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THE ROLE OF DIGITAL INITIATIVES IN ADVANCING ESG IN POLISH INDUSTRIAL COMPANIES

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Purpose: The purpose of this paper is to investigate the relationship between digital initiatives and Environmental, Social, and Governance (ESG) performance in the Polish industrial sector. The research aims to determine how the implementation of Industry 4.0 technologies contributes to corporate sustainability and supports the achievement of Sustainable Development Goals (SDGs).
Design/methodology/approach: The study adopts a mixed-method approach, combining qualitative textual analysis and quantitative statistical evaluation. Corporate sustainability reports of 15 publicly listed companies from the WIG50 index were analyzed using a predefined set of digitalization-related keywords to assess the presence and intensity of digital initiatives. Statistical analysis, including Pearson correlation and regression modeling, was used to identify relationships between digital transformation and ESG performance. The research also considers the influence of external factors, such as regulatory conditions and market competition, on digital strategy development.
Findings: The findings reveal a positive but moderated correlation between digital initiatives and ESG performance in the Polish industrial sector. Industry 4.0 technologies such as AI-driven energy optimization, IoT systems, and digital twins were found to significantly contribute to sustainability objectives. However, the results also highlight the complex nature of ESG performance, indicating that while digitalization is a key enabler, other organizational and environmental variables also play a critical role.
Research limitations/implications: The research is limited by its scope, focusing on 15 companies within the industrial sector in Poland. Future research should consider a broader dataset, use longitudinal methods, and include qualitative case studies to deepen insights into the evolving relationship between digitalization and sustainability.
Practical implications: The study offers practical insights by showing how digital transformation can enhance ESG performance. Companies can use these findings to guide strategic investment in digital technologies within sustainability and governance frameworks.
Originality/value: This paper provides novel empirical evidence on the digitalization–sustainability nexus in the Polish industrial context. It adds value by bridging the gap between digital transformation and ESG performance, and is relevant for researchers, practitioners, and policymakers interested in sustainable industrial development.
Keywords: digitalization, digital initiatives, ESG, SDG, Industry 4.0.
Category of the paper: Scientific research.

1. Introduction

The urgency of integrating sustainable practices into industrial activities has intensified in light of environmental challenges and the global push for achieving the United Nations Sustainable Development Goals (SDGs). Digital transformation is positioned as a key enabler of sustainable strategies, offering new methods for improving environmental efficiency, social engagement, and governance transparency within organizations. In the industrial sector, which traditionally carries a significant environmental and social footprint, digital technologies are increasingly recognized for their potential to drive responsible innovation. Industry 4.0 tools, such as the Internet of Things (IoT), artificial intelligence (AI), big data analytics, and predictive maintenance systems-support not only operational efficiency but also environmental stewardship and transparent governance.

Poland's industrial companies, navigating through both digital and sustainable transitions, represent a particularly interesting context. With increasing emphasis from the European Union on the twin transition (digital and green), Polish enterprises are progressively investing in smart technologies to align with global sustainability standards. This study focuses on assessing how digital initiatives influence the Environmental, Social, and Governance (ESG) performance of Polish industrial companies and how such transformations contribute to the achievement of the SDGs

2. Linking digital initiatives with ESG performance: a literature-based perspective

2.1. Theoretical foundations of digital transformation and its role in industrial sustainability

Digital transformation has emerged as a critical area of research in information systems and strategic management, profoundly impacting industries and organizational structures (Bharadwaj et al., 2013; Piccinini et al., 2015a). Defined as a process that enhances an entity through the integration of information, computing, communication, and connectivity technologies, digital transformation extends beyond mere technological adoption. It requires firms to implement strategic and structural changes to fully realize value creation (Majchrzak, 2016; Svahn et al., 2017). Research highlights that while technology is an enabler, organizational factors such as strategy, culture, and processes play equally crucial roles in the success of digital initiatives (Vial, 2019; Matt et al., 2015; Selander, Jarvenpaa, 2016). Digitalization in especially manufacturing is increasingly recognized as a key enabler for sustainability. Previous studies have underscored the role of digital transformation in improving

eco-efficiency, operational transparency, and governance practices (Fitzgerald et al., 2014; Westerman et al., 2011). However, with the passage of time and the changes made both in legislation and the development of technology, studies of recent years show the opposite trend. The integration of digital technologies has been shown to improve eco-efficiency, reduce resource consumption, and enhance operational transparency (Zheng et al., 2020; Skender et al., 2019).

As the study aim is to research a digital initiatives in lens of industrial sector it seems necessary to describe how the current paradigm shift into Industry 4.0. Digital transformation and Industry 4.0 are central themes in contemporary sustainability research. Studies have highlighted the potential of digitalization to revolutionize manufacturing processes through technologies like smart sensors, predictive maintenance systems, and digital twins (Wang et al., 2016; Oyekanlu et al., 2020). These innovations contribute to resource efficiency, reduced environmental impact, and improved decision-making, aligning with the principles of Industry 4.0 and the emerging paradigm of Industry 5.0, which emphasizes human-centric and sustainable development (Wolniak, 2023; Verma, 2024). Nonetheless, despite these technological advancements, empirical studies that link digital initiatives directly to measurable improvements in ESG (Environmental, Social, Governance) performance remain limited, particularly in the Polish industrial context.

Research question 1 ***(RQ$_1$)*** emerges from this gap:

RQ$_1$: *What is the relationship between digital initiatives and overall ESG performance in the Polish industrial sector?*

Further, the ESG framework serves as a critical benchmark for assessing corporate sustainability performance. Companies with higher ESG scores often demonstrate stronger commitments to environmental stewardship, social responsibility, and governance practices (CSRHub, 2024). Previous research has established that digital initiatives, such as AI-driven energy management and IoT-enabled production systems, positively influence ESG metrics by enhancing efficiency and reducing waste (Shrouf, Miragliotta, 2015; Nabati et al., 2020).

2.2. Conceptualizing ESG-driven digitalization in the Polish industrial sector

In Europe, eco-efficiency indicators and innovations have been identified as crucial elements of sustainable industrial practices (Łącka, Brzezicki, 2022; Madden et al., 2005). The European Union has prioritized digital transformation as a strategic objective, emphasizing its role in fostering sustainable development across member states (European Commission, 2024). In Poland, the focus on Industry 4.0 is evident in studies exploring technologies like augmented reality, and virtual reality applications in manufacturing, which support energy-efficient and personalized production processes (Pizoń et al., 2023; Górski et al., 2022). In Poland, the industrial sector has been undergoing significant digital transformation. Companies are adopting digital tools and strategies to improve production efficiency and align with global sustainability standards (Grzyb, 2017). Despite these advancements, there remains

a need for empirical research linking digital initiatives to measurable sustainability outcomes, such as ESG performance and contributions to the SDGs.

The intersection of digitalization and sustainability also involves the development of predictive maintenance systems and digital twins. These approaches not only optimize production but also contribute to long-term sustainability by reducing downtime and waste (Ersöz et al., 2022; Xu et al., 2022). Additionally, research on eco-innovations and national eco-efficiency highlights the broader impact of digital initiatives on achieving SDGs at the regional level (Gałązka, 2017; Ilić et al., 2022).

Based on that it can be stated that there is a growing body of evidence suggesting that specific dimensions of ESG performance environmental stewardship, social responsibility, and governance transparency can each be individually influenced by targeted digital initiatives. However, detailed analysis regarding how specific aspects of ESG are aligned with digital transformation efforts remains underdeveloped.

This leads to the second research question:

RQ$_2$: *How are digital transformation efforts aligned with specific aspects of ESG, such as environmental management and governance practices?*

While prior literature underscores the transformative potential of digitalization, it also points to challenges, such as ensuring equitable access to technology and addressing the environmental costs of digital infrastructure (Yang et al., 2023). This study contributes to the existing body of knowledge by focusing on the Polish industrial sector, providing insights into how digital initiatives influence ESG performance and support the realization of the SDGs.

The existing body of research underscores the transformative potential of digitalization in manufacturing, particularly in enhancing sustainability through improved efficiency, reduced environmental impact, and better governance practices. In Poland, where the industrial sector is rapidly evolving through digital initiatives, understanding the tangible impact of these transformations on ESG performance and SDG alignment is crucial. Despite the increasing adoption of Industry 4.0 and emerging Industry 5.0 principles, there is a need for more comprehensive analyses that connect digital advancements with measurable sustainability outcomes.

To answer the two research questions, the following hypothesis is proposed:

H$_1$: *The introduction and development of digital initiatives at industrial companies in Poland is positively impacting their related to their ESG (Environmental, Social, Governance) performance.*

To guide the empirical analysis, a conceptual model is introduced (Figure 1). It presents the hypothesized relationship between the intensity of digital initiatives and ESG performance.

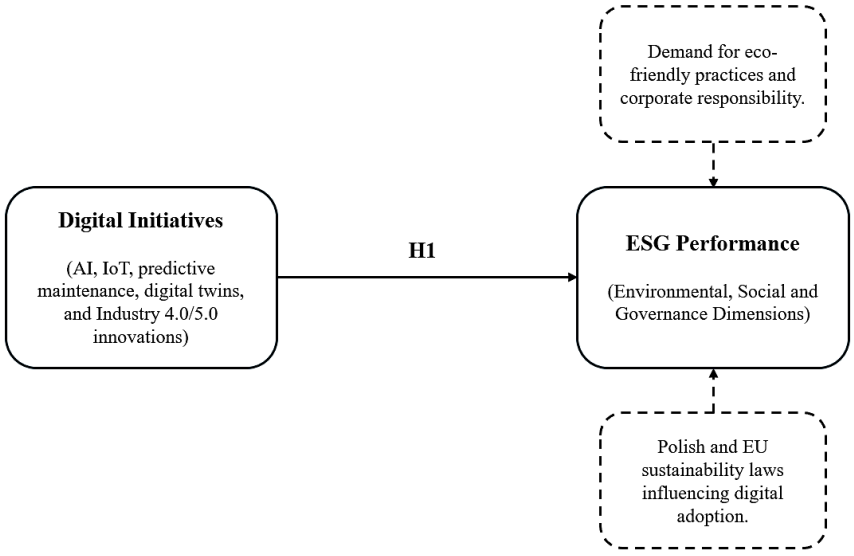

Figure 1. Conceptual model.

Source: Self-made.

Focusing on the industrial sector in Poland, a country undergoing significant economic and technological transformation, the study analyzed the ESG scores and digital initiatives of 15 Polish industrial companies listed in the WIG50 index. Using a combination of textual analysis of corporate reports and statistical methods, this study assesses the extent to which digital transformation efforts are linked to improved ESG scores and SDG alignment.

3. Methods

3.1. Sample and data collection procedure

This study investigated the relationship between digital initiatives and the achievement of Sustainable Development Goals (SDGs) in the industrial sector in Poland, hypothesizing that the introduction and development of digital initiatives in industrial companies positively impact their ESG (Environmental, Social, Governance) performance, enhancing their ability to achieve SDGs. The analysis focused on 15 industrial companies listed on the WIG50 index in 2024 by market capitalization. The ESG ratings of the selected companies were obtained from CSRHub, a platform that aggregates data from 957 sources covering 56,545 companies across 210 countries. CSRHub assigns ESG scores on a normalized scale of 0 to 100, with higher scores indicating better sustainability performance. The scores are based on four main categories:

- Community – evaluates a company's engagement with local, national, and global communities, considering charitable activities, respect for human rights, supplier relationships, and the social/environmental impact of its products and services.

- Employees – assesses policies on diversity, employee rights, compensation, benefits, training, health and safety, and workplace treatment.
- Environment – covers environmental compliance, resource management, climate initiatives, energy efficiency, green technology, and environmental risk management.
- Governance – analyses governance practices, including board independence, executive compensation, transparency, ethics, stakeholder engagement, and integration of sustainability into operations.

Each company's overall ESG rating was derived from scores within these categories and their respective subcategories.

To assess digital initiatives, textual analysis of companies' annual non-financial reports was performed. The analyzed documents included sustainability reports, integrated reports, and other non-financial disclosures, all downloaded directly from the companies' official websites. Textual analysis was conducted using 52 key phrases associated with digitization and Industry 4.0, identified based on the methodology of Ionaşcu et al. Python's text processing libraries, PyPDF2, Pandas, and Re, were used to extract and analyze text content, identifying the frequency of key phrases related to digitization. The results were normalized by calculating the proportion of keyword occurrences to the total word count in each document.

3.2. Methods

Statistical analysis involved the application of measures of central tendency and dispersion, including arithmetic mean, standard deviation, and minimum and maximum values. Arithmetic means provided a synthetic overview of the observed variables, while standard deviation served as a measure of variability around the mean. These measures constitute fundamental tools in descriptive data analysis and are widely used to characterize distributions and compare variability between groups (Bhaskar et al., 2019; Berry et al., 2021).

To assess the linear relationship between the level of digitalization and ESG performance, Pearson correlation analysis was employed. The Pearson correlation coefficient measures the strength and direction of a linear relationship between two continuous variables (Schober, Boer, Schwarte, 2018), Subsequently, linear regression analysis was conducted to examine the potential predictive effect of the independent variable (digital initiatives) on the dependent variable (ESG scores). Linear regression enables the modeling of relationships between variables and allows the prediction of the dependent variable based on values of the independent variable (Yan, Su, 2009).

Prior to conducting parametric analyses, the assumption of normality was verified using the Shapiro-Wilk test. A critical consideration in applying this test is the minimum sample size required for reliable results. According to the findings of Bartkowiak and Słowik (2016), the Shapiro-Wilk test can be effectively applied to samples as small as six observations. Its selection in this study was therefore justified by its high statistical power in small samples

and its widespread application in quantitative research. This test was used to verify the following two null hypotheses:

Null hypothesis 1 (H_{01}): The distribution of the data is a normal distribution.

Null hypothesis 2 ($H_0$2): The correlation coefficient in the population is equal to 0 (i.e., there is no correlation between the two variables).

Statistical analysis was conducted in Python within the Jupyter Notebook environment, utilizing libraries such as NumPy, Pandas, SciPy, Statsmodels, and Scikit-learn.

3.3. Hypothesis Testing

The central research hypothesis of this study states:

H_1: *The introduction and development of digital initiatives at industrial companies in Poland is positively impacting their related to their ESG (Environmental, Social, Governance) performance.*

To empirically verify this hypothesis, a parametric approach was adopted. The testing procedure consisted of two stages: (1) testing the assumption of normality and (2) examining the statistical relationship between variables through correlation and regression analysis.

In the first step, the Shapiro-Wilk test was applied to evaluate whether the ESG score data followed a normal distribution. The null hypothesis (H_{01}) assumed normality. A p-value greater than 0.05 would indicate that there is insufficient evidence to reject H_{01}, thus permitting the use of parametric tests such as Pearson's correlation and linear regression.

Subsequently, the strength and direction of the relationship between digital initiatives and ESG performance were tested using Pearson's correlation coefficient. The second null hypothesis (H_{02}) posited that there is no correlation between the two variables ($r = 0$). If the resulting p-value is less than or equal to 0.05, H_{02} is rejected, supporting H_1 and indicating that digital transformation is significantly associated with ESG outcomes.

Finally, simple linear regression analysis was used to assess the potential predictive power of digital initiatives. If the regression coefficient is statistically significant ($p \leq 0.05$), it confirms that digital initiatives contribute meaningfully to variations in ESG scores—thereby supporting the hypothesis that digitalization enhances corporate sustainability performance in the industrial sector.

In this study, the reliance on self-reported data from industrial companies poses potential challenges to the validity and objectivity of the findings. Specifically, the analyzed ESG scores and annual reports may reflect biases inherent to self-reporting practices. Companies often aim to present themselves in a favorable light to stakeholders, potentially overstating their ESG performance or selectively highlighting digital initiatives that align with sustainability goals. This risk of "greenwashing" could impact the accuracy of the correlations observed between digital initiatives and ESG performance. To address these challenges and increase the credibility of the survey results, mitigation strategies were employed. The study used ESG scores provided by CSRHub, a recognized and independent ESG rating platform that aggregates

data from more than 900 reliable sources. This provided a broader perspective and reduced reliance solely on company-reported indicators. Text analysis of non-financial reports was conducted using a pre-defined and revised list of 52 key phrases identified in earlier academic research. By focusing on unambiguous and consistent terminology, the risk of subjective interpretation of textual data was minimized.

4. Results

Analysis of the results begins with basic descriptive statistical analysis including arithmetic mean, standard deviation, minimum and maximum values. Arithmetic means were calculated to provide a summary measure of the central tendency of the observed data, while standard deviations were used to quantify the variability and dispersion around the mean. For ESG scores, a higher standard deviation indicates greater variability in the results, reflecting a wider spread of values and suggesting a higher degree of diversity within the dataset (Table 1). Conversely, for the proportion of words related to digitization, a lower standard deviation indicates that the values are closely clustered around the mean, signifying that the mean provides a more accurate representation of the entire sample.

Table 1.
Statistical analysis of ESG results and digital initiatives.

Variable	Arithmetic mean	Standard deviation	Minimum	Maximum
ESG score	45.87	19.44	18	77
Digital initiatives	0.0477	0.0398	0.0100	0.1254

Source: Self-made.

The null hypothesis for the Shapiro-Wilk Test **(H_{01})** posits that the data follows a normal distribution. The results of the test yielded a **p-value of 0.0716**, which exceeds the **conventional significance level of 0.05**. This indicates insufficient evidence to reject the null hypothesis, implying that the data distribution is consistent with normality. Consequently, we can assume that the ESG scores are normally distributed, an important assumption for the validity of subsequent parametric analyses, such as correlation and regression, which rely on the normality of the data. This finding supports the robustness and interpretability of the correlation analysis and strengthens the reliability of the results presented in subsequent statistical tests (Table 2).

Table 1.
Shapiro-Wilk test results

Variable	Statistic	p-value
ESG score	0.8919	0.0716*
*Note: p > 0.05 indicates no significant deviation from normality.		

Source: Self-made.

Next, Pearson's correlation coefficient was calculated to examine the relationship between ESG scores and the proportion of digital initiatives mentioned in the reports. The null hypothesis for the correlation analysis **(H_{02})** assumes that there is no correlation between the two variables. The Pearson correlation coefficient between ESG scores and digital initiatives was found to be 0.552 (Table x), indicating a moderate positive correlation. This means that as digital initiatives increase in the annual reports of industrial companies, their ESG ratings tend to increase as well. Although the correlation is not strong enough to assert a robust relationship, it does suggest a meaningful association between the variables.

The significance level for the Pearson correlation (Table 3) was found to be $p = 0.032$, which is less than the threshold of $p = 0.05$. This allows us to reject the null hypothesis and conclude that **there is a statistically significant correlation between digital initiatives and ESG performance.** Therefore, we can confidently reject the null hypothesis at the 95% confidence level.

Table 2.
Pearson Correlation Analysis

Variable	ESG score	Digital initiatives
ESG score	1.00	
Digital initiatives	0.552*	1.00
*Note: $p < 0.05$ indicates a statistically significant correlation.		

Source: Self-made.

The research hypothesis posited that **there is a relationship between digital initiatives in the industrial sector and the achievement of the SDGs, as assessed by ESG scores**. Based on the results, we can conclude that there is a moderate, statistically significant positive correlation between the digital initiatives undertaken by industrial companies and their ESG performance.

The regression analysis further elucidates the relationship between the independent variable, "Digital initiatives", and the dependent variable, "ESG score". The directional coefficient of the regression line (269.92) indicates that for every one-unit increase in digital initiatives, there is an associated increase of 269.92 units in the ESG score, assuming all other factors remain constant. This finding underscores the positive impact of digital initiatives on ESG performance, reinforcing the hypothesis of a significant relationship between these variables.

Table 3.
Regression Coefficient Analysis

Variable	Regression Line Coefficient	t-Statistic	p-Value	R^2	Adjusted R^2
Digital initiatives	1.00	2.387	0.033*	0.305	0.251
*Note: $p < 0.05$ indicates a statistically significant correlation.					

Source: Self-made.

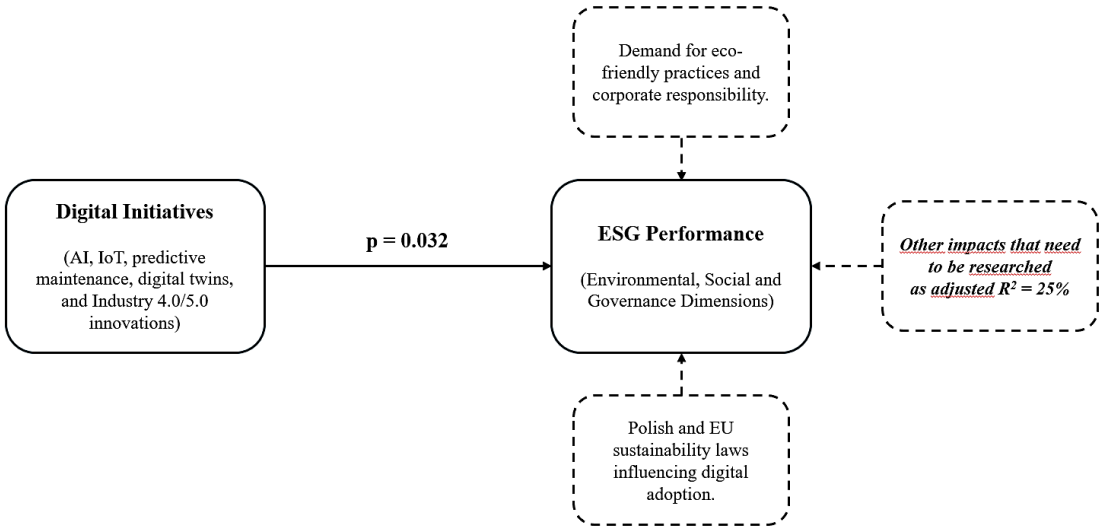

Figure 2. Correlation visualization on the conceptual model.

Source: Self-made.

The adjusted R2 value of 0.251 (Table 4) suggests that the model accounts for approximately 25.1% of the observed variability in ESG scores. While this indicates a statistically significant relationship, the relatively low value of the adjusted R2 highlights that a majority of the variability in ESG scores is attributable to factors not captured by the model, but also the one included as potentially impacting it. This underscores the complexity of ESG performance, which is likely influenced by additional variables such as industry-specific practices, regulatory compliance, and broader economic conditions.

These findings point to the potential of digital initiatives as a contributing factor to ESG improvement, while also emphasizing the need for a multifaceted approach to understanding and enhancing sustainability outcomes. Future models could incorporate additional predictors to better capture the complexity of ESG performance dynamics.

5. Discussion and contribution

The results of this study provide empirical evidence supporting the hypothesis that digital initiatives in Polish industrial companies are positively associated with their ESG performance, thereby contributing to the realization of Sustainable Development Goals (SDGs). The Pearson correlation coefficient (0.552) and regression analysis results indicate a moderate but statistically significant relationship between the extent of digitalization efforts and ESG scores.

When comparing these findings with existing literature, the results align with previous research highlight the role of digital transformation in enhancing eco-efficiency and sustainability performance. Furthermore, the study is consistent with European trends emphasizing digitalization as a key enabler of sustainable industrial practices. However,

the relatively modest adjusted R2 value (0.251) suggests that ESG performance is influenced by multiple factors beyond digital initiatives alone, including regulatory policies, corporate culture, and external economic conditions.

The positive correlation between digital initiatives and overall ESG scores supports earlier propositions that digital transformation acts as a critical enabler of sustainable practices within organizations (Bharadwaj et al., 2013; Piccinini et al., 2015a). By integrating smart technologies into manufacturing and management processes, companies appear to enhance not only operational efficiency but also social and governance standards, a finding consistent with the works of Majchrzak et al. (2016) and Svahn et al. (2017a), who emphasized the necessity of organizational adaptation alongside technological adoption.

The results also resonate with the broader theoretical frameworks of Industry 4.0 and the emerging Industry 5.0 paradigm (Wang et al., 2016; Oyekanlu et al., 2020; Wolniak, 2023; Verma, 2024). The evidence from the Polish industrial sector suggests that digitalization efforts not only optimize production processes but also support broader sustainability objectives, consistent with the human-centric, resilient industrial models proposed in recent literature.

Nevertheless, despite the positive association between digital initiatives and ESG performance, the relatively moderate strength of the correlation indicates that digital transformation is not the sole determinant of sustainable development success. This is consistent with earlier assertions that achieving superior ESG outcomes requires a multifaceted approach, including strong leadership, regulatory compliance, employee engagement, and transparent governance structures (Yang et al., 2023).

Furthermore, the study's results reinforce previous claims about the environmental benefits of digitalization. The observed trends toward higher ESG scores among firms undertaking digital initiatives reflect the findings of Fitzgerald et al. (2014) and Westerman et al. (2011), who argued that digital technologies such as IoT and AI systems significantly contribute to eco-efficiency and resource management. In this context, the positive relationship identified in the Polish industrial sector illustrates the tangible impact of these technologies on corporate sustainability performance.

At the same time, the research does not clearly indicate the causal nature of the correlation studied. At this point, we cannot clearly determine whether digital transformation is the cause of enhancing ESG, or whether there is an inverse relationship.

In light of the study’s findings, several practical recommendations can be proposed to support the effective alignment of digital transformation with ESG objectives in the Polish industrial sector. First, industrial companies should integrate ESG criteria directly into their digitalization strategies. Rather than treating sustainability as a separate initiative, organizations can embed environmental, social, and governance considerations into digital investment decisions. This includes selecting technologies not only for efficiency but also for their potential to reduce emissions, improve transparency, and promote employee well-being.

To ensure coherence across departments, companies are encouraged to establish cross-functional teams involving IT, sustainability, and operations units. These teams can collaboratively develop and monitor digital projects that deliver measurable ESG outcomes. Additionally, organizations should implement internal governance mechanisms, that support real-time tracking and accountability.

From a policy perspective, there is a strong rationale for governmental support of ESG-oriented digitalization. Incentive programs for companies that adopt digital technologies aligned with sustainability goals could accelerate the twin transition agenda. Moreover, regulatory bodies may consider developing standardized ESG reporting templates that integrate digital indicators, thus improving transparency and benchmarking across the industrial landscape.

Small and medium-sized enterprises (SMEs), which often face resource constraints, should be supported through dedicated programs that provide access to shared digital infrastructure and targeted training in ESG-compliant technology use. Public-private partnerships can play a vital role in reducing these barriers.

Altogether, the alignment of digital transformation with ESG principles requires a coordinated approach involving corporate leadership, technical innovation, and supportive public policy. These recommendations aim to facilitate not only compliance with evolving sustainability standards but also long-term competitive advantage through responsible and forward-looking industrial strategies.

6. Limitations

Despite these promising results, the study acknowledges certain limitations, including potential biases in self-reported data and the influence of external factors not accounted for in the model. While the first of this limitation is mitigated by use of CSRHub, future research could incorporate additional independent sustainability assessments to validate the findings further. Another consideration is the sample size, as the study focuses on 15 industrial companies listed in the WIG50 index. Expanding the sample to include more firms from diverse sectors would enhance the generalizability of the results. Future research could also expand the scope to include all WIG50 companies and explore alternative methodologies such as case studies or in-depth interviews.

Future research could also explore causal relationships by conducting longitudinal studies or leveraging machine learning techniques to analyze patterns in digital adoption and ESG performance over time. Additionally, qualitative analyses, such as interviews with industry leaders, could provide deeper insights into the strategic motivations behind digitalization efforts and their perceived impact on sustainability. By addressing these aspects, future studies can

offer a more nuanced understanding of the intersection between digitalization and sustainable development in the Polish industrial sector. It is also worth mentioning that the relatively low adjusted R^2 value suggests that while digital transformation plays a role in enhancing ESG performance, additional variables contribute to sustainability outcomes.

7. Conclusion

This study examined the relationship between digital initiatives and ESG performance in the Polish industrial sector. The findings indicate a moderate yet significant positive correlation between digital transformation efforts and ESG scores, supporting the hypothesis that digital initiatives contribute to sustainability improvements. The regression analysis further confirms this relationship, showing that increased digitalization is associated with higher ESG scores.

Despite these promising results, the study acknowledges certain limitations, including potential biases in self-reported data and the influence of external factors not accounted for in the model. The relatively low adjusted R^2 value suggests that while digital transformation plays a role in enhancing ESG performance, additional variables contribute to sustainability outcomes.

Future research should expand the scope to include all WIG50 companies and explore alternative methodologies such as case studies or in-depth interviews. Additionally, incorporating time-series analyses could help determine whether the impact of digital initiatives on ESG performance strengthens over time. By addressing these aspects, future studies can offer a more nuanced understanding of the intersection between digitalization and sustainable development in the Polish industrial sector.

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