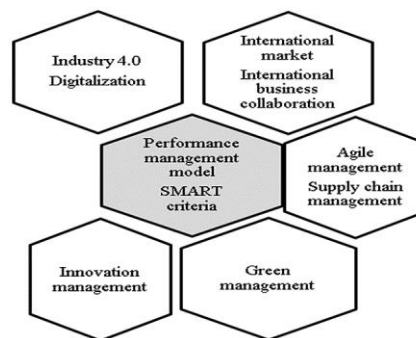
We found that environmental costs in the monitored years in the individual countries recorded a progressive development, especially significant growth in Mexico, China, and Brazil, proportional growth was recorded in Slovakia, and Italy shows a moderate progressive growth. Already based on the geographical operation of the divisions of the parent company EMBRACO, large differences in environmental costs can be seen. In Europe, environmental costs range between €120-430 thousand, while in America and Asia, the range is very wide between €60 thousand. €. up to €2.9 million. The total state of the environmental costs by individual country represents the lowest value in Italy (€373 thousand) and Slovakia (€1.2 million). In Brazil, Mexico, and in China, environmental costs are in the millions of euros. Environmental costs are at the level of €1.9-€3.1 million, which represents a significant difference in terms of the geographical operation of the divisions. Based on these results, the parent company can decide on the possibilities of positioning its divisions in terms of strategic business. From this point of view, it is better to place divisions in Europe than in America or Asia, which can bring competitive advantages to the parent company. In the second step of the economic analysis (Table 2), we evaluated individual cost categories in terms of development and structure according to formula 2, 3. We evaluated the cost development trend and cost structure for individual categories. The lowest environmental costs are for the category of air costs in the range of 0.2-16% for all divisions and the second category of costs with low values are other environmental costs, while Brazil and Mexico do not record this category of costs in the accounting. The key category for minimizing environmental costs is water costs for Slovakia and China (32-88%) and other waste costs for Italy, Brazil, and Mexico (22-97%). The hazardous waste category represents (0.9-32%). From this analysis, it follows that it is necessary to look for ways to reduce water consumption within the production process in the EMBRACO company and at the same time to minimize other waste that forms items are examples: scrapped equipment, iron, copper, steel, aluminium, cardboard, sawdust from ferrous metals, wood and plastic packaging, and others. From the point of view of the development of costs, extreme changes were recorded in air costs in Brazil and Mexico in the range of 6-9 times the increase of the item and in the category of other waste in the range of 6-182 times of the increase of the item in Brazil and in Mexico.

The causes of these extremes were classified from the STTEPLI factors. We found that the key causes were political, legislative, and technological factors influencing the development of environmental costs. Reducing environmental costs can be realized through the synergy of different approaches in the divisions of the parent company (Figure 2).

**Table 2**  
*Economic analysis of environmental costs in divisions in countries (€).*

Environmental costs	Atmosphere	Water	Dangerous waste	Other waste	Other environmental costs
<b>Slovakia</b>					
I2022/2021	0.51	1.10	1.09	0.97	1.18
I2021/2020	0.87	1.25	0.96	0.96	0.91
S (%)2020	16%	32%	29%	19%	5%
S (%)2021	13%	38%	27%	17%	4%
S (%)2022	7%	42%	30%	17%	5%
<b>Italy</b>					
I2022/2021	8.66	1.30	1.50	0.83	1.69
I2021/2020	0.22	1.39	0.64	1.19	0.31
S (%)2020	0.4%	19%	22%	56%	2%
S (%)2021	0.4%	19%	22%	56%	2%
S (%)2022	3%	23%	30%	41%	3%
<b>Brazil</b>					
I2022/2021	6.78	0.96	1.28	6.32	-
I2021/2020	0.82	2.83	1.02	0.16	-
S (%)2020	2%	8%	17%	73%	-
S (%)2021	3%	43%	32%	22%	-
S (%)2022	7%	17%	17%	58%	-
<b>Mexico</b>					
I2022/2021	9.51	0.14	1.92	182.15	-
I2021/2020	2.50	0.17	0.29	3.51	-
S (%)2020	1%	75%	21%	2%	-
S (%)2021	12%	43%	21%	25%	-
S (%)2022	2%	0.1%	0.9%	97%	-
<b>China</b>					
I2022/2021	0.10	2.85	0.68	1.80	0.98
I2021/2020	2.64	0.91	2.47	1.61	0.83
S (%)2020	2%	81%	11%	2%	3%
S (%)2021	4%	65%	25%	4%	2%
S (%)2022	0.2%	88%	8%	3%	0.8%

Source: own calculation according to formulas 2, 3.



**Fig. 2** Strategy and instruments for minimizing the environmental costs

The important base for minimizing environmental costs is goals SMART. SMART goals mean environmental goals based on 'specificity', 'measurability', 'achievability', 'relevancy', and 'time-based'. These SMART goals are for assessing the quality of environmental indicators [16]. Environmental costs create in business processes and digitalization of environmental costs is part of Industry 4.0 and it

means using business process management systems (BPMS) [17]. BPMS investigates all indicators of business processes for the evaluation of business performance [18]. Part of business performance is relationships with suppliers and external institutions. Suppliers for the business processes are important and Supply Chain Management is the dimension of performance based on the Balanced Scorecard perspective which builds – financial, customer, internal processes, and learning growth [19]. All BSC perspectives are part of the industry 4.0 model for circular economy and cleaner production [20]. Supply chain management is quite an important management tool. Environmental and social sustainability SCM must know the determinants, factors, and barriers of the supply chain [21]. All other help processes in the firms relate to the environment and create environmental costs [22]. It is very important to estimate risks and identify all risks of these processes [23, 24]. All the suggestions for changes in processes are part of innovation management and part of Industry 5.0 [25]. In the praxis is used for changes in new projects with SMART goals and those projects begin by designing the product with an approach of agile management [26]. Very important processes belong to maintenance because they create environmental costs too [27]. All supported processes in the firm must base on energy saving and minimization costs [28]. Minimalization of environmental costs relates to performance indicators and important information for customer satisfaction [29]. Customers prefer eco products, eco production, eco material, and eco recycling after using products [30].

## CONCLUSION

Low environmental quality affects economic growth and high environmental costs of the divisions influence profit creation in the parent company. Environmental costs of the divisions are at the level of €1.9-€3.1 million, which represents a significant difference in terms of the geographical operation of the divisions. Based on these results, the parent company can decide on the possibilities of positioning its divisions in terms of strategic business. The total state of the environmental costs by individual country represents the lowest value in Italy and Slovakia. The lowest environmental costs are for the category of air costs for all divisions and the second category of costs with low values are other environmental costs, while Brazil and Mexico do not record this category of costs in the accounting. The key category for minimizing environmental costs is water costs for Slovakia and China and other waste costs for Italy, Brazil, and Mexico. The hazardous waste category represents (0.9-32%). This analysis points out that it is necessary to look for ways to reduce water consumption within the production process in the EM-BRACO company and at the same time to minimize other waste. The green economy solves environmental costs with an orientation on STTEPLI factors, we found that the key causes were political, legislative, and technological factors influencing the development of environmental costs in all divisions. Reducing environmental costs can be realized through the synergy of different approaches and

so place the divisions in the country which can bring competitive advantages to the parent company.

## ACKNOWLEDGEMENTS

*The submitted paper is a part of the project VEGA 1/0317/19 "Research and development of new smart solutions based on the principles of Industry 4.0, logistics, 3D modelling and simulation for streamlining production in the mining and building industry" and project VEGA "Research into the design of production systems based on progressive technologies of educational robots and logistics"...*

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