

## COMPARISON ANALYSIS OF PRO-QUALITY AND PRO-ENVIRONMENTAL APPROACHES TO PRODUCTS IMPROVING IN SMES FROM THE VISEGRAD GROUP COUNTRIES

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**Purpose:** The purpose of the research was to perform an in-depth comparative analysis of pro-quality and pro-environmental approaches to the products improvement in SMEs (belonging to the electrical machinery industry) from V4 countries.

**Design/methodology/approach:** An in-depth comparative analysis of pro-quality and pro-environmental approaches to product improvement was carried out in SMEs from V4 countries. Based on previous research (survey research conducted from March to September 2023 including 379 SMEs from V4 countries), two benchmarks for these approaches were developed and further analysed. Statistical analyses were used, i.e. Box-and-whisker chart and Wilcoxon paired test in STATISTICA 13.3. on the level of significance  $p < 0.05$ .

**Findings:** It was shown that SME entrepreneurs from V4 countries have a relatively similar approach to the improvement of pro-quality and pro-environmental products. The pro-quality approach is more important than pro-environmental in case of product improvement.

**Practical implications:** Research results can be the basis for defining more precise directions for the development of SMEs in V4 countries and increasing cooperation between consortium regions in the development of product production in line with the idea of sustainable development and current customer expectations.

**Social implications:** The results can have a positive impact on public attitudes, mainly entrepreneurs from SMEs, but not only in making further efforts to improve the quality of products while reducing the negative impact on the environment. This behavior may contribute to increased customer satisfaction with purchased products, but also to the development of the economies of the V4 countries and to meeting the requirements of sustainable development.

**Originality/value:** Originality of the research includes determining the current approach of SMEs in the electrical machinery industry in V4 countries to meeting customer expectations regarding product quality, while striving to achieve environmentally friendly products.

**Keywords:** V4, Visegrad Group, product quality, environmental impact, sustainable development, SMEs, production engineering.

**Category of the paper:** Research paper.

## 1. Introduction

The countries of the Visegrad group (V4, i.e. Poland, Slovakia, Czech Republic, and Hungary) (Siwiec, Varga, Pacana, 2023). The V4 countries are in the centre of Europe and are policy group. In the V4 countries, many decisions both external and internal are made together by governments of these countries. These countries have a similar history and similar development of market (Lacko et al., 2021). In these countries, it is important to develop open economies, and simultaneously development of system transformation. It is favourable when investments offer a relative good localization and resources by the small cost. These activities are powered by small and medium-sized enterprises (SMEs) (Golovko, Valentini, 2011; Ključnikov et al., 2023; Lu et al., 2022), which are the largest group of enterprises in the world. SMEs ensure many workplaces, and has important participation of market (Pacana, Siwiec, 2022; Siwiec, Pacana, Pacana, 2023). However, SMEs' activities translate into impact on natural environment, and this impact is significant given the large number of these enterprises (Masocha, 2018).

As part of sustainable development, it is necessary to reduce the negative impact of SMEs on natural environment (Khan et al., 2021; Wolf, Chomkamsri, 2015). However, actions that reduce negative impact should be combined with actions that achieve customers' requirements from products' quality (Ostasz et al., 2022; Pacana, Siwiec, Bednárová, et al., 2023). It is difficult during turbulent and dynamic changes of customers' expectations and market. In the last period, these difficulties were mainly caused by SARS-CoV-2 and the Russian-Ukrainian war (Renzi et al., 2022). Mainly, it is problematic for countries still developing like V4 countries, which strive to reach the level of highly developed countries. Visegrad Group countries are still searching for optimal cooperation with all countries, mainly with neighboring ones. Their aim is to develop democracy in all part of Europe (Drews, 2016). Therefore, it is important to analyse current actions and also general approaches of V4 counties to sustainable development (Gajdzik, Wolniak, 2022; Gawlik, 2015). As mentioned, it has an important impact on the development in these countries of small businesses. Based on the literature review, for example (Belas et al., 2022; Falkowski, 2023; Golovko, Valentini, 2011; Hoogendoorn et al., 2015; Ivanová, Masárová, 2018; Lacko et al., 2021; Lopes de Sousa Jabbour et al., 2020; Lu et al., 2022), it was concluded that current approaches to qualitative and environmental aspects of product improvement in SMEs from V4 countries were not analysed in comparative way.

Therefore, the purpose of the research was to perform an in-depth comparative analysis of pro-quality and pro-environmental approaches to improving products in SMEs (belonging to electrical machinery industry) from V4 countries.

Originality of the research includes determining the current approach of SMEs in the electrical machinery industry in V4 countries to meeting customer expectations regarding product quality, while striving to achieve environmentally friendly products.

## 2. Method research

The research was carried out as part of the survey research. The survey was distributed to small and medium-sized enterprises (SMEs) belonging to electromechanical industry (Pacana, Siwiec, Stolarik, et al., 2023). These SMEs were from countries of the Visegrad Group (V4), i.e.: Poland, Slovakia, Czech Republic and Hungary (Hudakova et al., 2021).

The survey was realised in paper form, and also by electronic form (by using MS FORMS). The survey is presented in QuEn - Research Questionnaire For Enterprise. The survey questions were created as part of initial research, for example: Hajduk-Stelmachowicz et al., 2022; Siwiec et al., 2022; Siwiec et al., 2023. Also, the questions included in the survey resulted from literature review, i.e.: Benito-Hernández et al., 2023; Bryła, 2020; Hudakova et al., 2021; Saqib et al., 2023; Wysocki, 2018).

The survey included 36 questions, of which a few as presented, for example, in the study (Siwiec, Pacana, Simková et al., 2023). From these questions, two main questions which refer to pro-quality and pro-environmental approaches to the improvement (Siwiec, Varga, Pacana, 2023). These questions included 14 statements covering pro-quality and pro-environmental approaches, respectively. These questions were analysed separately in before articles. In this study, an in-depth comparative analysis of these two approaches which were based on the two questions of survey research. The following hypothesis was checked:

**H<sub>1</sub>:** SMEs from V4 countries have a relatively similar approach to the improvement of pro-quality and pro-environmental products.

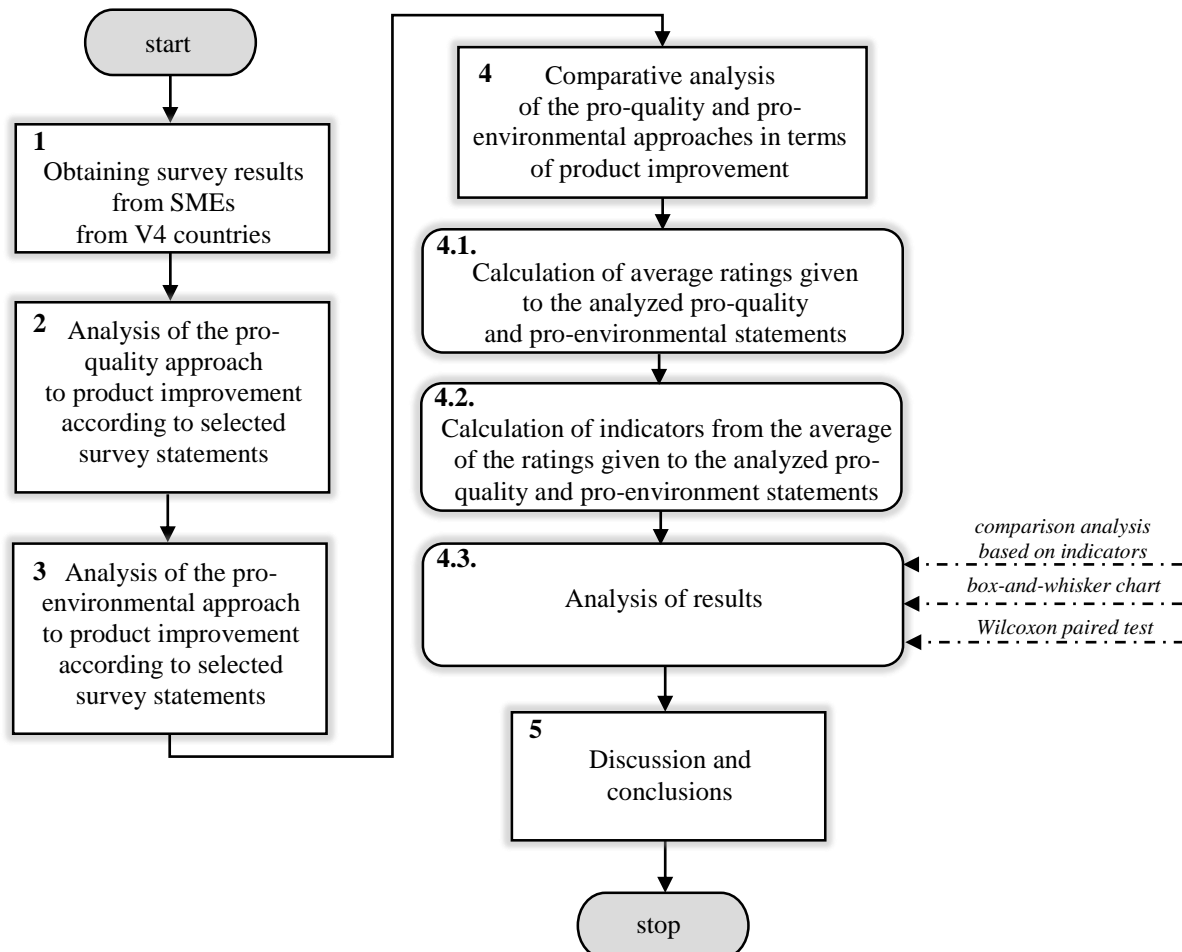
The comparative analysis of the pro-quality and pro-environmental approaches in terms of product improvement included:

- Calculation of average ratings given to the analysed pro-quality and pro-environmental statements;
- Calculation of indicators from the average of the ratings given to the analysed pro-quality and pro-environment statements;
- Analysis of results.

The analysis of results was supported by created indicators that were developed based on average assessments of each statement. Comparison analysis was also supported by the box-and-whisker chart and Wilcoxon's paired test. The box and whisker chart was created to show the difference between pro-quality and pro-environmental approaches. The Wilcoxon paired test was performed to check whether the differences between these assessments are significant

in a statistical way. The choice of these tests resulted from their suitability for the analysis of two independent variables. Statistical analyses were realized in STATISTICA 13.3. on the level of significance  $p < 0.05$ .

Figure 1 presented the assumed method of analysing the pro-quality and pro-environmental approaches to improving products in SMEs from V4 countries.



**Figure 1.** Method of analysis of pro-quality and pro-environmental approaches to products' improvement in SMEs from V4 countries.

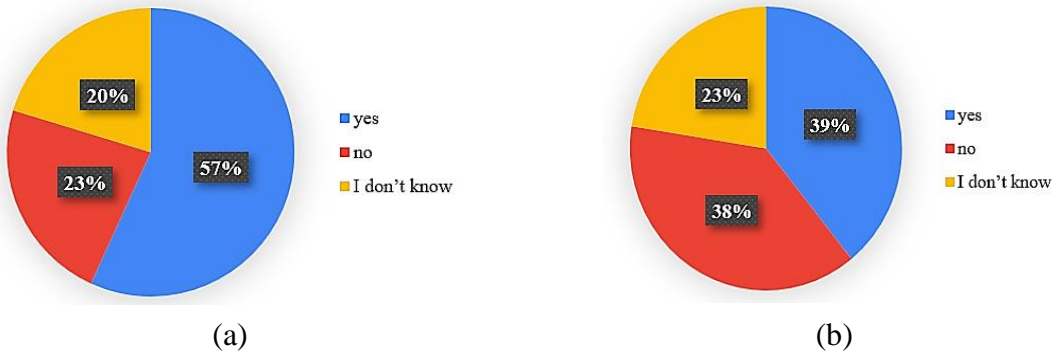
Source: Own elaboration.

The method of comparison analysis of these approaches was realized in fifth main stages. Stages 1 to 3 were carried out as part of previous activities that were carried out as part of an international project (IVF 22230264), during which the results presented in this study were obtained. Stages 4 and 5 (with steps 4.1, 4.2, and 4.3) refer to realized comparison analysis presented in the next chapter of the study.

### 3. Results

The study presented part of research results that refers to pro-quality and pro-environmental approach to product improvements. The research involved qualitative-environmental approaches to the improvement of products and was carried out as part of an international project „Qualitative-environmental aspects of products improvement” (IVF 22230264). The results presented in the study refer to two main questions of the research and including detailed information about SMEs that participated in the research. The sample size was equal to 379 SMEs from V4 countries (41% Poland, 25% Hungary, 24% Slovakia, 10% Czech Republic). This sample size was obtained from March to November 2023.

Firstly, analyzed status of implementing systems, i.e.: ISO 9001:2015, ISO 14001:2015, and EMAS. Figure 2 presented this results.

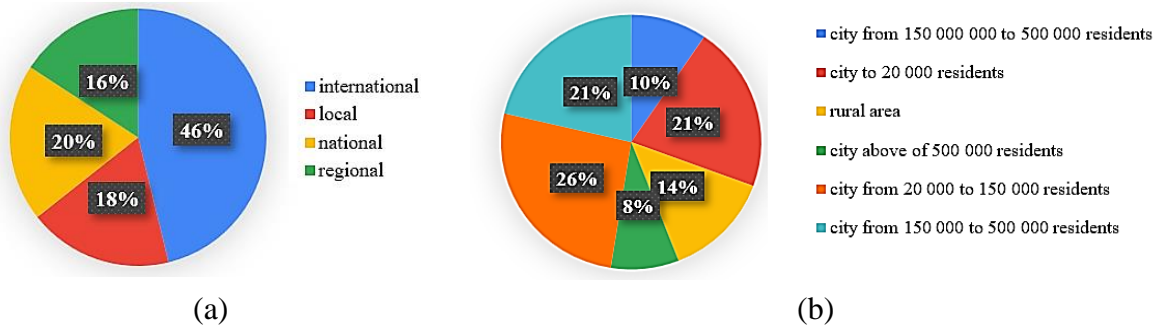


**Figure 2.** Results of implemented: (a) ISO 9001:2015 system, (b) ISO 14001:2015 system or EMAS system.

Source: Own elaboration.

Based on the results of the survey datasheet, it was shown that 57% of SMEs from V4 countries implemented the ISO 9001:2015 system, 20% of entrepreneurs did not know about the implementation of this system, and 23% decelerated that had not implemented this system. Less than half of the SMEs in the V4 countries (39%) implemented the ISO 14001: 2015 system or the EMAS system. 23% of the entrepreneurs did not know if these systems were implemented and 38% of entrepreneurs decelerated that had not implemented the ISO 14001:2015 system or EMAS system.

Then, it was analyzed the range of activity and company headquarters of SMEs from V4 countries. Figure 3 presented this results.



**Figure 3.** Results of: (a) range of activity, (b) company headquarters.

Source: Own elaboration.

46% of SMEs form V4 belong to international range, then 20% national, 18% local, and 16% regional. In case of company headquarters: 26% were city from 20 000 to 150 000 residents, then 21% were city from 150 000 to 500 000 residents, and also city to 20 000 residents. Other SMEs were located in rural area (14%), city from 150 000 to 500 000 residents (10%) and city above of 500 000 residents (8%).

Then, the approaches of the V4 countries to pro-quality and environmental products were compared. The analysed questions are presented in Table 1. For these questions it was possible to mark one answer for each statement in scale: 1 – I totally don't agree, 2 – less than once every three years, 3 – once every two to three years, 4 – I mostly agree, 5 – I totally agree.

**Table 1.**

*Survey questions for pro-quality and pro-environmental approaches of products improvement*

No.	What is your opinion about every statement refers to pro-quality improving of products?	What is your opinion about every statement refers to pro-environmental improving of products?
1	All customers in the supply chain attach great importance to the quality of products	Customers attach great importance to the pro-environmental actions of analyzed enterprise
2	Customers will pay more if they get high quality product	Customers will pay more if the product is pro-ecological
3	A high-quality product is the product that meets the current requirements of customers	A pro-ecological product is the product that meets the current requirements of customers
4	Currently, high-quality products have also a high level of environmental friendliness	Currently, pro-ecological products have also a high level of quality
5	Wealthy customers usually choose high-quality products	Wealthy customers usually choose pro-ecological products
6	Choosing a high-quality product can improve a customer's self-esteem	Choosing a pro-ecological product can improve a customer's self-esteem
7	Customers pay attention to the high-quality of packaging of product	Customers pay attention to the pro-ecological packaging of product
8	High-quality products are sufficiently promoted	Pro-ecological products are sufficiently promoted
9	We as a company strive to continuously improve products' quality	We as a company strives to produce pro-ecological products
10	The higher price of high-quality products significantly discourages customers from buying them	The higher price of pro-ecological products significantly discourages customers from buying them
11	Customers are more likely to buy a high-quality product if it has been previously recommended/tested	Customers are more likely to buy a pro-ecological product if it has been previously recommended/tested

Cont. table 1.

12	Customers have a lot of knowledge about the attributes of products that affect their high quality	Customers have a lot of knowledge about the attributes of products that affect their pro-ecological features
13	Higher quality products have a higher price	Pro-ecological products have higher prices
14	Customers will pay more for products from enterprises that are active in improving the quality of products	Customers will pay more for products from enterprises that take real pro-ecological actions

These pro-quality and pro-environmental approaches were analysed in other studies. Therefore, in this article, only the average values of the ratings of SME entrepreneurs from V4 countries for the pro-quality and pro-environmental approaches. Table 2 presents these average values.

**Table 2.**

*Average values from the ratings given by entrepreneurs for pro-quality and pro-environmental statements for product improvement*

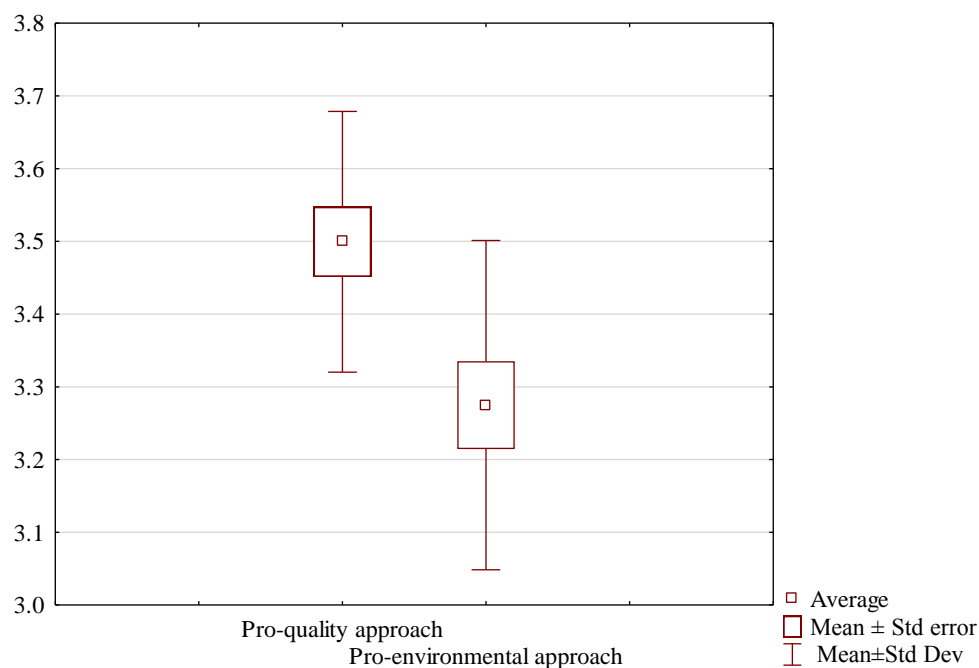
No. of statement	Poland	Slovakia	Czech Republic	Hungary	Poland	Slovakia	Czech Republic	Hungary
	Pro-quality approach				Pro-environmental approach			
1	3.86	3.06	3.44	4.05	3.06	2.72	3.05	3.20
2	3.67	3.19	3.46	3.30	2.99	3.00	3.00	2.94
3	4.19	3.19	3.54	3.64	3.14	2.86	3.21	2.82
4	3.44	2.84	3.41	3.38	3.16	2.82	3.00	3.56
5	3.44	3.12	3.33	3.41	3.27	2.91	3.18	3.64
6	3.75	3.31	3.38	3.76	3.38	3.14	3.44	3.73
7	3.69	3.21	3.10	3.33	3.17	2.98	3.28	3.44
8	3.28	3.23	3.38	3.65	3.08	3.11	3.28	3.52
9	4.01	3.63	3.72	3.98	3.38	3.00	3.72	3.44
10	3.10	3.07	3.13	4.14	3.30	3.28	2.95	4.28
11	4.06	3.64	3.51	3.39	3.58	3.27	3.69	3.52
12	3.44	2.86	3.41	3.69	3.09	2.77	3.49	3.41
13	4.03	3.48	3.38	4.19	3.89	3.50	3.54	4.29
14	3.68	3.32	3.41	3.67	3.15	3.09	3.31	3.37

Based on average values of pro-quality and pro-environmental approaches to products' improvement, two indicators were calculated, that is, the pro-quality indicator (the average of the average values of the ratings of SME entrepreneurs from the V4 countries for the pro-quality approach) and the pro-environmental indicator (the average of the average values of the ratings of SME entrepreneurs from the V4 countries for the pro-environmental approach). These indicators are presented in Table 3.

**Table 3.**  
*Pro-quality and pro-environmental indicators*

No. of statement	Pro-quality indicator	Pro-environmental indicator
1	3.60	3.01
2	3.41	2.98
3	3.64	3.01
4	3.27	3.14
5	3.33	3.25
6	3.55	3.42
7	3.33	3.22
8	3.39	3.25
9	3.84	3.39
10	3.36	3.45
11	3.65	3.52
12	3.35	3.19
13	3.77	3.81
14	3.52	3.23

These indicators are compared by using Box-and-whisker (in STATISTICA 13.3), as shown in Figure 4.



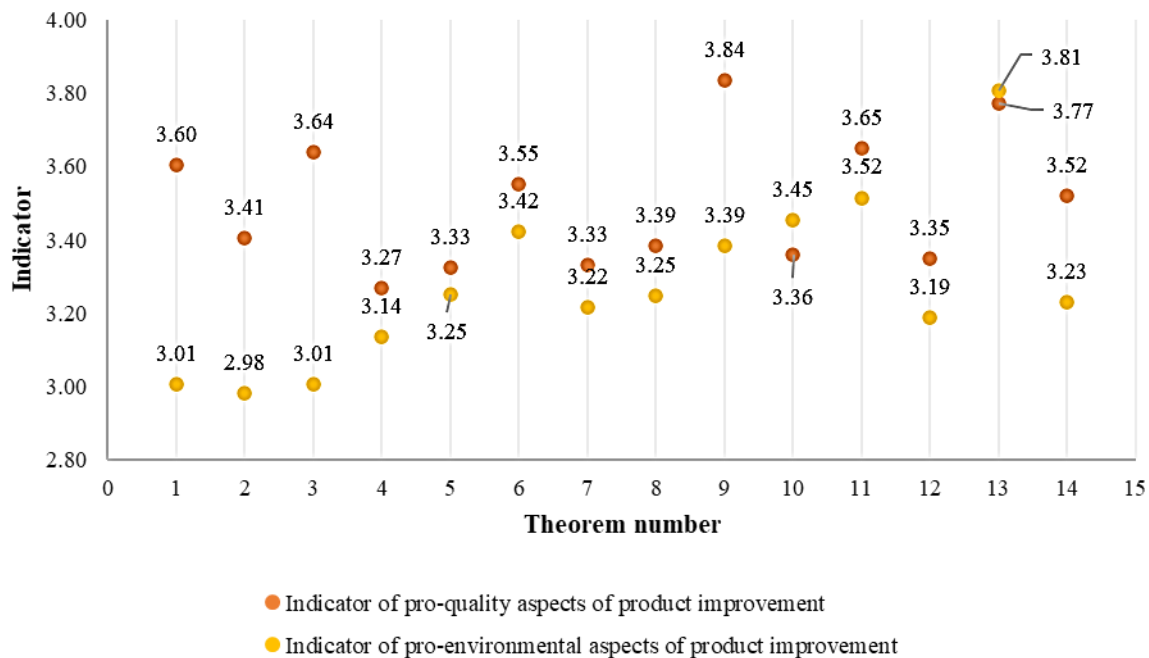
**Figure 4.** Box-and-whisker chart including the average of the average values of entrepreneurs' assessments for pro-quality and pro-environmental product improvement.

Source: Own elaboration.

Based on box-and-whisker chart shown that pro-quality and pro-environmental approaches in general approach were assessed in different way. The highest ratings were obtained for the pro-quality approach, which demonstrates greater involvement of SMEs from V4 countries in these activities.



Then, the Wilcoxon paired test was used to check if the difference between these assessments is significant by statistic way. This test was carried out using STATISTICA 13.3 software. Based on the results, it was shown that the pro-quality and pro-environmental approaches differ statistically significantly ( $p < 0.05$ ). A detailed analysis of the differences between the indicators is presented in Figure 5.



**Figure 5.** Comparison of approaches to pro-quality and pro-environmental product improvement by SMEs from the V4 countries.

Source: Own elaboration.

The approach to improving the quality of the product was observed to be much better in most aspects by the entrepreneurs of the V4 countries, for example: (1) all customers in the supply chain attach great importance to the quality of the products (3.60), or (2), customers will pay more if they get a high quality product (3.41).

Compared to the evaluation of the pro-environmental aspects, only several the pro-quality aspects were rated worse, that is, (10) the higher price of high-quality products significantly discourages customers from buying them (3.36), and (13) higher quality products have a higher price (3.77).

Both the pro-quality and pro-environmental aspects can be assumed to be on relatively similar level, that is, 4,5,6,7,8,10,11,13. However, as shown in previous analyses, all differences in pro-quality and pro-environmental indicators were statistically significant ( $p < 0.05$ ).

Therefore, it was concluded that the pro-quality aspects are in the vast majority of cases more important to SMEs in the V4 countries. Therefore, as part of hypothesis ( $H_1$ ), it was shown that SME entrepreneurs from V4 countries have a relatively similar approach to the

improvement of pro-quality and pro-environmental products. The pro-quality approach is more important than pro-environmental in case of product improvement.

#### 4. Discussion and conclusion

Striving for sustainable development continues to be a challenge, mainly in developing countries, such as the countries of the Visegrad group. It is important to take appropriate action in the largest group of enterprises, which are small and medium enterprises (SMEs). Therefore, the purpose of the research was to perform an in-depth comparative analysis of pro-quality and pro-environmental approaches to improving products in SMEs (belonging to electrical machinery industry) from V4 countries. This analysis was carried out based on survey results obtained from March to September 2023 from 379 SMEs from V4 countries. The method of analysis refers to a thorough comparative analysis of pro-quality and pro-environmental approaches to improving products in SMEs from the V4 countries. This analysis was supported by statistical analysis, i.e. the box-and-whisker chart and Wilcoxon paired test which were performed at the level of significance  $p < 0.05$ . After analysis, it was shown that:

- pro-quality and pro-environmental approaches in general approach were assessed in different way;
- the highest ratings were obtained for the pro-quality approach, which demonstrates greater involvement of SMEs from V4 countries in these activities;
- pro-quality and pro-environmental approaches differ statistically significantly ( $p < 0.05$ );
- compared to the evaluation of the pro-environmental aspects, only several the pro-quality aspects were rated worse, that is, the higher price of high-quality products significantly discourages customers from buying them, and higher quality products have a higher price.

After analysis, it was concluded that SMEs from V4 countries have a relatively similar approach to the improvement of pro-quality and pro-environmental products, but the pro-quality approach are more important than pro-environmental in case of products' improvement.

Originality of the research includes determining the current approach of SMEs in the electrical machinery industry in V4 countries to meeting customer expectations regarding product quality, while striving to achieve environmentally friendly products.

These results can be used by SMEs from V4 countries to make more precise decisions about product improvement and reduce the negative impact of these products on the natural environment. Furthermore, these results can be the basis for increasing cooperation between consortium regions in the development of product production according to the idea of sustainable development and the current customer expectations. These results can be good tips

for the development of the economies of the V4 countries and meeting the requirements of sustainable development.

## Acknowledgements

The article was created as part of research conducted in the project Visegrád Fund, project ID: 22230264, Title: Qualitative-environmental aspects of products improvement, carried out from February 1, 2023 to March 31, 2024: Applicant: Politechnika Rzeszowska im. Ignacy Łukasiewicz. Rzeszow University of Technology, Rzeszów, PL.

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