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The Impact of Consumer Behavior on the Formation of Sustainable Development Strategies of Companies in the Context of Digitalization and Virtualization

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ABSTRACT: Market shifts such as the growth of the urban middle class and the increasing number of women in the labor force are changing consumer habits, while the rise in education and digital literacy has expanded consumer engagement online. The article presents a conceptual model of interaction between consumers and companies in a virtual environment that ensures the effective implementation of sustainable development principles in business processes. The purpose of this study is to develop and empirically validate a conceptual model of consumer-company interaction in the digital environment that facilitates corporate adaptation to sustainability demands. To achieve this, a mixed-methods approach was used, including an expert survey and correlation analysis of 50 companies. The results demonstrate a statistically significant relationship between virtual consumer activity and companies' sustainability indicators, confirming the model's relevance and predictive potential. The study concludes that informed and active consumers play a transformative role in shaping sustainable business strategies in the context of digitalization and labor market evolution.

Keywords: education, labor market, digitalization, consumer behavior, sustainable development, virtual environment.

I. INTRODUCTION

The digital age has fundamentally changed the interaction between consumers and companies [1]. It has created unprecedented opportunities for public preferences to influence corporate sustainability strategies [2-4]. With increased transparency of business processes and availability of information, consumers are transforming from passive recipients of goods and services into active participants in the formation of corporate policies in the area of environmental and social responsibility [5-7]. Current studies suggest that consumers increasingly often make purchasing decisions based on the company's compliance with sustainable development principles. An analysis of IRI data reveals that 50% of the growth in the US consumer packaged goods (CPG) market from 2013 to 2018 came from products promoted with an emphasis on sustainability [8]. This creates strong economic incentives for companies to incorporate sustainability practices into their business models [9].

The digital transformation of business processes opens up new channels of consumer-company interaction. Tsimonis [10] and Silveira et al. [11] note that the digital environment changes existing forms of communication and gives rise to fundamentally new patterns of consumer behavior and engagement. Digital platforms enable two-way information exchange, allowing consumers to actively express their sustainability preferences and enabling companies to quickly adapt their strategies to changing societal demands [12].

Scientific literature offers two primary approaches to the problem. The first approach focuses on changes in consumer behavior in connection with increasing environmental and social awareness [13]. Lu [14] points to the emergence of "responsible consumers" [15-17], for whom the product's compliance with sustainability principles becomes a decisive factor in making a purchase decision. Stofejova et al. [18] emphasize the role of the environmental aspect in consumer behavior and demonstrate a rise in willingness to pay for eco-friendly products [13, 19-21]. The second approach dives into the mechanisms of corporate adaptation to changing consumer preferences [22-23]. Cano et al. [24] explore the transformation of e-commerce business models in the face of growing demand for sustainable development. Wilson et al. [25] analyze the processes of integrating circular economy principles into corporate strategies through digital consumer interactions.

In parallel, the transformation of consumer behavior in the digital environment is closely linked to broader shifts in the labor market and education systems. The increasing demand for digital skills and sustainability literacy shapes not only consumer preferences but also corporate strategies. As digitalization penetrates the economy, it redefines employment structures and professional competencies, reinforcing the role of informed, proactive individuals in shaping sustainable development. Therefore, the interaction between education, the labor market, and digital technologies becomes a key factor in the evolution of consumer-company relationships. While digital activism's role in promoting corporate sustainability is increasingly acknowledged [26], few studies attempt to quantify its actual impact on corporate strategies particularly in emerging markets, where digital infrastructure, regulatory conditions, and consumer awareness differ from developed contexts. Although, there remains a significant gap in understanding how virtual consumer activity directly influences corporate strategies for sustainable development. This problem is especially acute in the context, where empirical data on digital consumer engagement and its strategic consequences for companies are limited.

The study aimed to develop a conceptual model of consumer-company interaction in a virtual environment, ensuring effective incorporation of sustainability principles into corporate strategies.

1. To achieve this goal, the following objectives were set:
2. To develop the conceptual model of consumer-company interaction in the virtual environment aimed at achieving sustainable development goals;
3. To analyze current trends in consumer influence on the sustainable development of companies relying on the developed model;
4. To identify the features of consumer behavior in the virtual environment in the context of sustainable development;
5. To identify key factors in effective consumer-company interaction in the virtual environment.

Based on the study's aims and objectives, the following research questions (RQs) guide the investigation:

1. RQ1: How do consumers influence corporate sustainability strategies in the context of digital environments?
2. RQ2: Which virtual mechanisms (e.g., social media activity, online reviews, digital participation) are most impactful in shaping corporate behavior?
3. RQ3: How are these virtual consumer influences linked to measurable indicators of corporate sustainability performance?
4. RQ4: What components should a conceptual model include to effectively capture consumer company interaction for sustainable development?

II. LITERATURE REVIEW

Delmas and Burbano's seminal definition of greenwashing as "the intersection of two firm behaviors: poor environmental performance and positive communication about environmental performance" provides a backdrop for understanding why digital consumer's matter. Greenwashing is the act of simply deceiving customers about a company's environmental practices or the environmental benefits of a product or service [27]. Contemporary consumers increasingly insist on corporate ethical performance. Recent studies indicate that 62% of customers expect companies to take a stand on social or environmental issues, and many will defect

to competitors if firms fail to meet their values; 47% will switch to other brands, and 17% may never come back [28].

Hernandez-De-Menendez et al. [29] explained the amplification of pressure by social media and digital platforms in their study involving Generation Z. They noted that social media plays a fundamental role in building engaging relationships with consumers who are more aware of the impacts of products and corporate practices. In line with this, Silveira et al. [30] displayed that direct brand-led communication of environmental initiatives via social media significantly boosts consumer engagement with sustainability, even more so than influencer-driven messages. Zhan et al. [31], in their empirical study, concluded that corporate digital transformation through data sharing, connectivity, and analytics significantly inhibits greenwashing behavior in heavily polluting firms, thereby enabling consumer behaviors to serve as regulation or accountability yardsticks for greenwashing activities. Wong et al. [32] argue that transparent disclosure enables stakeholders to make informed decisions, confront disclosers, and hold them accountable. Accountability theory suggests that simply knowing stakeholders can help identify, monitor, evaluate, and pressure the firm towards improvements in corporate behavior.

Recent studies examined how sustainability concepts extend into digital ecosystems and virtual economies. Liu et al. [33] contend that digital technologies are a promising means of moving production and consumption towards the circular economy. Digital platforms such as cloud services, blockchain networks, and IoTs ’(internet of things) aid in establishing tighter links among firms, consumers, and suppliers. They also enable close communication and efficient automation that reshape value chains [34]. Wu et al. [34] discovered that open digital platforms such as blockchain tracing provide critical support for circular economy (CE) adoption, improving information integration and closed-loop supply chains. Aivazidou et al. [35] build on this by introducing the concept of Circular Economy 5.0, which integrates digital innovation with CE principles. They modeled how institutional pressures and organizational readiness interact via feedback loops to drive a digitalized sustainability transition. Recent reviews highlight digital twins, real-time virtual replicas of physical assets, as cornerstones of circular economy and sustainable development achievements [36]. Digital twins allow continuous linking between the virtual and physical worlds, yielding comprehensive data to optimize resource use. For instance, in healthcare and agriculture case studies, DT-driven systems enable better monitoring and decision-making, reducing inputs (energy, water, travel) while improving outcomes, thereby advancing multiple SDGs [36]. Similarly, immersive virtual reality (VR) is emerging as a sustainability tool. VR lets firms and customers co-create products in silico: Royo-Vela et al. [37] describe VR as the newest vehicle for co-producing and co-creating value, enabling firms to innovate sustainably without physical prototypes. VR’s immersive presence facilitates active co-production and co-creation among companies and clients, which can reduce resource consumption by shifting experimentation and training into the virtual realm [37].

The proposed five-component model draws on diverse theories to ensure each element is theoretically grounded. Digital infrastructure serves as a strategic resource base, and in line with resource-based and dynamic-capability views, investments in IT platforms become rare and valuable assets as they enable intelligent operations that can significantly increase productivity, value, and competitiveness [38]. Thus, robust digital infrastructure is conceptualized as an enabler of sustainable innovation, matching resource-based view (RBV) logic. Transparency mechanisms align with stakeholder/legitimacy paradigms; systematic disclosure of environmental data builds stakeholder trust and meets stakeholder demands for accountability [32].

Feedback systems embody accountability theory: feedback loops such as real-time consumer ratings, social media, and regulatory audits give stakeholders a way to monitor firms. As Wong et al. [32] noted, firms conscious of being identified, monitored, evaluated, and pressured by stakeholders adapt their disclosures and behaviors to improve. In practice, digital feedback operationalizes this theory, ensuring companies respond to consumer/stakeholder signals. Joint value creation is rooted in service-dominant logic and co-creation theory: consumers are treated not as passive targets but as active collaborators. Prahalad and Ramaswamy’s co-creation concept underlies this approach. In line with Royo-Vela et al. [37], our model sees customers as actors jointly innovating solutions in virtual spaces. Analytical systems integrate knowledge-management and decision-making theories as data analytics enables learning and adaptive management, consistent with dynamic-capability thinking.

In summary, each component corresponds to a theoretical lens: e.g., accountability theory for feedback, co-creation theory for joint creation, RBV for infrastructure, and stakeholder/legitimacy theory for transparency. Importantly, this model fills a noted gap in the literature. Prior frameworks like stakeholder theory or traditional corporate social responsibility (CSR) lack the digital-consumer focus of our model. Stakeholder theory, for instance, argues firms should create value for all stakeholders (thus improving competitiveness via trust) but typically treats consumers as one stakeholder group with limited mechanisms for real-time engagement [39]. Traditional CSR approaches often emphasize corporate-driven initiatives with minimal consumer agency or digital integration.

In contrast, our model makes the consumer an active co-producer of sustainability and embeds IT-driven feedback throughout the value chain. Table 1 contrasts these approaches: For example, whereas stakeholder theory views consumers as one among many passive beneficiaries, our model assigns them a proactive role; where CSR models rely on static reporting, we emphasize continuous digital feedback; and unlike CSR's largely reputational impact, our model's strategic impact is to co-create innovative, shared-value outcomes. Moreover, existing studies have scarcely examined these interactions in virtual or regional contexts, and notably, consumers are only beginning to embrace sustainable values, and few studies address how digital dialogue between Kazakhstani consumers and companies can shape corporate sustainability [40]. Thus, by integrating digital infrastructure, transparency, feedback, co-creation, and analytics into a cohesive framework, this study addresses a clear gap: it explicitly examines consumer–company sustainability dynamics in virtual environments and tailor's insights to the understudied context.

Table 1. Structure of the sample of companies for the study.

Framework	Consumer Role in Sustainability	Digital Integration	Feedback Mechanisms	Strategic Impact
Proposed Model	Consumers as active co-creators of value; collaborative participants (beyond mere buyers).	Central: requires digital infrastructure, platforms, and analytics at core of operations (IoT, data sharing, etc.).	Continuous two-way feedback (real-time ratings, open data, social media channels) enabling accountability.	Drives joint value creation, innovation and sustained strategic alignment of sustainability goals.
Stakeholder Theory	Consumers seen as one stakeholder group among many; their input is considered but less actively managed.	Moderate: digital tools for stakeholder engagement (e.g. CSR websites) but not integral to theory.	Limited: periodic stakeholder dialogues, surveys, or reporting frameworks (one-way communication).	Improves legitimacy and trust; sustainable performance achieved by balancing stakeholder demands.
Traditional CSR	Consumers are targets of marketing/PR; largely passive recipients of corporate sustainability efforts.	Minimal: pre-digital era orientation; relies on traditional media and reports.	Minimal: one-way reporting (e.g. annual CSR reports); little structured feedback incorporation.	Focus on compliance and reputation; strategic impact often reactive (avoiding criticism) rather than proactive co-innovation.

III. MATERIAL AND METHOD

1. STUDY DESIGN

To comprehensively investigate consumer influence on the sustainable development of companies in the virtual environment, the research was carried out using a sequential mixed-methods design with the qualitative stage (expert survey) preceding the quantitative stage (correlation analysis). This approach allowed first to identify the key mechanisms of influence and effectiveness factors based on expert assessments and then to

quantitatively test the identified patterns on a wider sample of companies. As part of the methodological design of the study, we developed a theoretical conceptual model of interaction between consumers and companies in a virtual environment for the effective implementation of sustainable development principles. The model relies on the integration of existing theoretical approaches to consumer behavior in the digital environment [10], the concept of joint value creation [7], and the principles of information transparency [41] (Figure 1).

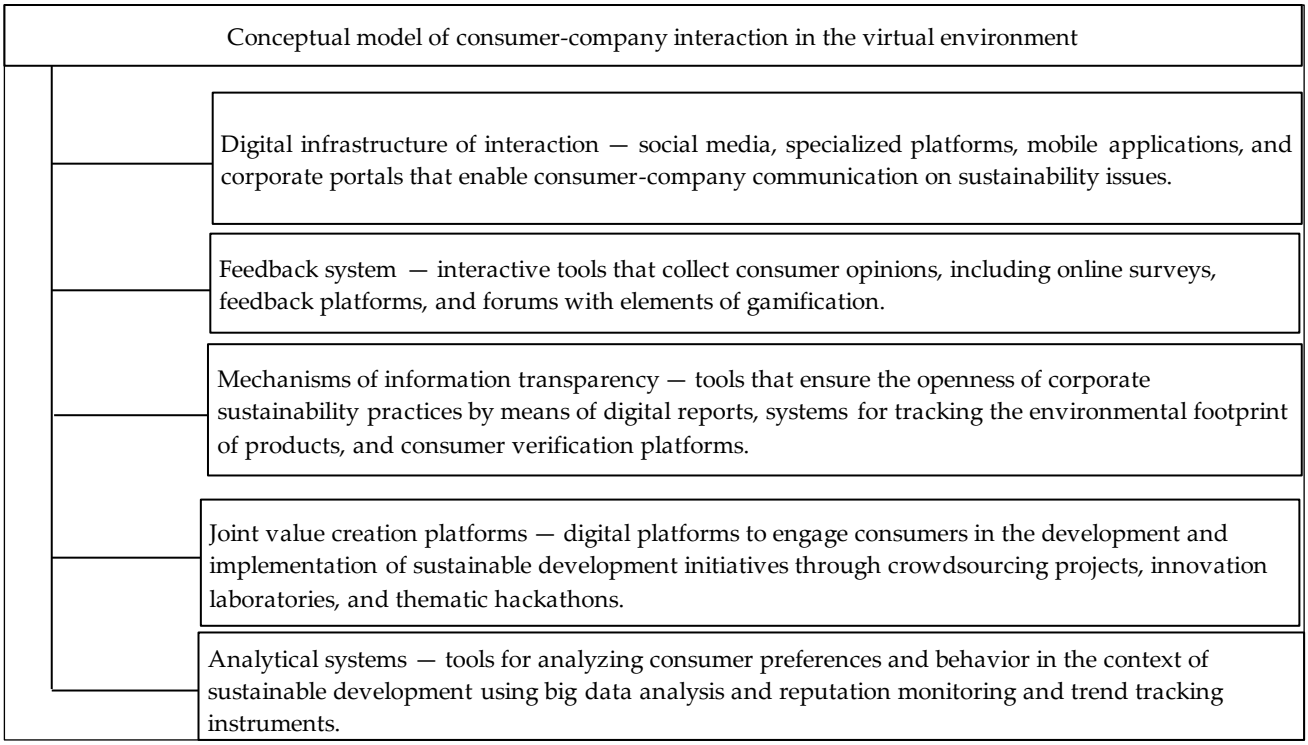

FIGURE 1. Conceptual model of consumer-company interaction in the virtual environment.

The interaction between the model components provides a cyclical process of adapting corporate sustainability strategies to changing consumer preferences in the virtual environment. The model's effectiveness is determined by the intensity of information flows between its components and the ability to transform consumer insights into strategic decisions. We validated the model using an expert survey and correlation analysis to assess the relationship between its components and the indicators of companies' sustainable development. The expert survey was conducted to identify the key mechanisms of consumer influence on the sustainable development of companies in the virtual environment. The survey methodology was based on a modified Delphi approach adapted to the research problem.

2. SAMPLE AND DATA COLLECTION

The sample of experts was formed by purposive sampling using the criterion of maximum variation to ensure diverse perspectives. The initial expert pool included members of the Sustainability Managers' Association (n = 15) and academic researchers with publications on sustainability and the digital economy (n=5), identified through professional networks. The final sample (n=50) included:

- 18 representatives of the corporate sector (heads of sustainability departments and ESG directors in companies from various industries);
- 15 representatives of the scientific community (researchers with publications on sustainable development and digital economy);
- 12 consultants specializing in the development of sustainable development strategies;

- Five civil servants working in economic development for at least 5 years (representatives of specialized departments of the Ministry of Economic Development and regional authorities).

Experts were recruited using purposive and snowball sampling methods, with the following inclusion criteria:

- A minimum of five years of professional experience in sustainability, ESG management, or related academic/consulting roles.
- Active involvement in corporate sustainability initiatives or research.

To ensure relevance and clarity, the survey instrument was pilot-tested with three experts (two academic researchers and one corporate ESG consultant). Feedback from the pilot led to minor refinements in question wording and the addition of clarifying definitions for technical terms. The final version of the questionnaire was distributed via the Qualtrics platform and included both Likert-scale items and open-ended questions.

3. ASESSMENT METHODS

For the survey, we developed a structured questionnaire combining quantitative scores (5-point Likert scale) and open-ended questions. The survey consisted of the following blocks:

1. Assessment of the significance of different factors in customer influence in the virtual environment (15 factors, 5-point scale);
2. Quantitative characteristics of the mechanisms of consumer influence on corporate sustainable development strategies (open-ended questions);
3. Identification of optimal digital tools for interaction in the context of sustainable development (mixed questions);
4. Forecasting the evolution of influence mechanisms in the short (1–3 years) and middle (3–5 years) term.

Procedure. The survey was conducted in March–May 2024, in two consecutive stages:

1. Online survey on the Qualtrics platform;
2. Structured in-depth interviews with a subsample of experts (n=8) to elaborate on the key insights gained in the first phase.

The interviews lasted 45–60 minutes each. All interviews were recorded with the experts' consent and transcribed for subsequent analysis.

Analytical methods**.** Survey results were statistically analyzed (means, SDs, Kendall's W). Open-ended responses were processed using thematic content analysis, following the Corbin and Strauss (2008) coding paradigm.

4. CORRELATION AND REGRESSION ANALYSIS

To test the relationship between consumer activity in the virtual environment and companies' sustainable development indicators, correlation analysis was conducted on a sample of companies.

Sample. The analysis was performed on data from 50 selected by stratified random sampling to ensure the representation of different industries (Table 2).

Table 2. Structure of the sample of companies for the study.

Economic sector	Number of companies	Share in the sample (%)
FMCG (fast-moving consumer goods)	12	24
IT and telecommunications	10	20
Energy	8	16
Finance	8	16
Retail	7	14
Industry	5	10
Total	50	100

The analysis included the following groups of variables:

1. Independent variables indicators of consumers' activity in the virtual environment:

- X_1: Number of messages through digital channels on sustainable development issues (normalized by the size of the customer base);
- X_2: Activity on the company's social media on sustainable development issues (composite index including the number of posts, comments, reposts, and likes normalized by reach);
- X_3: Participation in the company's online initiatives on sustainable development (percentage of engaged customers from the total customer base).

2. Dependent variables indicators of companies' sustainable development:

- Y_1: Volume of investments in environmental projects (percentage of revenue);
- Y_2: Number of implemented social initiatives (absolute value);
- Y_3: Position in sustainable development rankings (composite index based on positions in Kazakhstan and international rankings).

Data sources. Data for the analysis were collected from the following sources:

- Companies' public sustainability reports (for 2020–2023);
- Data from social media monitoring systems (Brand Analytics, YouScan) for 2020–2023;
- Data from corporate CRM systems on customer interactions (provided by companies on condition of anonymity);
- Data from rating agencies (RAEX, ACRA, ESG) for 2020–2023

Analytical methods. Relationships between variables were analyzed using Spearman's rank correlation coefficient. This test is optimal for our study because it does not require a normal distribution, can detect nonlinear monotonic relationships, and is resistant to outliers. The correlation coefficient (r) and statistical significance (p-value) were determined for every pair of variables. In addition, regression analysis was conducted to assess the contribution of each independent variable to the variation of the dependent variables.

IV. DATA ANALYSIS

1. EXPERT SURVEY RESULTS

The expert survey highlights the key factors and mechanisms of consumer influence on the sustainable development of companies in the virtual environment. The coefficient of concordance of expert assessments (Kendall's W) amounts to 0.74, indicating a high level of consensus among experts. Table 3 presents the mean estimates of the significance of factors in consumers' influence on the sustainable development of companies in the virtual environment.

Table 3. Factors of consumers' influence on the sustainable development of companies in the virtual environment.

Factors	Mean significance score (on a 5-point scale)	Standard deviation	Interquartile range
Digital activism (social media campaigns)	4.7	0.5	0
Consumer reviews of environmental and social aspects of companies' operations	4.5	0.6	1
Participation in online surveys and polls on sustainable development issues	4.2	0.7	1
Using digital platforms for monitoring the ecological footprint of products	4.0	0.8	1
Joint value creation in the virtual environment (crowdsourcing)	3.9	0.9	2
Personalized communication with companies through digital channels	3.8	0.7	1

Engagement in virtual communities promoting sustainable consumption	3.7	0.8	1

As shown in Table 2, digital activism emerged as the most significant factor influencing the sustainable development of companies in the virtual environment, receiving the highest expert rating with a mean score of 4.7 on a 5-point scale. The consumer influence factors rated by experts as most significant conceptually align with the model's key components. In particular, "Digital activism" (mean score 4.7) and "Consumer reviews of environmental and social aspects of companies' operations" (4.5) are connected with "Digital infrastructure of interaction" and "Mechanisms of information transparency". "Participation in online surveys and polls" (4.2) and "Using digital platforms for monitoring" (4.0) are conceptually associated with "Feedback system" and "Joint value creation in the virtual environment" (3.9) is directly related to its namesake component. This indicates a strong consensus on the transformative role of consumer-driven social media campaigns and digital mobilization efforts.

Qualitative analysis of open-ended questions points to three key mechanisms of consumer influence on the sustainable development of companies in the virtual environment:

1. Informational impact distribution of information on the social and environmental aspects of companies' operations through virtual communication channels. One expert noted: "In the virtual environment, the information asymmetry between companies and consumers is greatly reduced. Consumers have access to various information sources and actively share information, creating a snowball effect". The high significance of this mechanism was noted by 92% of experts.
2. Direct economic impact changes in consumer decisions based on the evaluation of the company's compliance with sustainable development principles. According to experts, "Digital platforms allow consumers to efficiently coordinate their economic decisions by creating large-scale campaigns to support or boycott brands". This mechanism was characterized as highly significant by 88% of experts.
3. Reputational impact shaping public opinion about the company through digital channels with potential impact on intangible assets. According to experts, "The digital environment radically increases the speed at which reputation capital is built and potentially destroyed. One viral campaign can undo years of work on the company's image in a matter of days". The influential role of this mechanism was highlighted by 96% of experts.

The experts have also identified the specific characteristics of the virtual environment that change the mechanisms of consumer influence (Figure 2).

Characteristics of the Virtual Environment	
Temporal compression the time lag between the company's actions and consumer reactions is significantly shorter	Reduced coordination costs collective action is much easier to organize
Scalability of impact the ability to quickly transition from individual initiatives to large-scale collective action	Network effects non-linear amplification of influence due to the network structure of interactions

FIGURE 2. Features of the mechanisms of consumer influence on companies' sustainable development in the virtual environment.

2. RESULTS OF CORRELATION ANALYSIS

Correlation analysis reveals statistically significant relationships between the indicators of consumer activity in the virtual environment and the indicators of companies' sustainable development. The results of the analysis are presented in Table 4.

Table 4. Correlation coefficients between the indicators of consumers' activity in the virtual environment and the indicators of companies' sustainable development.

Indicator	Volume of investments in environmental projects (Y_1)	Number of implemented social initiatives (Y_2)	Position in sustainable development rankings (Y_3)
Number of messages through digital channels on sustainable development issues (X_1)	0.68*	0.72*	0.65*
Activity on the company's social media on sustainable development issues (X_2)	0.75*	0.64*	0.78*
Participation in the company's online initiatives on sustainable development (X_3)	0.62*	0.76*	0.70*

* $p < 0.01$

The results of correlation analysis show a close relationship between consumer activity in the virtual environment and the indicators of companies' sustainable development. The strongest correlation ($r = 0.78$) is observed between activity on the company's social media on sustainable development issues (X_2) and the company's position in sustainable development rankings (Y_3). In the correlation analysis, the variables showing the strongest statistical relationships with companies' sustainability performance also correlate with individual components in the model. The variable of "Activity on the company's social media on sustainable development issues" (X_2) is an empirical indicator of "Digital infrastructure of interaction" and "Participation in the company's online initiatives" (X_3) reflects the operation of "Joint value creation platforms".

Regression analysis demonstrates the differentiated contribution of these indicators to the variation of sustainability indicators, which indirectly confirms the functional importance of the corresponding model components in various aspects of corporate sustainability. The expert survey results confirm the significance of all five model components. The highest scores were awarded by experts to "Mechanisms of information transparency" (a mean of 4.5 on a 5-point scale) and "Feedback system" (4.3). The component of "Analytical systems" received lower, albeit significant, scores (3.8), which indicates its great promise, even though its potential has not yet been fully realized in business contexts. The additional regression analysis shows the relative contribution of each independent variable to the variation of the dependent variables. The results of multiple linear regression are provided in Table 5.

Table 5. Results multiple linear regression

Dependent variable	Independent variable	Standardized β-coefficient	t-test	p-value	R^2
Volume of investments in environmental projects (Y_1)	X_1	0.25	2.87	0.006	0.68
	X_2	0.49	5.42	<0.001	
	X_3	0.18	2.14	0.038	
Number of implemented social initiatives (Y_2)	X_1	0.32	3.65	<0.001	0.72
	X_2	0.21	2.45	0.018	
	X_3	0.46	5.28	<0.001	
Position in sustainable development rankings (Y_3)	X_1	0.23	2.76	0.008	0.75
	X_2	0.52	6.14	<0.001	
	X_3	0.29	3.42	0.001	

Regression analysis indicates that the greatest contribution to the volume of investment in environmental projects (Y_1) and position in sustainability rankings (Y_3) is made by activity on the company's social media on sustainable development issues (X_2). The number of implemented social initiatives (Y_2) depends most on consumers' participation in the company's online sustainability initiatives (X_3).

The high determination coefficients (R^2 from 0.68 to 0.75) suggest that the variation of independent variables explains a substantial share of the variation in the dependent variables. This confirms the high level of consumer influence in the virtual environment on companies' sustainable development indicators.

V. DISCUSSION

The study allows us to formulate reasonable conclusions about the influence of consumers on the sustainable development of companies in the context of the virtual environment. We empirically confirmed that the digital environment transforms the mechanisms of consumer influence through changes in the information ecosystem, reducing the costs of coordinating collective actions and changing the temporal characteristics of interaction [42]. This phenomenon of temporal compression the drastic reduction in time between corporate actions and consumer reactions emerges as a critical theoretical insight. It underscores a shift in how reputational risks must be managed in digital ecosystems, where viral backlash or support can unfold within hours, not weeks [43]. The three key mechanisms of consumer influence identified in the study use different influence channels but end up synergistically amplified in the virtual environment. Informational impact in the form of distributing information on the social and environmental aspects of the company's operations creates a basis for direct economic impact through changes in consumer decisions [44]. In turn, reputational impact, which is generated by forming public opinion about the company through digital channels, has a cumulative effect and affects the company's long-term position in the market. The interplay of these mechanisms is driven by network effects and the scalability of influence in the virtual environment.

The statistically significant correlation found between consumer activity in the virtual environment and the indicators of companies' sustainable development testifies to the transformational potential of digital communications [45-46]. The strongest correlation is found between social media activity and the company's position in sustainability ratings, indicating the strategic importance of digital dialog for corporate reputation and brand value [47]. Regression analysis shows the differentiated influence of various consumer activity factors on corporate sustainability indicators, which calls for an integrated approach to managing consumer interactions [48].

The results support a dichotomous model of corporate adaptation to consumer influence in the virtual environment, including reactive and proactive digital transformation. These findings also support the advancement of Sustainable Development Goal 12 (Responsible Consumption and Production) by demonstrating how informed and digitally active consumers play a critical role in holding companies accountable and shaping more sustainable business practices through virtual interaction channels. Reactive digital adaptation is characterized by superficial changes in communication strategies while keeping the basic business model intact [49], which corresponds with the concept of greenwashing described by Abel and Chinaza [50]. Proactive digital transformation, on the contrary, implies a fundamental reinvention of business processes to integrate sustainability principles into the strategic core of the company [51], which aligns with the concept of digital circular economy as explained by Wilson et al. [25] and Sadaa et al. [52].

VI. CONCLUSIONS

The integrated results of the expert survey and correlation analysis paint a comprehensive picture of the mechanisms of consumer influence on the sustainable development of companies in the virtual environment. The proposed conceptual model of virtual interaction integrates five interconnected components: digital infrastructure, information transparency mechanisms, feedback systems, joint value creation platforms, and analytical systems. Empirical validation confirms the model's effectiveness in predicting corporate sustainability strategies and establishes the pivotal role of activity on social media and participation in online initiatives as critical success factors.

When interpreting the results, it is critical to consider several methodological limitations. First, the observed correlations between consumer activity in the virtual environment and companies' sustainability indicators do not necessarily indicate a cause-and-effect relationship. Alternatively, companies with a pre-existing commitment to sustainability could be more actively engaging consumers in digital communication. Additional research with a longitudinal design and causal modeling methods is needed to verify causal

relationships. Second, the focus on companies prevents generalization of the findings to the global context. The specifics of the business landscape, the cultural features of consumer behavior, and the characteristics of digital infrastructure can influence the mechanisms of consumer influence on the sustainable development of companies. Cross-cultural comparative studies on a more heterogeneous sample of companies are needed to increase external validity. Third, the study is limited by its reliance on self-reported data on companies' environmental investments and social projects. Since corporate reporting may contain inaccuracies or exaggerations, future research could benefit from verifying this data with independent sources of information on companies' actual sustainability practices.

While this study focused on virtual consumer-company interaction due to its scalability and immediacy, we recognize that hybrid online-offline dynamics may also shape corporate sustainability strategies—particularly where digital mobilization leads to offline action or vice versa. Future research could explore how these dual pathways interact to reinforce or dilute corporate responses. Promising directions for further research include analyzing the industry specifics of consumer influence on companies' sustainable development taking into account the business models of different economic sectors, conducting cross-cultural comparative studies of consumer influence mechanisms, developing methodological tools to measure the effectiveness of digital interaction systems, and longitudinal research into the long-term effects of transforming business models under the influence of consumer preferences in the context of sustainable development.

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Author Contributions

The author conducted all aspects of the research, including conceptualization, methodology, investigation, data curation, formal analysis, and writing-original draft preparation, as well as review and editing.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

Data supporting the reported results is available from the author upon request.

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