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Seeking for enterprise-level competitiveness: The role of environmental performance

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This study contributes to a better understanding of the link between enterprise-level competitiveness and environmental performance by approaching both concepts multidimensionally. Quantitative statistical analysis was conducted on a sample of Hungarian enterprises with international embeddedness. The sample includes 209 Hungarian enterprises (82% SMEs), which are representative in terms of company size and sector. Cluster analysis was applied to classify enterprises along with their environmental performance. Analysis of variance (ANOVA) was used to quantify the links between clusters and multi-faceted environmental performance and competitiveness variables. Correlation analysis and ANOVA were applied to measure the internal consistency of the environmental variables. As a result, the main hypothesis was confirmed. The clusters with the best (and worst) environmental performance scored the highest (lowest) according to the multidimensional firm competitiveness index used. Regarding specific dimensions of competitiveness, the research hypotheses were partly confirmed. In summary, sound and effective environmental performance is 'worth it' if competitiveness is also considered comprehensively.

Keywords: competitiveness, firm competitiveness index, environmental performance

The aspects of enterprise-level performance and competitiveness have been the key focus of both managers and academics from the beginning. Beyond important, but somewhat narrow-minded financial indicators, there is a wide range of aspects of competitiveness *(Falciola et al., 2020; Teece, 2016)* that differentiates between ordinary and dynamic capabilities. A joint analysis can provide a more complete picture of competitiveness.

In parallel, the sustainability challenge also urges companies to address this issue by implementing improved environmental and social strategies and management tools. Similarly to competitiveness, enterprise-level environmental performance is also a complex field *(Ammenberg et al., 2002).* The link between

enterprise-level competitiveness and environmental performance has been widely studied in the literature. However, the findings diverge considerably mainly because of the multidimensional nature of both concepts not covered properly by many pieces of empirical research and the different measurement theories and practices used *(*see *Dusek, 2024)*. Indeed, *Bhawsar–Chattopadhyay (2015)* concluded that previous studies on competitiveness have only considered economic aspects and emphasised the need to incorporate social and environmental aspects.

We address this research gap and contribute to a better understanding of the link between enterprise-level competitiveness and environmental performance by following a multi-faceted approach to both fields. The empirical analysis is based on the Competitiveness Research Centre (CRC) survey of the Corvinus University of Budapest with a final sample of 209 internationally embedded enterprises.

The rest of the study is structured as follows. A literature review on the multidimensional nature of enterprise-level competitiveness and environmental performance is provided, as well as previous empirical studies on the link between the two, with reflections on what aspects were considered. The hypotheses are derived based on the literature review. The research methodology section presents the research design, data and statistical methods used for the analysis. The next section presents and discusses the results on the link between environmental performance and competitiveness, and the last section summarises the conclusions.

1. Literature review and hypotheses development

1.1 A multi-factor approach of enterprise-level competitiveness

The traditional approach to assessing enterprise performance is to monitor financial performance. Financial statements (balance sheet, profit and loss account and cash flow statement), data on turnover, profits or asset changes are also readily available because of financial reporting requirements. Indicators based on financial data, such as profitability, asset turnover or liquidity, are also available or can be easily calculated. However, firm performance is a more complex concept. Financial results are the consequences of operational processes and market outcomes. Different (operational, market and financial) performance levels are also reflected in multi-faceted performance management approaches. Integrated

performance measurement systems are considered important and useful in the management accounting toolkit *(Chenhall–Langfield-Smith, 2007; Giovannoni–Maraghini, 2013).*

Competitiveness is linked to performance that can be ensured in the longer term. It can be interpreted and analysed at the national, regional, sectoral and organisational/enterprise levels *(Chikán, 2008; Szilágyi, 2008; Falciola et al., 2020).*

However, it is important to underline that macro-level competitiveness is also strongly dependent on the competitiveness of the actors (organisations and enterprises). Firms represent the root of the industrial and national competitiveness *(Bhawsar–Chattopadhyay, 2015)*. The relationship between the different levels of competitiveness was analysed, for example, by *Chikán (2008)*; *Falciola et al. (2020).*

Businesses need to operate in a way that meets the expectations of the market (customers), providing adequate profitability for owners and investors and creating customer and shareholder value *(Feurer–Chaharbaghi, 1994).* Competitive firms can meet these conditions in the longer term by performing better than their competitors and operating efficiently and effectively. Identifying and understanding capabilities behind competitiveness at the enterprise level also contributes to their long-term success. *Teece (2016)* differentiated ordinary and dynamic capabilities. While ordinary abilities enable meeting current objectives and efficiency, dynamic capabilities enable the innovative and effective or, in a word, 'entrepreneurial' development of the ordinary capabilities of an enterprise, *(Teece, 2016, p. 210).*

Firm-level competitiveness is therefore based on resources and capabilities that can ensure better performance in the longer term. Competitiveness factors are in several groups, and several indices have been developed (e.g. *Stocker–Várkonyi, 2022).* In our research, we build on Chikán's (2006) definition and his validated firm competitiveness index (FCI), which suggests that competitiveness includes multiple elements and can be measured as FCI = (Operationality + Adaptivity) × Market Performance, where all the three latter elements altogether have further 24 variables as sub-components (details are presented in the methodology section). The FCI has the advantage of incorporating ordinary and dynamic capabilities (in operationality and adaptivity measures) and interpreting Market Performance from both market and financial perspectives based on the logic of dual value creation as a relative measure of market share and return on sales (compared with competitors). The FCI was tested on a sample of several hundred companies *(Chikán, 2006; Chikán et al., 2022; Wimmer–Csesznák, 2021)*. The FCI permits a detailed analysis of the relationship between competitiveness and various firm characteristics. Examining its underlying variables also provides an opportunity to

investigate the role of various operational and dynamic capabilities in contributing to firm performance and competitiveness. Therefore, in this study, FCI is used to measure the competitiveness of enterprises.

1.2 The concept of enterprise-level environmental performance

Enterprise-level environmental performance is a multidimensional concept, and extensive literature on its approach exists. A widely accepted classification is to differentiate between environmental management performance (EMP) and environmental operational performance (EOP) *(Ammenberg et al., 2002; Harangozó, 2008, Trumpp et al., 2015)*, both of which supplement each other. EMP covers management efforts through different management tools and measures to cope with environmental challenges. EOP focuses on the physical impacts of the companies on the environment (e.g. unintended outflows such as waste and other emissions and the use of natural resources). The two domains are not independent. EMP is supposed to impact EOP.

EMP can be tracked usually based on self-reporting (surveys, company reports or rankings, see e.g. Dragomir [2018]). In the case of EOP, a further data source beyond EMP can be external databases, such as the Toxics Release Inventory database *(EPA, n.d.)* in the United States or the Carbon Disclosure Project (2023). Although different reporting, scoring or ranking schemes, such as the ISO 14031 guideline *(ISO, 2021)* on measuring environmental performance, the Global Reporting Initiative *(GRI 2023)* reporting standard and the Dow Jones Sustainability Index (n.d.) or different ESG-related reporting and ranking schemes, such as the Corporate Sustainability Reporting Directive *(CSRD, EC, 2022)* or *Refinitiv (2022)*, can provide a balanced overview between EMP and EOP, in practice, there seems to be several issues. First, EMP is much simpler to measure, which resulted in the domination of this aspect over EOP in environmental performance assessment frameworks quite often *(Harangozó et al., 2010)*. Second, EOP indicators are diverse and hard to interpret or compare, resulting in a divergence *(Dragomir, 2018)*. Third, a comprehensive environmental performance measurement most often targets larger companies, whereas smaller enterprises are often left out *(Hitchens et al., 2005)*. Furthermore, validity and reliability issues apply when measuring environmental performance *(Szennay et al., 2019)*. Despite these concerns, a balanced approach can provide a reasonably fair view of the environmental performance of enterprises, which is also important from a broader sustainability perspective *(Bartus, 2013)*.

Many drivers of enterprise-level environmental performance can be addressed along with different expectations of internal and external stakeholders *(Kassinis–Vafeas, 2006).*

1.3 The link between enterprise competitiveness and environmental performance

Several studies have been published in the literature analysing the link between competitiveness and environmental performance. Many related studies found a positive relationship between competitiveness and environmental performance, although using a narrow-sighted definition of at least one of the two fields. In many empirical studies, competitiveness is narrowed down to a few financial indicators *(*e.g. *Al-Tuwaijri et al., 2004; Lu–Taylor, 2017)*, many of which disregard EMP or EOP when grasping environmental performance. *Harangozó et al. (2010)* studied an OECD sample, which included firms from the CEE region (focusing only on EMP), whereas *Clarckson et al. (2011), Horvathova (2012)* and *Takács–Erdős (2023)* considered EOP aspects only. However, an interesting finding of these studies is that only time-lagged EOP relates positively to financial performance, supporting Porter's hypothesis on the longer-term return of investing in environmental protection. *Wagner–Schaltegger (2004)* also found a somewhat surprisingly stronger positive link between the UK and German sample in the case of companies following a shareholder value-oriented strategy.

Further studies lack a multi-aspect approach to competitiveness. *Csutora–De Palma (2008)* analysed the environmental costs of companies, pointing out that better environmental management pays back. *Urbaniec (2014)* studied a Visegrád group sample of how environmental management systems (EMP aspect of environmental performance) impacted competitiveness (without specifying the latter in detail). *Long et al. (2017)* found an indirect positive link between (financial) competitiveness and EOP in a Chinese manufacturing sample (both positively related to openness to environmental protection).

Hermundsdrottir–Aspelund (2022) found a positive relationship between environmental strategies and innovation (thus EMP only) and competitiveness in a multi-aspect approach on a Norwegian manufacturing company sample. A Spanish SME sample *(Jorge et al., 2015)* and a Vietnamese survey among Vietnamese managers *(Nguyen et al., 2021)* had similar findings. But again, environmental performance was mostly measured with EMP-related variables.

Beyond studies finding a positive relationship between the two fields, many other outcomes can be found in the literature. In *Horvathova's (2010)* meta-

analysis of 64 earlier studies between (financial) competitiveness and environmental performance (with various focus), various outcomes were detected (35 positive, 10 negative and 19 indifferent). Similarly, *Earnhart–Lizal (2007)* found a neutral relationship in a Czech manufacturing sample. On a Pakistani automotive industry sample, *Sarwar et al. (2023)* found various relationships between competitiveness and environmental performance (but the exact variables of the two domains were not specified).

Latinovic–Obradovic (2013) found a negative relationship between financial returns and environmental performance. However, it must be mentioned that better environmental performance may relate to lower (financial) risks and, thus slightly lower financial returns.

Several studies have detected an interesting inverse U-shaped link between (financial) competitiveness and environmental performance (*Guo–Lu [2021]* on a Chinese construction sample and *Broadstock et al. [2017]* on an international sample), having found a positive link until a certain level of environmental performance, however, it turns negative beyond that point.

Overall, the link between firm competitiveness and environmental performance has been studied by many authors, with various outcomes. Although the findings are rich and interesting, much of the literature only partly studied the multi-aspect nature of competitiveness and environmental performance.

Based on the theoretical framework and the empirical results presented, the following research hypotheses are formed:

H1: *There is a positive relationship between (multi-aspect) enterprise environmental performance and (multi-aspect) enterprise-level competitiveness.* This hypothesis can be divided into three sub-hypotheses, still at the enterprise level:

- **H1a:** *There is a positive relationship between environmental performance and the the market performance aspect of competitiveness.*
- **H1b:** *There is a positive relationship between environmental performance and the operationality aspect of competitiveness.*
- **H1c:** *There is a positive relationship between environmental performance and the adaptivity aspect of competitiveness.*

2. Research methodology

2.1 Research design

Our research is affiliated with the research programme of the CRC, 'In Global Competition', of the Corvinus University of Budapest. Since 1996, the CRC has been conducting extensive questionnaire surveys in Hungary to explore corporate competitiveness and its determinants, in which four senior managers of the surveyed companies answer questions on corporate strategy and key functional areas. The answers reflect the senior managers' assessment and opinions on the respective topics. Questions on environmental management were also included in the questionnaires to examine senior managers' attitudes, corporate practices and results concerning firm competitiveness. Six surveys have been carried out (1996, 1999, 2004, 2009, 2013 and 2018–2019) using a similar methodology with questionnaires designed and continuously improved by teams of experts. We have contributed to developing several sub-areas of the questionnaires, to which the present research also relates. Our analysis is based on the latest (sixth) competitiveness questionnaire survey data.

CRC's large-scale research has examined the relationship between firm competitiveness and several functional areas in previous years, such as operations *(Chikán–Demeter, 2006)*, marketing, logistics and manufacturing *(Demeter–Kolos, 2009)*, managerial decision-making *(Zoltay-Paprika et al., 2008)* and market orientation *(Stocker–Várkonyi, 2022)* but has not yet covered a multidimensional analysis of environmental performance relating to competitiveness. Its size and characteristics (internationally embedded, partly foreign-owned and export-oriented) make the sample of companies suitable to look for generalisable linkages between environmental management and competitiveness.

2.2 Data and sampling

The CRC's latest, sixth competitiveness survey was conducted between October 2018 and July 2019 with the collaboration of TÁRKI Zrt. More than 2,000 firms active in Hungary were contacted during the data collection. The sample was selected by considering the characteristics of the number of employees, the region and the sector group. Four different questionnaires were sent to enterprises to be filled out by the general manager and managers responsible for production, finance and marketing. Executives of 234 firms answered the questionnaires. After data

clearing and validation, the final sample included 209 companies, covering 5.5% of Hungarian companies with more than 50 employees, and is representative of company size and sector *(Chikán et al., 2019).*

2.3 Statistical methods and key variables used

Quantitative statistical methods were used to test the research hypotheses developed based on the literature review. First, cluster analysis has been conducted to classify the sample ~~b~~based on environmental performance (EMP and EOP). Then, clusters were analysed and compared along different aspects of enterprise-level competitiveness, the FCI and its components. For the comparisons, analysis of variance (ANOVA) was applied.

For EMP measurement, eight different environmental management tools were covered (as dummy variables—yes or no). As an aggregated variable, the sum of those tools was applied (from 0 to 8) (see also *Henri–Journeault, 2008)*. For the EOP component, six variables were used based on the improvement in the last three years of the following fields of environmental load (measured on a 5-point Likert scale, with 1 as the worst and 5 being the best performance), similar to *Durach–Wiengarten (2017)* and *Long et al. (2017)*. Again, these variables were aggregated to an overarching EOP variable for the clustering calculated as the average of the six variables (Table 1).

Table 1

Components of the environmental performance of enterprises

Environmental Management Performance	Environmental Operational Performance
• Written environmental policy	• Carbon emissions per product unit
• Environmental performance measurement	• Waste emissions per product unit
• Environmental training programme for employees	• Water consumption per product unit
• Environmental criteria for employee assessment	• Material consumption per product unit
• Audit of environmental activities	• Energy consumption per product unit
• Accounting system for environmental expenditure	• Number of accidents at work
• Public environmental/sustainability/CSR report	
• Measurement of CO_2 emissions	

Source: *Henri–Journeault (2008), Durach–Wiengarten (2017), Long et al. (2017).*

To measure firm competitiveness, we used the previously mentioned concept of *Chikán's (2006)* FCI, which is a validated composite index based on Market Performance, Operationality and Adaptivity, with variables on a 5-point Likert scale (again, 1 as the worst and 5 as the best). Thus, the maximum value of the

whole index is 50. The FCI is based on 24 basic variables, as summarised in Table 2.

Table 2

Components of the Firm Competitiveness Index

Market Performance (MP)	Operationality (OP)	Adaptability (AD)
• Market share • Return on sales	• Cost-effectiveness • Competitive prices • Product/service quality • Quality of manufacturing activity • Quality of materials • Delivery time/service time • Delivery/service accuracy • Flexible responding to consumer demand • Flexibility of the production system • Flexibility of the logistics system • Product/service assortment • Quality of production/customer service • Distribution channels • Ethical behaviour	• Direct relationship with consumers • Forecasting market changes • Innovative sales promotion methods • Skills and qualifications of employees • Preparedness and skills of managers • Decision-making methods and techniques • Technology level • R&D expenditures

Source: based on *Chikán (2006).*

The clustering was based on aggregated EMP and EOP variables. To avoid the dominance of either variable, the aggregated variables were standardised (mean = 0 and standard deviation = 1). Considering the sample size, a K-mean clustering was preferred (instead of a hierarchical method). The variables were appropriate for clustering (the Pearson correlation coefficient between the aggregated EMP and EOP variable was 0.349, showing a modest correlation; and also varied between 0 and 0.4 for the specific variables).

After running several settings, a 4-cluster option was chosen (above 4, there were one or more extremely small ones, whereas the 2- and 3-cluster solutions resulted in big clusters with information loss). Both the EMP and EOP variables proved to be appropriate for the clustering ($p < 0.001$), with F-values of 179 and 213, respectively (indicating that the EOP component has a somewhat bigger contribution to the clustering).

The clusters were then characterised along the specific EMP and EOP variables, the pressure of external and internal stakeholders on the environmental protection activity of enterprises (on a 5-point Likert scale, where 1 means the weakest and 5 the strongest influence), see also *Hitchens et al. (2005).* As the key output of the cluster analysis, clusters are compared along different aspects of competitiveness,

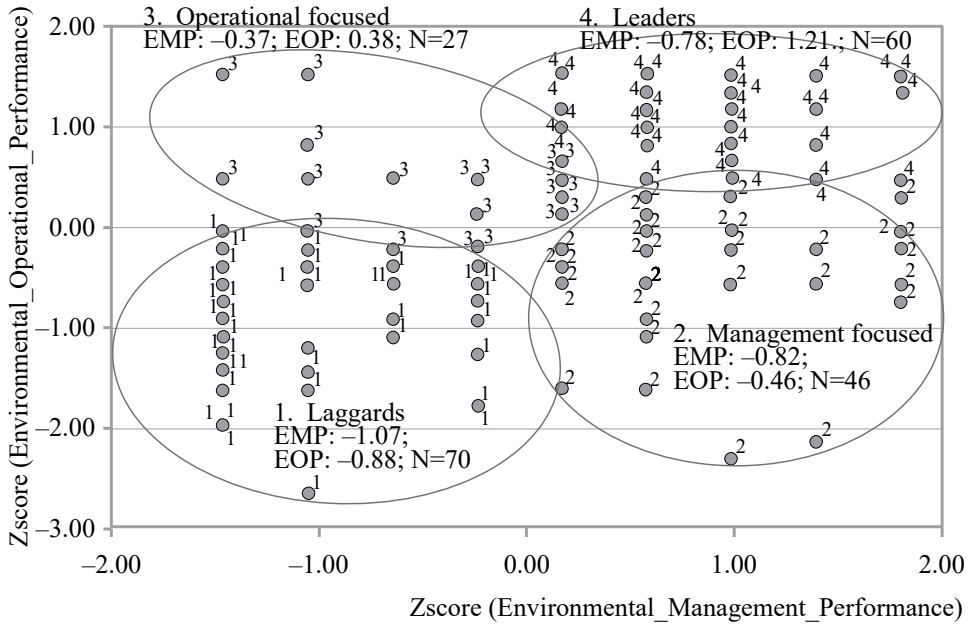
the FCI and its components. For the comparisons, ANOVA was applied, with the Levene-test for the homogeneity of variances as a precondition ($p > 0.05$ was satisfied in all cases).

3. Results and discussion

The environmental clusters resulting from the classification process described in the previous section are summarised in Figure 1.

Figure 1

Environmental performance clusters based on the EMP and EOP variables (N = 203)



Source: Own elaboration.

The ‘Leaders’ cluster overperformed along both EMP and EOP. The clusters with management and operational focus overperformed in the environmental management tools or the environmental load improvement categories (and underperformed along the other category), whereas the ‘Laggards” cluster underperformed in both categories. The four clusters are comparable in size, the reason behind the smallest cluster (Operational focus) can be underpinned by the

modest but positive correlation of EMP and EOP (it is hard to overperform in terms of environmental load indicators without proper environmental management tools).

To better understand the environmental performance, the clusters were characterised by the specific environmental performance indicators, as shown in Table 3.

Table 3

EMP and EOP characteristics of the different environmental performance clusters. (% of application of EM tools and development along EOP indicators in the last three years on a 5-point Likert-scale, where 1 is the worst and 5 is the best)

EP variables	1. Laggards	2. Management focused	3. Operational focused	4. Leaders	F-value*
EM tools applied					
Written environmental policy	25.8%	84.6%	64.0%	96.7%	43.2
Environmental performance measurement	18.2%	76.9%	28.0%	40.0%	15.0
Environmental training programme for employees	24.2%	56.4%	28.0%	78.3%	17.7
Environmental criteria for employee assessment	12.3%	56.4%	32.0%	41.7%	9.0
Audit of environmental activities	12.1%	84.2%	48.0%	79.7%	41.8
Accounting system for environmental expenditure	3.0%	66.7%	32.0%	90.0%	74.9
Public environmental/ sustainability/CSR report	4.6%	53.8%	12.5%	83.3%	57.3
Measurement of CO_2 emissions	10.6%	74.4%	29.2%	75.0%	19.1
EOP indicators					
Carbon emissions per product unit	2.57	3.11	4.00	4.79	118.3
Waste emissions per product unit	2.67	3.07	4.12	4.60	134.6
Water consumption per product unit	2.78	3.11	3.72	4.66	109.9
Material consumption per product unit	2.87	3.22	3.96	4.50	90.7
Energy consumption per product unit	2.88	3.15	3.76	4.66	101.7
Number of accidents at work	2.40	2.80	3.76	4.86	111.3

Source: Own compilation.
* Significance levels are not included directly, as $p < 0.001$ is applied in the ANOVA in all cases.

All variables differ along clusters ($p < 0.001$ for all), following the pattern in Table 3. However, some seem to be better influenced by cluster membership (with

higher F-values). In the case of EMP, environmental accounting, public environmental/sustainability reports and written environmental policy are the three most important tools in this respect. For the EOP, waste emissions, carbon emissions and accidents have the largest impact (but the difference among the EOP variables is smaller than for the EMP variables). Clusters also differ based on the pressure of stakeholders, as summarised in Table 4.

Table 4

Pressure of different stakeholders on the environmental performance of enterprises in the various clusters (on a 5-point Likert scale, where 1 is the weakest, 5 is the strongest)

Stakeholder	1. Laggards	2. Management focused	3. Operational focused	4. Leaders	F-value*
Owners	3.96	3.77	4.27	4.20	2.7
Employees	3.66	3.77	4.08	4.32	5.5
Consumers/Customers	3.64	3.65	4.38	4.54	11.2
Public authorities	3.99	3.86	4.08	2.70	23.9
Trade unions	2.20	2.71	3.54	3.32	10.8
Residents	3.23	3.26	3.92	4.50	19.1

Source: Own compilation.
* Significance levels are not included directly, as $p < 0.01$ applied for most cases and $p = 0.048$ for owners.

Again, the pressure of all stakeholder groups differs among clusters, but authorities, residents and consumers/customers have the highest variability.

Leaders seem to be by far the least oriented in regulating their environmental performance, whereas consumers have the biggest impact, showing the market orientation of this group. The Operational-focused cluster also has a higher consumer than regulatory pressure. Furthermore, these two clusters are also under strong pressure from employees and residents, the groups that seem to be the most closely linked to the operational processes of the firms. In contrast, the 'laggards' and 'management focused' clusters appear to be under the greatest pressure from public authorities. Owners are highly important in all cases, but their relative priority is lower in the case of the Leaders.

Table 5 compares the FCI, its sub-indices and the basic variables among the four clusters.

Table 5

The aspects of enterprise competitiveness of the different environmental performance clusters (The overall Firm Competitiveness Index has a maximum value of 50, whereas sub-indices and individual variables range between 1 and 5. Indicators where significant differences are applied among clusters are highlighted with grey.)

Competitiveness variables	1. Laggards	2. Management focused	3. Operational focused	4. Leaders	p-value*
Firm Competitiveness Index (FCI)	25.5	26.7	28.2	31.4	0.000
Market Performance					
Market Performance (MP) total	3.41	3.64	3.67	4.06	0.000
Market share	3.46	3.69	3.62	3.84	0.019
Return on sales	3.33	3.60	3.73	4.28	0.000
Operationality					
Operationality (OP) total	3.72	3.64	3.78	3.84	0.158
Cost-effectiveness	3.49	3.55	3.46	4.33	0.000
Competitive prices	3.40	3.57	3.58	3.71	0.216
Product/service quality	3.79	3.80	4.00	3.74	0.480
Quality of manufacturing activity	3.83	3.79	4.04	3.57	0.058
Quality of materials	3.63	3.61	3.65	3.53	0.887
Delivery time/service time	3.75	3.53	3.64	3.53	0.445
Delivery/service accuracy	3.86	3.57	3.81	3.74	0.251
Flexible response to consumer demand	3.91	3.68	3.80	3.78	0.418
Flexibility of the production system	3.77	3.62	3.88	3.76	0.538
Flexibility of the logistics system	3.82	3.71	4.08	3.91	0.186
Product/service assortment	3.78	3.60	3.92	4.14	0.003
Quality of production/customer service	3.82	3.74	3.84	4.10	0.045
Distribution channels	3.60	3.60	3.84	4.09	0.002
Ethical behaviour	3.85	3.75	4.12	4.21	0.007

(Table continues on the next page.)

(Continued.)

Competitiveness variables	1. Laggards	2. Management focused	3. Operational focused	4. Leaders	p-value*
Adaptivity related					
Adaptivity (AD) total	3.64	3.54	3.86	3.87	0.003
Direct relationship with consumers	3.89	3.68	3.70	4.07	0.037
Forecasting market changes	3.61	3.44	3.83	3.75	0.112
Innovative sales promotion methods	3.46	3.43	4.00	3.63	0.025
Skills and qualifications of employees	3.58	3.45	3.88	3.88	0.011
Preparedness and skills of managers	3.85	3.70	3.96	4.00	0.229
Decision-making methods and techniques	3.72	3.54	4.00	3.86	0.056
Technology level	3.73	3.69	3.96	3.76	0.518
R&D expenditures	3.23	3.33	3.84	3.76	0.001

Source: Own compilation.

The FCI differs significantly among clusters, with the Leaders having the highest FCI (31.4) and Laggards the lowest (25.5).

In the FCI sub-indices, Market Performance is significantly different among clusters (again, with the highest values among Leaders and lowest among Laggards). Regarding two variables of this sub-index, there is an apparent difference in return on sales, where Leaders' performance is significantly better. The differences along market share are smaller, but still significant, indicating that there may be weaker and stronger firms in terms of environmental performance among firms with different market positions. These findings agree with those of *Wagner–Schaltegger (2004).* The difference in profitability is in line with the significant difference in the cost-effectiveness included in the Operationality elements.

Although Operationality seems not to be significantly influenced by cluster membership, there are several variables even in this field, where significant differences apply. In line with the findings in the previous passage, Leaders outstandingly overperform other clusters in terms of cost-effectiveness, which follows some earlier research, indicating that environmental performance pays (this link can even be unintentional; efficiency improvement, new machinery or the use of high-level ICT solutions also improves EOP *(Nagy–Diófási-Kovács, 2020)*. There seem to be some further fields, where environmental Leaders outperform other clusters (Among the OP elements, Leaders are the best

performers in all the Servicing core variables (such as product/service assortment, quality of production, distribution and ethical behaviour). Typically, however, the Operational-focused cluster is ahead of the remaining two.

Adaptability differs significantly between environmental clusters, as 'Leaders' and 'Operational focused' outperform the other two clusters. At the level of basic indicators, the relationship is more diverse. Leaders are better in customer relationships, but the Operational-focused cluster is at least as good (or even better) in innovative sales promotion, employee skills and R&D expenditure (the same applies to decision-making techniques at the borderline of significance).

Based on the empirical results,

- **H1** can be accepted. There is a positive relationship between enterprise-level environmental performance and competitiveness (both fields are approached multidimensionally).
- **H1a** is also accepted. Environmental performance is positively related to market performance.
- **H1b** on the link between environmental performance and operationality is rejected, even though there are some connections (e.g. between environmental performance and cost-effectiveness).
- **H1c** on the link between environmental performance and adaptability is partly accepted, even though not all indicators of the latter differ significantly among the environmental performance clusters.

The results suggest that better environmental performance can be more cost-effective, more profitable and better in different fields of Operationality and Adaptability. This agrees with the findings of *Al-Tuwaijri et al. (2004), Lu–Taylor (2017),* but adds a broader coverage of both EMP and EOP. Our findings also support those of *Long et al. (2017)* but consider enterprise competitiveness much more comprehensively.

Interestingly, the Management-focused cluster is close to the Operational-focused group in terms of Market Performance indicators but underperforms them along several Operationality and Adaptability indicators (in some cases, even Laggards). This may also suggest that environmental management efforts are appreciated by the market, but do not (yet) necessarily translate into improved operational efficiency and responsiveness. EMP indicates the intention to improve environmental performance, whereas EOP reflects more on achievements. Similar to the findings of *Horvathova (2012)* about the time-lagged impact of EOP on financial performance, the future impacts of EMP on broadly defined competitiveness would need more empirical research.

4. Conclusions

This study addressed the research gap related to the link between enterprise-level competitiveness and environmental performance, as the complexity of these two concepts is often disregarded when the relationship between the two is analysed. After highlighting this research gap in the literature, a multidimensional approach for both fields was applied.

Enterprise-level competitiveness was approached using the FCI with three sub-indices: Market Performance, Operationality and Adaptability. Environmental performance was divided into EMP and EOP.

With a sample of 209 enterprises, four clusters were formed based on their environmental performance. Cluster sizes suggest that implementing environmental management tools positively impacts physical (operational) environmental performance; thus, entrepreneurial engagement is also needed to improve in this field. Environmental Leaders are mostly motivated by market stakeholders, whereas Laggards are highly regulation-driven.

Our main hypothesis (H1) was confirmed. The clusters with the best (and worst) environmental performance scored the highest (lowest) according to the FCI multidimensional competitiveness scale. Such a relationship could also be detected between environmental performance and Market Performance (H1a). Market Performance is typically associated with better profitability. However, market share was also important from the environmental performance perspective. Even though the link between environmental performance and Operationality (H1b) could not be confirmed, several cost-effectiveness and servicing-related factors (quality, delivery and flexibility-related characteristics) showed a positive relationship with environmental performance. The link with Adaptivity (H1c) was also confirmed, even though not all basic variables differed based on the environmental performance clustering. Its role is also important because it is a characteristic that reflects dynamic capabilities. Further thinking *Teece's (2016)* approach, improving environmental performance is often seen as a goal beyond current operational expectations, as indicated by the positive relationship with the variables related to Adaptivity: market relations, human skills and organisational responsiveness.

The results suggest that sound and effective environmental performance is 'worth it' and positively related to competitiveness, raising several implications. For entrepreneurs and businesses, a clear implication is that it makes sense to think of a comprehensive, multi-perspective, operationally embedded competitiveness. Within this framework, improving environmental performance is not just a

regulatory-driven must, but an organic factor valuable to the market and supporting enterprise-level competitiveness.

For policymakers, the results imply that economic and environmental policymaking should not be considered a zero-sum game but should be developed hand in hand. Environmental policymakers should better understand the existing market need and logic for fine-tuning regulation.

In the business education and training fields, reinforcing multidisciplinary approaches, including the link between environmental performance and competitiveness, and attention to interactions and relationships will provide business actors with higher chances to contribute to sustainability.

The limitation of this research is that it only focuses on one country (Hungary). However, as the enterprises in the sample are mostly internationally embedded, the findings may cautiously be generalised to a Central European context.

For future research, two major streams arise related to this study. One is that more empirical evidence is needed on the link between (multidimensionally approached) competitiveness and environmental performance, considering regional, cultural and sectoral characteristics. Another opportunity is going beyond the link studied here and approaching environmental or sustainability aspects as a part of a multidimensional competitiveness framework (similarly, ESG frameworks seek to cover corporate performance).

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References

Al-Tuwaijri, S. A. – Christensen, T. E. – Hughes, K. E. (2004): The relations among environmental disclosure, environmental performance, and economic performance: a simultaneous equations approach. *Accounting, Organisations and Society*, 29(5-6), 447–471. https://doi.org/10.1016/S0361-3682(03)00032-1.

Ammenberg, J. – Hjelm, O. – Quotes, P. (2002): The connection between environmental management systems and continual environmental performance improvements. *Corporate Environmental Strategy*, 9(2), 183–192. https://doi.org/10.1016/S1066-7938(02)00011-8

Bartus, G. (2013): The concept of sustainable development the impact of the interpretation of indicators selection of indicators (A fenntartható fejlődés fogalom értelmezésének hatása az indikátorok kiválasztására). *Statisztikai Szemle*, 95(8-9), 842–869.

Bhawsar, P. – Chattopadhyay, U. (2015): Competitiveness: Review, reflections and directions. *Global Business Review*, 16(4), 665–679. https://doi.org/10.1177/0972150915581115

Broadstock, D. C. – Collins, A. – Hunt, L. C. – Vergos, K. (2017): Voluntary disclosure, greenhouse gas emissions and business performance: assessing the first decade of reporting. *The British Accounting Review,* 50(1), 48–59. https://doi.org/10.1016/J.BAR.2017.02.002.

CDP (n.d.): The Carbon Disclosure Project. https://www.cdp.net/en (downloaded: October 2023)

Chenhall, R. H. – Langfield-Smith, K. (2007): Multiple perspectives of performance measures. *European Management Journal,* 25(4), 266–282. https://doi.org/10.1016/j.emj.2007.06.001

Chikán, A. (2006): Measuring the competitiveness of companies. A competitiveness index and its application. *Public Finance Quarterly,* 61(1), 45–59.

Chikán, A. (2008): National and firm competitiveness: A general research model. *Competitiveness Review*, 18(1), 20–28. https://doi.org/10.1108/10595420810874583

Chikán, A. – Demeter, K. (2006): Company characteristics, operations competitiveness and overall performance. *International Journal of Operations and Quantitative Management*, 12(2), 107–125.

Chikán, A. – Csutora, M. – Czakó, E. – Demeter, K. – Harangozó, G. – Hoffmann, K. – Kazainé Ónodi, A. – Kolos, K. – Losonci, D. – Móricz, P. – Stocker, M. – Tóbiás, D. – Wimmer, Á. (2019): *A 4. ipari forradalom küszöbén. Gyorsjelentés a 2019. évi kérdőíves felmérés eredményeiről* (At the beginning of the 4th industrial revolution. Preliminary report on the results of the 2019 survey). Versenyképesség Kutató Központ, Budapest.

Chikán, A. – Czakó, E. – Kiss-Dobronyi, B. – Losonci, D. (2022): Firm competitiveness: A general model and a manufacturing application. *International Journal of Production Economics,* 243. https://doi.org/10.1016/j.ijpe.2021.108316

Clarkson, P. M. – Li, Y. – Richardson, G. D. – Vasvari, F. P. (2011): Does it really pay to be green? Determinants and consequences of proactive environmental strategies. *Journal of accounting and public policy*, 30(2), 122–144. https://doi.org/10.1016/j.jaccpubpol.2010.09.013

Csutora, M. – De Palma, R. (2008): Using EMA to Benchmark Environmental Costs – Theory and Experience from Four Countries Through the UNIDO TEST Project. In: *Environmental Management Accounting for Cleaner Production*, pp. 143–164. Dordrecht: Springer Netherlands.

Demeter K. – Kolos K. (2009): Marketing, manufacturing and logistics: an empirical, examination of their joint effect on company performance. *International Journal of Manufacturing Technology and Management,* 16(3), 215–233. https://doi.org/10.1504/IJMTM.2009.022433

DJSI (n.d.): *The Dow Jones Sustainability World Index*. https://www.spglobal.com/spdji/en/indices/esg/dow-jones-sustainability-world-index/#overview (downloaded: October 2023)

Dragomir, V. D. (2018): How do we measure corporate environmental performance? A critical review. *Journal of Cleaner Production,* 196, 1124–1157. https://doi.org/10.1016/j.jclepro.2018.06.014.

Durach, C. F. – Wiengarten, F. (2017): Environmental management: The impact of national and organisational long-term orientation on plants' environmental practices and performance efficacy. *Journal of Cleaner Production,* 167, 749e758. https://doi.org/10.1016/J.JCLEPRO.2017.08.183

Dusek, T. (2024): Some basic questions of measurement and measurement theory (A mérés és a méréselmélet néhány alapkérdése). *Statisztikai Szemle*, 102(2), 107–157. https://doi.org/10.20311/stat2024.02.hu0107

Earnhart, D.– Lizal, L. (2007): Effect of pollution control on corporate financial performance in a transition economy. *European Environment,* 17, 247–266. https://doi.org/10.1002/eet.447

European Commission [EC] (2022): *Corporate Sustainability Reporting Scheme Directive*.

EPA (n.d.): *Toxics Release Inventory Program. United States Environmental Protection Agency*. https://www.epa.gov/toxics-release-inventory-tri-program (downloaded: October 2023)

Falciola, J. – Jansen, M. – Rollo, V. (2020): Defining firm competitiveness: A multidimensional framework. *World Development,* 129, 104857. https://doi.org/10.1016/j.worlddev.2019.104857

Feurer, R. – Chaharbaghi, K. (1994): Defining Competitiveness: A Holistic Approach. *Management Decision,* 32(2), 49–58. https://doi.org/10.1108/00251749410054819

Giovannoni, E. – Maraghini, P. M. (2013): The challenges of integrated performance measurement systems: Integrating mechanisms for integrated measures. *Accounting, Auditing & Accountability Journal,* 26(6), 978–1008. https://doi.org/10.1108/AAAJ-04-2013-1312

GRI (2023): *The Global Reporting Initiative*. https://www.globalreporting.org/ (downloaded: October 2023)

Guo, H. – Lu, W. (2021): The inverse U-shaped relationship between corporate social responsibility and competitiveness: Evidence from Chinese international construction companies. *Journal of Cleaner Production*, 295, 126374. https://doi.org/10.1016/j.jclepro.2021.126374

Harangozó, G. – Kerekes, S. – Zsóka, Á. (2010): Environmental management practices in the manufacturing sector – Hungarian features in international comparison. *Journal for East European Management Studies*, 15(4), 312–347.

Harangozó, G. (2008): What makes a company green – or what does good environmental performance mean? *Budapest Management Review,* 39(1), 27–36.

Henri, J-F. – Journeault, M. (2008): Environmental performance indicators: An empirical study of Canadian manufacturing firms. *Journal of Environmental Management*, 87(1), 165–176. https://doi.org/10.1016/j.jenvman.2007.01.009

Hermundsdottir, F. – Aspelund, A. (2022): Competitive sustainable manufacturing – Sustainability strategies, environmental and social innovations, and their effects on firm performance. *Journal of Cleaner Production*, 370, 133474. https://doi.org/10.1016/j.jclepro.2022.133474

Hitchens, D. – Thankappan, S. – Trainor, M. – Clausen, J. – De Marchi, B. (2005): Environmental performance, competitiveness and management of small businesses in Europe. *Tijdschrift voor economische en sociale geografie*, 96(5), 541–557. https://doi.org/10.1111/j.1467-9663.2005.00485.x

Horvathova, E. (2010): Does environmental performance affect financial performance? A meta-analysis. *Ecological Economics,* 70, 52–59. https://doi.org/10.1016/J.ECOLECON.2010.04.004

Horvathova, E. (2012): The impact of environmental performance on firm performance: short-term costs and long-term benefits? *Ecological Economics,* 84, 91–97. https://doi.org/10.1016/J.ECOLECON.2012.10.001

ISO (2021): *ISO 14031:2021 Environmental management – Environmental performance evaluation – Guidelines*.

Jorge, M. L. – Madueño, J. H. – Martínez-Martínez, D. – Sancho, M. P. L. (2015): Competitiveness and environmental performance in Spanish small and medium enterprises: Is there a direct link? *Journal of Cleaner Production*, 101, 26–37. https://doi.org/10.1016/j.jclepro.2015.04.016

Kassinis, G. – Vafeas, N. (2006): Stakeholder pressures and environmental performance. *Academy of Management Journal,* 49(1), 145–159. https://doi.org/10.5465/AMJ.2006.20785799

Latinovic, M. – Obradovic, T. (2013): The Performance of Socially Responsible Investments. *Entrepreneurial Business and Economics Review*, 1(2), 29–40. https://doi.org/10.15678/EBER.2013.010203

Long, X. – Chen, Y. – Du, J. – Oh, K. – Han, I. – Yan, J. (2017): The effect of environmental innovation behavior on economic and environmental performance of Chinese firms. *Journal of cleaner Production*, 166, 1274–1282. https://doi.org/10.1016/j.jclepro.2017.08.070

Lu, W. – Taylor, M. E. (2017): A study of the relationships among environmental performance, environmental disclosure, and financial performance. *Asian Review of Accounting*, 26(1), 107–130. https://doi.org/10.1108/ARA-01-2016-0010.

Nagy, J. – Diófási-Kovács, O. (2020): How can advanced information and communication technology support corporate environmental performance? *Budapest Management Review*, 51(11), 39–50. https://doi.org/10.14267/VEZTUD.2020.11.04

Nguyen, N. T. T. – Nguyen, N. P. – Hoai, T. T. (2021): Ethical leadership, corporate social responsibility, firm reputation, and firm performance: A serial mediation model. *Heliyon*, 7(4). https://doi.org/10.1016/j.heliyon.2021.e06809

REFINITIV (2022): *Environmental, Social and Governance Scores from Refinitiv*.

Sarwar, H. – Aftab, J. – Ishaq, M. I. – Atif, M. (2023): Achieving business competitiveness through corporate social responsibility and dynamic capabilities: An empirical evidence from emerging economy. *Journal of Cleaner Production*, 386, 135820. https://doi.org/10.1016/j.jclepro.2022.135820

Stocker, M. – Várkonyi, L. (2022): Impact of market orientation on competitiveness: Analysis of internationalized medium-sized and large enterprises. *Entrepreneurial Business and Economics Review*, 10(1), 81–95. https://doi.org/10.15678/EBER.2022.100106

Szennay, Á. – Szigeti, C. – Kovács, N. – Szabó, D. R. (2019): Through the blurry looking glass – SDGs in the GRI reports. *Resources*, 8(2), 101.https://doi.org/10.3390/resources8020101

Szilágyi, Gy. (2008): Measuring competitiveness in the international methodology of international comparisons (A versenyképesség mérése a nemzetközi összehasonlítások módszertanának tükrében). *Statisztikai Szemle*, 86(1), 5–21.

Takács, A., – Erdős, S. (2023): Ok vagy okozat? A környezeti és a pénzügyi teljesítmény összefüggésének elemzése nemzetközi nagyvállalati adatokon (A consequence or a criterion? An analysis of the relationship between environmental and financial performance based on data of large international firms). *Statisztikai Szemle*, 101(5), 387–402. https://doi.org/10.20311/stat2023.05.hu0387

Teece, D. J. (2016): Dynamic capabilities and entrepreneurial management in large organizations: Toward a theory of the (entrepreneurial) firm. *European Economic Review*, 86, 202–216. https://doi.org/10.1016/j.euroecorev.2015.11.006

Trumpp, C. – Guenther, T. (2017): Too little or too much? Exploring U-shaped relationships between corporate environmental performance and corporate financial performance. *Business Strategy and the Environment,* 26(1), 49–68. https://doi.org/10.1002/bse.1900.2017.08.070.

Urbaniec, M. (2014): Implementation of International Standards for Environmental Management in Visegrad Countries: A Comparative Analysis. *Entrepreneurial Business and Economics Review*, 2(2), 65–76. https://doi.org/10.15678/EBER.2014.020206

Wagner, M. – Schaltegger, S. (2004): The effect of corporate environmental strategy choice and environmental performance on competitiveness and economic performance: an empirical study of EU manufacturing. *European Management Journal,* 22(5), 557–572. https://doi.org/10.1016/J.EMJ.2004.09.013.

Wimmer, Á. – Csesznák, A. (2021): *Competitiveness characteristics of Hungarian companies during the fourth industrial revolution.* Alinea – CUB Competitveness Research Centre. https://doi.org/10.14267/978-615-5669-49-1

Zoltay-Paprika, Z. – Wimmer, Á. – Szántó, R. (2008): Managerial decision making and competitiveness: the case of Hungary. *Competitiveness Review: An International Business Journal,* 18(1/2), 154–167. https://doi.org/10.1108/10595420810874655