

Article

From Theory to Practice: ESG as a Management Tool for Sustainable Manufacturing—Empirical Evidence from Bulgaria

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Abstract

The focus of the research is on ESG integration in manufacturing companies. Most of the studies in the field regard ESG as an external assessment or reporting tool, but this does not reflect how it functions at the company level. In this study, it is examined as an internal management approach which can support sustainable production practices. The aim of the study is to evaluate the extent of ESG integration, identify the main challenges and opportunities, and examine the relationship between ESG integration and sustainable production practices in the Bulgarian manufacturing sector. The significance of the study stems not only from the growing regulatory and strategic role of ESG and the predominant treatment of ESG as an external rating or reporting framework, but also from the limited amount of empirical evidence on how ESG practices are implemented at the company level in the national manufacturing context. In order for the aim to be achieved, the study employs a quantitative approach based on a survey of 150 Bulgarian manufacturing companies. The analysis includes descriptive statistics, internal consistency reliability testing, a one-way analysis of variance comparing ESG integration across company-size categories, and a simple linear regression model examining the relationship between ESG integration and sustainable production practices. An uneven but relatively high level of ESG integration and sustainable production practices has been shown by the results, with higher scores reported among large companies. The regression analysis found a positive statistical relationship between ESG integration and sustainable production practices. This study contributes to the field by presenting a conceptualization of ESG as an internal management approach and by providing evidence from a national manufacturing context with limited empirical coverage.

Keywords: ESG integration; sustainable manufacturing; sustainable development; manufacturing companies

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1. Introduction

The broad adoption of the concept of Sustainable Development (SD) has resulted in significant changes in how companies operate. These changes are not limited to production processes and management. The emergence of the stakeholder perspective in management theory has also been identified as a significant factor in this regard. The need for businesses to measure and manage their impacts across multiple dimensions was driven by growing governmental and societal pressure. The Triple Bottom Line (TBL) was developed as a framework requiring companies to account for their economic, social, and

environmental performance at the same time [1–3]. The conceptual foundation for ESG practices in manufacturing is based on this framework.

The manufacturing sector can be considered a fundamental pillar of economic sustainability [4,5]. It creates jobs, generates wealth, and powers national economies while at the same time it is one of the biggest sources of environmental damage and social impact. Manufacturing as an industry consumes significant amounts of raw materials and energy, generates waste and pollution, and provides employment for many people. For these reasons, the industry faces serious expectations and pressure. This includes using resources wisely, avoiding energy waste, keeping emissions low, providing fair treatment to employees, and acting responsibly with every supplier and partner, from raw materials to the final product delivered to customers [6–8].

If a company focuses only on improvements in resource efficiency or reductions in harmful emissions, it cannot provide a comprehensive overview of its sustainability status and achievements. There is an increasing demand in the research for a more thorough review of the organizational processes that produce these outcomes. Without understanding the key components such as how management responsibilities are allocated, how internal policies are structured, how production processes are managed, and how sustainability expectations are communicated to suppliers, it is impossible to meaningfully assess whether a company's performance is systematic and sustainable or merely coincidental.

All mentioned components must be considered because the concept of sustainable production is not just a set of final environmental indicators. Furthermore, sustainable production must be addressed as interrelated management mechanisms, processes, and results [9–11]. Research in the field of environmental performance and reporting indicates that production outcomes and the methods used to report them should be viewed as being closely interrelated, rather than as entirely separate areas of management [12].

To integrate environmental, social, and governance considerations into business operations, the ESG framework represents one of the most relevant and practical approaches. An analysis of the scientific publications [13–15] reveals that ESG should not be interpreted solely as an external evaluation framework or as a communication instrument. Rather, it should be interpreted as a broader organizational strategy through which sustainability is integrated into management decisions, internal procedures, accountability systems, and operational practices. ESG is closely linked to a long-term management focus and increased transparency. For this reason, it is associated with the development of more advanced systems that include stakeholders and facilitate non-financial reporting. Finally, ESG is associated with a clearer distribution of responsibilities within the company.

The growing body of literature emphasizing the connection between sustainable company practices and better organizational performance further highlights the significance of ESG. Although they are implemented and measured differently, numerous studies demonstrate that the relationship between ESG factors and company performance is generally positive [16–18]. This finding is considered important because it suggests that ESG encompasses more than regulatory compliance and reputational effects. Companies often adopt ESG practices to mitigate risks, build trust, and remain competitive in the long term. These practices provide benefits to the business and the many stakeholders affected by it as well [19,20].

It should be noted that a majority of the research is focused on large public companies, secondary databases, and macro-empirical models. The focus of these studies often lies in ESG performance, green transformation, intelligent manufacturing, or the financial implications of ESG. Nevertheless, the manufacturing sector is highly sensitive to European regulations, market pressure for greater transparency, and the need for more structured adaptation to sustainable management and production models. Most of the studies in the field regard ESG as an external assessment or reporting tool, but this does not reflect

how ESG functions as an organizational and managerial process in manufacturing companies, particularly in less-studied national contexts, such as the Bulgarian context. This study addresses the theoretical gap in the limited understanding of ESG functioning as an internal management approach that can support sustainable production practices at the company level. The aim of the study is to evaluate the extent of ESG integration, identify the main challenges and opportunities, and examine the relationship between ESG integration and sustainable production practices in the Bulgarian manufacturing sector. The study examines ESG integration by presenting a conceptual ESG framework as an internal management approach that incorporates sustainability principles into policies, responsibilities, procedures, reporting, stakeholder engagement, and production practices. This perspective broadens the dominant approach in the literature where ESG is often analyzed through external ratings, financial indicators, or secondary databases. Thus, the contribution goes further than merely providing data on the Bulgarian manufacturing sector. It also focuses on linking ESG integration to sustainable production practices at the company level. The study emphasizes the relationship between managerial adoption of ESG and practical implementation of sustainable production solutions. Furthermore, this study explores the intersection of two significant research themes in the literature: ESG as a management framework for sustainability and sustainable production as an organizational and process transformation within the manufacturing sector [9,11,13]. Within the scope of this study, a distinction is made between the terminology of “sustainable production” and “sustainable production practices.” The first term is used when discussing broader theoretical frameworks, while the second is used to refer to the specific managerial, technological, or organizational practices measured through the survey instrument.

2. Literature Review

2.1. ESG as a Framework for Better Corporate Sustainability and Performance

Adopted by the United Nations in 2015, the Sustainable Development Goals (SDGs) aim to address poverty, inequality, climate change, and environmental degradation [21,22]. These goals establish a holistic global framework that necessarily extends to the environmental, social, and economic spheres of business activity. Although SD was previously viewed as an opportunity to enhance a company's image, nowadays it is a crucial strategic component for its long-term market position [9,11,23]. Further, it has transformed the financial and accounting sector and given rise to sustainable finance goals, which are supported by institutional investors and individuals interested in investing in companies with strong environmental, social, and governance performance [24]. The contemporary understanding of ESG was established in the report *Who Cares Wins* [25]. The formalization of the ESG concept as a strategy for incorporating sustainability into investment and management practices was subsequently advanced by the UN Principles of Responsible Investment. Particularly, the notion of ESG emerged from the social and environmental awareness movements in the late 20th century. They shed light on various issues, such as pollution, the overuse of resources, and unethical business practices [26]. The three pillars of ESG have subsequently evolved in order to form more structured and measurable criteria. The development of ESG as an institutional framework is also closely linked to the growing importance of non-financial reporting, transparency, and governance mechanisms for sustainability. The report *Who Cares Wins* places ESG at the centre of the contemporary debate on the relationship between sustainability, investment decisions, and corporate governance [25]. Subsequent studies show that companies that integrate sustainability into their business models and management processes establish more clearly defined responsibilities and more developed mechanisms for stakeholder engagement. They also expand the scope of internal measurement systems and achieve a higher level of disclosure of non-financial information [13–15]. This means that ESG should not

be viewed solely as an external assessment tool, but as an internal management system through which sustainability is transformed into specific goals, processes, responsibilities, and accountability. In this regard, companies launched ESG performance indexes and evaluation criteria [27]. This creates an increasing demand for them to organize and implement activities in a way that aligns with the principles of sustainable development.

The contemporary understanding of ESG has to be viewed through the lens of stakeholder theory, corporate sustainability, and triple bottom line logic interrelation. Freeman (1984) laid the theoretical foundations for this framework [2]. He put the emphasis on the relationships among the employees, customers, suppliers, civil society communities, and public institutions. He expands on the understanding of the purpose of a business organization's operations beyond the interests of shareholders. The stakeholder theory developed by Donaldson, T. and Preston, L. E. (1995) builds on the previous theory and lays the theoretical foundation for the need to integrate ESG into manufacturing companies [28]. They stated that the companies have obligations not only to shareholders but to all stakeholders. Further development is made by Jones (1995), who demonstrates that the significant competitive advantages can be achieved only if the company creates trust, maintains cooperation, and ethical behavior [3]. According to Legitimacy Theory, companies must constantly align their activities not only with stakeholder expectations but also with social norms in order to gain social approval, which is directly linked to their effective activity in the long term [29]. This implies that the adoption of ESG frameworks in manufacturing companies must be viewed as institutionally mandatory.

Indeed, the reasons for the need to implement ESG have been examined by a number of authors. Stakeholder pressure is identified as the main contributing factor. As stated by [30–33], stakeholders who have the power to influence decisions regarding the implementation of ESG can be divided into two groups: internal stakeholders, which include employees, and external stakeholders. As external stakeholders, administrative authorities, civic organizations, financial institutions, suppliers, and customers are cited as having a considerable impact. Another significant factor driving the implementation of sustainable practices in corporate management and practices is market dynamics [34].

For companies that are already following ESG standards, ESG ratings have triggered internal changes. They included more reporting, changes to the company's organization, raising awareness, learning, comparing performance to others, and implementing new policies. These internal changes are focused on climate change, diversity, and human rights [35]. The increasingly complex, multi-faceted nature of business ethics and sustainability is evaluated and managed by stakeholders, for which ESG ratings play an important role [36]. ESG data is being used more and more often by investors to monitor the ethical and sustainability practices of the companies in which they are investing.

Integrating ESG frameworks into corporate strategy is imperative to ensure that business efforts are aligned with global sustainability objectives, rather than undermining them [4,6].

One of the most important questions in the literature is whether, and to what extent, ESG is linked to organizational performance [37]. Hence, several authors have discussed the integration of ESG criteria and their impact on corporate sustainability performance and ESG dimensions and corporate risks [38,39]. Accordingly, some studies show that the relationship between sustainable corporate behavior and business outcomes in most cases is positive. Orlitzky et al. (2003) were among the earliest to identify a positive relationship between corporate social performance and corporate financial performance [17]. Later analyses confirm the robustness of this relationship across various contexts. The most comprehensive meta-analysis, encompassing more than 2000 empirical studies, concludes that the business case for ESG is empirically well-founded [16]. Expanding on this, Wang et al. (2016) show that the strength and direction of this relationship also depend on

contextual factors [18]. This suggests that the impact of ESG factors is not automatic, but rather depends on institutional environments, sector-specific characteristics, and organizational features.

From a management perspective, these findings are significant because they suggest that ESG should not be viewed solely as a matter of compliance, symbolic legitimacy, or reputational communication. On the contrary, sustainability can be a source of better risk management, greater reliability of organizational processes, and longer-term strategic positioning. Along this line, Porter and Kramer (2011) propose the concept of creating shared value, according to which sustainable and socially responsible management practices can create value simultaneously for companies and their broader environment [20]. In the context of ESG, this means that the integration of environmental, social, and governance principles can be viewed not merely as a response to external pressure, but as a mechanism for strengthening organizational sustainability.

2.2. ESG Integration and Sustainable Manufacturing

ESG integration in manufacturing companies is based on three complementary frameworks. Agency theory establishes that the key mechanism for aligning managerial and stakeholders' interests is corporate governance structures based on commitment and monitoring by the board of directors, management accountability, and transparency [40].

The resource-based view suggests that if a company incorporates ethical and sustainable practices into its day-to-day operations, this creates a sustainable competitive advantage, as it makes specific capabilities difficult to imitate [41].

The explanation for why ESG integration is both a management requirement and long-term value creation factor can be found in the Triple Bottom Line theory (1998). Measuring economic, environmental, and social outcomes together is essential and Elkington (1997) systematized the need to analyze economic performance balanced against the environmental and social impacts [42].

Because ESG enhances transparency, promotes accountability, and facilitates company comparisons, it has become a practically applicable approach to corporate sustainability [43].

Recent studies show that the manufacturing sector needs to be transformed. Essential for this transformation is the implementation of ESG since it contributes to the transparency, optimization of resources, smart manufacturing, and green transition.

However, to truly achieve these results, it is necessary to take the company's size into account. Researchers have noted that larger companies with more resources tend to have higher ESG ratings. However, these ratings do not always reflect the company's actual sustainability. Rather, they show how well a company is able to report and present its activities [44–47]. Along this line they argue that due to the resource capacity, larger companies are capable of providing more comprehensive ESG disclosures, unlike the smaller ones which do not have enough resources to dedicate [48].

The manufacturing industry is the foundation not only of the economy but also of society as a whole. It is facing a significant challenge as a result of sustainability imperatives. They demand fundamental changes in technology, business models, and organizational culture. This challenge stems from the fact that the assumption of unlimited natural resources and infinite environmental regenerative capacity is no longer valid [49].

The manufacturing sector plays a central role in the analysis of sustainable development, as it combines a significant economic role with a high degree of environmental and social sensitivity.

Manufacturing is resource intensive. This has a negative impact on the company's reputation. It also creates conflicts with stakeholders. Furthermore, there is a persistent institutional pressure on the companies to address pollution and environmental

performance [50]. Companies are under pressure from both internal and external factors to improve their social and environmental performance [51].

The definition of sustainable manufacturing is the integration of processes and systems to produce high-quality products and services using fewer and more sustainable resources [52–54].

In the literature, sustainable production is of particular interest, as the activities involved in its implementation are directly linked to energy efficiency, resource intensity, waste, emissions, occupational safety, and the impact on the supply chain [9,11]. Furthermore, Hart (1995), in his natural-resource-based view of the company, demonstrates that the long-term competitiveness is increasingly linked to the ability to manage natural resources, environmental constraints, and the associated organizational innovations [23].

Unlike the outdated view that a manufacturing company is sustainable simply because it emits fewer harmful emissions and uses fewer energy resources, the more recent understanding acknowledges that these results alone are not sufficient for a realistic assessment. Attention must also be paid to the decision-making process, accountability, internal rules and procedures, and management of relationships with staff and suppliers. In this regard, Lee and Kazakova (2024) argue that the outcome and the process that led to it should both be measured [9]. Tiuncika and Bormane (2024) further elaborate on this concept, emphasizing that a company's management style is a fundamental aspect of its sustainability [11]. These observations are important for assessing corporate sustainability because they enable meaningful comparisons. For example, even if two companies have the same level of harmful emissions, it matters which company achieved this through a genuine internal system rather than simply manipulating the results.

Sharma et al. (2023) point out that sustainable production cannot be reduced to results or processes alone [10]. They identify the three main dimensions of a company's sustainability as what it achieves, how it achieves it, and how it is managed, which need to be assessed together. This is necessary to respond to the increasing pressure to use resources more efficiently, to introduce greener technologies, and to adapt its organizational structure to meet new environmental demands.

Clarkson et al. (2008) expand on this explaining that what a company actually does in the environmental field and what it reports on are closely linked [12]. This is particularly important in manufacturing, because there is a real risk that a company may appear sustainable on paper without actually being sustainable in practice.

The main challenge they draw attention to is the difference between real transformation and symbolic communication. A company can publish impressive sustainability reports, use “green” language, and score well on ESG ratings—without fundamentally changing the way it operates. In manufacturing, where the environmental and social stakes are high, this gap between appearance and reality can be significant and misleading.

Another issue that has attracted considerable attention in the literature is how ESG evolves from a reporting framework into a functioning organizational system. Research on corporate sustainability shows that companies with a higher degree of sustainability are characterized by more clearly institutionalized management responsibilities, stronger commitment from senior management, a longer-term orientation, and more developed systems for tracking and disclosing non-financial information [13]. This is particularly important because it draws attention to the management as a mediator between strategic sustainability and day-to-day operational practice.

A number of authors have found that ESG is not merely a document that demonstrates a company's sustainability. Rather, it is linked to an internal system that enables the company to be managed more effectively, to be sustainable, and to make that sustainability measurable. Rusu et al. (2024) view ESG reports as a tool to help managers achieve

their goals by coordinating information and activities across different departments within the company [15]. Ioannou and Serafeim (2019) point out that sustainability reporting is necessary to ensure that key aspects of a company's operations, such as carbon emissions, working conditions, and corporate governance, are not overlooked [14]. This not only makes the company's operations more transparent but also fosters internal discipline. If there are no well-developed internal procedures, managerial responsibilities, and an accounting infrastructure, it would be very difficult to implement sustainability, which is directly relevant to manufacturing enterprises.

2.3. Research Gap and New ESG Empirical Approach in Manufacturing Context

Recent empirical studies in the manufacturing sector indicate that ESG is increasingly linked to broader processes of technological, organizational, and green transformation. Huang et al. (2024) analyze the relationship between intelligent manufacturing and ESG performance and show that transparency, green innovation, and supply chain collaboration are important intermediary mechanisms [46]. While interest in ESG integration is on the rise, current research mostly focuses on the business and financial side of sustainability, with a lack of studies that look at how ESG is put into management practices at the company level in specific regions [55].

Despite the growing body of literature on the subject, several significant limitations can be identified. First, a significant part of empirical research focuses on the ESG effects on financial performance, credit ratings, green innovation, or technological transformation, but rarely examines the process of internal ESG integration as an internal management approach. Second, the recent studies are predominantly concentrated on large public companies and secondary databases, which limits the understanding of how ESG is perceived and implemented across a broader range of manufacturing companies. Third, there is a lack of sufficient empirical research on the manufacturing sector in a national context, even though it is particularly sensitive to growing demands for transparency, sustainability, and adaptation to new regulatory and market frameworks. Thus, it is clear that there is an evident need for context-specific, survey-based studies that focus on how manufacturing companies perceive and integrate ESG practices into their internal management systems.

In line with the reviewed literature, the present study is based on the understanding that a higher degree of ESG integration should be associated with a higher degree of implementation of sustainable production practices. The study seeks the intersection between ESG as a management framework for sustainability and sustainable production as a process and organizational transformation within the manufacturing sector [9,11,13]. The study is based on categories described in the literature review above and is developed using a conceptual framework created by the authors (Figure 1). This framework is structured as a logical sequence that links the input ESG factors, the management approach for their integration, and the expected outcomes for sustainable production.

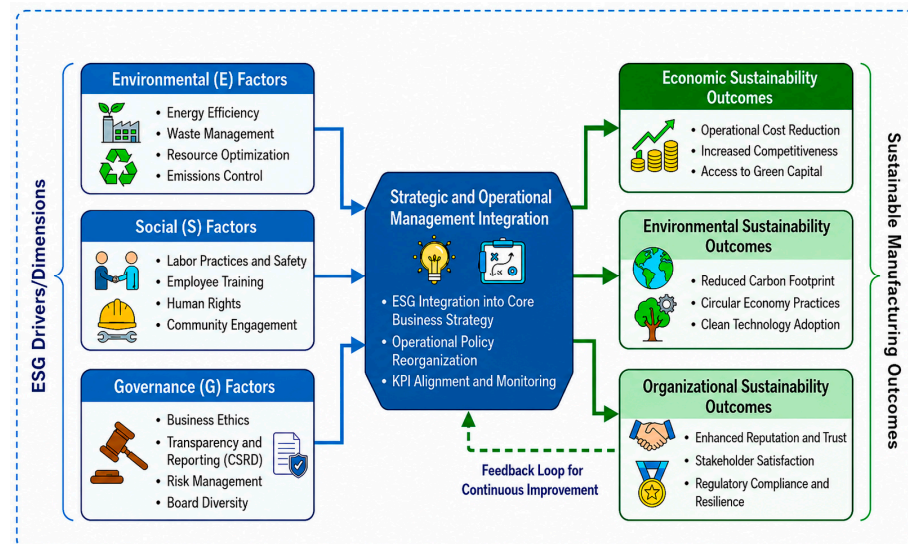


Figure 1. A conceptual framework for the transition from individual ESG measures to integrated sustainable production in the Bulgarian context. Note: Blue arrows represent the integration of ESG factors into management processes, green arrows indicate the transition to sustainability outcomes, and the dashed green arrow represents the feedback loop for continuous improvement. Source: Author's own work.

As shown in Figure 1, the conceptual framework is based on the premise that the transition to sustainable production models in the Bulgarian context is not a single event, but rather a systematic management process. The process begins with identifying specific environmental (E), societal (S), and governance (G) factors. When viewed through the lens of company management, these factors lead to long-term sustainable production. The developed framework serves as a visual basis for the empirical verification presented in Section 3. The analysis of the survey data will follow the “Inputs—Process—Outputs” framework to assess the extent to which reported ESG policies are transformed into real sustainable production practices at the sectoral level.

2.4. Research Questions and Hypotheses

Based on the reviewed literature and the conceptual framework presented, the following Research Questions (RQs) and Hypotheses (Hs) were formulated. They ensure the connection between the conceptual framework and the subsequent empirical testing. They outline the analytical logic according to which the constructive elements, indexes, and statistical procedures are defined in the methodological section. They are consistent with the cross-sectional survey design and do not imply cause-and-effect relationships.

The research questions that were formulated are as follows:

RQ1: To what extent are ESG principles integrated into the Bulgarian manufacturing companies?

RQ2: To what extent have sustainable production practices been implemented?

RQ3: Is there a relationship between ESG integration and sustainable production practices?

Based on these research questions, the following hypotheses were formulated for empirical testing:

H1: A higher extent of ESG integration is positively related to a higher degree of sustainable production practices.

H2: The extent of ESG integration varies depending on the size of the company.

H3: The extent to which sustainable production practices are implemented varies depending on the size of the enterprise.

3. Materials and Methods

This study employs a quantitative research approach based on a structured questionnaire distributed to manufacturing companies operating in Bulgaria. This methodology was chosen to collect consistent and comparable data on the extent of ESG integration and sustainable production practices. This approach is particularly suitable for studies focusing on organizational policies, management strategies, and practices that should be examined and compared across companies [13,15].

3.1. Questionnaire Development and Measurement

The survey instrument was structured into several thematic sections: company profile, ESG integration, sustainable production practices, perceived challenges, and perceived opportunities. The indicators were developed based on the theoretical categories identified in the literature review and were aligned with the study's objective of analyzing ESG as an internal management approach. All key indicators were measured using a five-point Likert scale, where 1 indicates the lowest level of agreement or application, and 5 indicates the highest level of agreement or application. Using a common scale for all indicators made it possible to aggregate the individual indicators into aggregated indexes. The indexes were constructed based on the arithmetic mean of the included indicators, with a higher value indicating a higher extent of development of the respective component. The respondents included business owners, CEOs, production, and quality managers, as well as experts in the fields of sustainable development, CSR, and ESG practices. Other senior management representatives who are familiar with organizational policies, production practices, and reporting are also included in the study. This research framework is based on the premise that the integration of ESG and sustainable production are organizational and managerial aspects that cannot be effectively evaluated without an in-depth understanding of internal systems, responsibilities, and processes [9,13].

The study sample includes manufacturing companies in Bulgaria. A detailed overview of the survey instrument and the correspondence between the individual survey items and the aggregate indexes is provided in Appendix A (Table A1). The selection of this sector is based on several key considerations. First, the manufacturing sector plays a central role in Bulgaria's economy by creating jobs, adding value, and fostering technological development. Second, this sector involves key aspects such as resource intensity, energy efficiency, waste management, emissions control, and ensuring a healthy and safe working environment. Third, integrating ESG practices into manufacturing companies directly impacts value chain management, internal management systems, stakeholder relations, and sustainability reporting.

3.2. Selection Procedure and Sample Size

The sample was formed through purposive sampling and voluntary participation of 150 manufacturing companies selected to ensure representation across different company sizes. The sample comprised 45 small companies (30%), 60 medium-sized companies (40%), and 45 large companies (30%). This provides the minimum required representation for comparative analysis. Geographically, the sample is concentrated in Sofia, Burgas, Varna, and Plovdiv regions. The study period was one month, during which an anonymous online questionnaire survey was conducted.

This approach was employed due to the lack of a consistent publicly available sampling frame that would allow for a probability-based selection of all manufacturing enterprises in the country. Such an approach is also consistent with recommendations for

research focused on organizational behavior and innovation implementation, in which the depth of the analysis has priority over statistical generalization [56]. Furthermore, purposive sampling is widely used and methodologically appropriate in sector-specific organizational research where the goal is comprehensive coverage of a defined professional population rather than statistical generalization to a heterogeneous one. The results should be interpreted as empirical data for the studied sample, rather than as generalizations applicable to all manufacturing companies in Bulgaria. For this reason, the study does not claim to be nationally statistically representative. Instead, the sample was structured to include companies of varying sizes, regional locations, industrial subsectors, export activity, and the presence or absence of ESG/non-financial reporting. Selection bias cannot be completely excluded because participation was voluntary. Companies that are more sensitive to ESG issues and sustainability may have been more likely to respond to the survey. This limitation has been taken into account in the interpretation of the results and in the formulation of the conclusions.

For analytical purposes, the study employs two main categories. The first is “ESG integration”. This category includes ESG policies, senior management commitment, clearly defined management responsibilities, ESG goals, internal procedures, stakeholder engagement, reporting and disclosure, and human resource policies. The second category is “sustainable production practices”. This category covers energy efficiency, waste reduction, resource optimization, emissions control, circular economy practices, the utilization of clean technologies, workplace health and safety, staff training, and sustainability requirements for suppliers.

3.3. Measurement of Construct Elements and Development of Indexes

After defining the main analytical categories, it was necessary to specify how they are transformed into measurable empirical indicators. For this reason, measures for the key construct elements were developed. They link the individual dimensions of ESG integration, sustainable production practices, and challenges and opportunities to specific indicators and aggregate indexes. This approach provides greater transparency in the measurement process and enables subsequent use of the indexes in descriptive, comparative, and regression analyses.

The measurement framework is summarized in Table 1.

Table 1. Measurement of construct elements.

Construct Element/Index	Number of Indicators	Key Measurements	Aggregation Method	Methodological Function
ESG Integration Index	8	ESG Policies; Senior Management Commitment; ESG Responsibilities; ESG Goals; Internal Procedures; Stakeholder Engagement; ESG/non-financial Reporting; Social HR Policies	Arithmetic mean of the indicators	Measures the extent of internal management integration of ESG
Sustainable Manufacturing Practices Index	9	Energy efficiency; Waste Reduction; Resource Optimization; Emissions Control; Circular Practices; Clean Technologies; Healthy and Safe Working Conditions; Training; Supplier Requirements	Arithmetic mean of the indicators	Measures the extent to which sustainable production practices have been implemented
Challenges Index	6	Financial Resources; Expertise; Administrative Capacity; Regulatory Clarity; Internal Motivation; Market Pressure	Arithmetic mean of the indicators	Measures perceived barriers to ESG integration
Opportunities Index	6	Regulatory Compliance; Reputation; Efficiency; Market Access; Stakeholder Relations; Risk Mitigation	Arithmetic mean of the indicators	Measures the perceived benefits and opportunities of ESG integration

Note: The indexes are developed as composite management indicators based on the theoretical dimensions, rather than reflective latent constructs.

Source: Original research.

The presented measurements demonstrate that the indexes are not introduced as individual numerical values with no theoretical connection to the model. Rather, they are presented as composite indicators derived from predefined managerial, organizational, and production dimensions. This approach ensures a clear and direct connection between the literature review, the conceptual framework, and the empirical section. The interpretation of the results is based on a measurement logic that is clearly traceable, enhancing the reliability and validity of the study.

To conduct the data analysis, two main analytical levels are considered. First, descriptive statistical methods are used to outline the profile of the sample and determine the frequency of ESG practices and sustainable production practices. At this stage, absolute values, relative shares, percentage distributions, and average values are used for the respective indicators. Second, a comparative analysis based on company size in the “Manufacturing” sector is conducted. Here, the focus is on identifying differences in the extent of ESG integration and the implementation of sustainable production practices among different groups of companies. This highlights differences between small, medium, and large companies and enables us to identify characteristics based on the scope of their activities.

3.4. Analytical Strategy and Statistical Procedures

A one-way analysis of variance (ANOVA) was performed to determine whether the observed differences between small, medium, and large companies were statistically significant. Company size was used as an aggregating variable with three categories: small, medium, and large firms. The dependent variables included individual indicators of ESG integration, individual indicators of sustainable production practices, and the two aggregate indexes. To assess the practical significance of the differences between the groups along with the p -values, the effect size was reported using η^2 . Additionally, a simple linear regression model was employed to evaluate the relationship between the aggregate ESG integration index and the aggregate sustainable production practices index. The sustainable production practices index was the dependent variable and the ESG integration index was the independent variable. This model was not interpreted as causal, but rather as a test of the strength and relationship direction of the two indexes. A summary of the additional statistical tests used to assess group differences and the relationship between ESG integration and sustainable production practices is provided in Appendix B (Table A2).

4. Results

4.1. Sample Profile

The study encompasses 150 manufacturing companies, which are classified by size as follows: 45 small companies (30%), 60 medium companies (40%), and 45 large companies (30%). This enables a comparative analysis of the different company groups, as well as identification of differing levels of ESG integration and sustainable manufacturing practices. Geographically, the largest share (32.0%) is represented by companies in Sofia, followed by companies in Plovdiv (20.0%), Varna (16.0%), and Burgas (14.0%). The remaining 18.0% are distributed across other regions of the country. Most companies are in the food and beverage industry, mechanical engineering, and metal product manufacturing. The majority of the companies in the sample are engaged in export activities, and approximately one-third of them report the integration of ESG or non-financial reporting.

A summary of the sample structure by key indicators is presented in Table 2.

Table 2. Sample profile.

Indicator	Category	Number	%
Company size	Small	45	30.0%
	Medium	60	40.0%
	Large	45	30.0%
Geographical location	Sofia City	48	32.0%
	Plovdiv	30	20.0%
	Varna	24	16.0%
	Burgas	21	14.0%
	Other regions in the country	27	18.0%
	Food and beverage industry	30	20.0%
Business activity	Machinery and equipment	27	18.0%
	Metal products	24	16.0%
	Chemical and pharmaceutical industry	21	14.0%
	Textiles and clothing	18	12.0%
	Woodworking and furniture	15	10.0%
	Plastics and rubber	15	10.0%
Export activity	Yes	87	58.0%
	No	63	42.0%
ESG/non-financial reporting	Yes	54	36.0%
	No	96	64.0%

Source: Original research.

4.2. Extent of ESG Integration

The results show that the overall level of ESG integration in the surveyed companies is relatively high. However, it is unevenly distributed across individual components. The highest average scores are in senior management's commitment to ESG integration ($M = 3.92$) and in human resources policies ($M = 4.02$). It is found that in the social and governance dimensions, companies demonstrate greater internal readiness. At the same time, lower values are recorded for reporting and disclosure ($M = 3.06$), internal procedures ($M = 3.18$), and the existence of ESG policies ($M = 3.24$). The analysis shows that the institutional aspects of ESG integration remain less developed.

Table 3 presents the results related to ESG integration indicators.

Table 3. Statistical indicators of the degree of ESG integration.

Indicator	Average Value	Standard Deviation	Interpretation
The company has integrated ESG policies	3.24	1.18	Moderate level
Senior management is committed to ESG integration	3.92	0.96	High level
There are clearly defined ESG responsibilities	3.38	1.07	Moderate level
Specific ESG goals and priorities are in place	3.46	1.02	High level
Internal procedures are in place to monitor ESG practices	3.18	1.11	Moderate level
The company maintains mechanisms for stakeholder engagement	3.52	0.94	High level
There is a practice of ESG/non-financial reporting	3.06	1.20	Moderate level

The company implements social policies for human resources	4.02	0.88	High level
Overall ESG integration index	3.47	0.79	High level

Source: Original research.

Empirical data indicate that higher ratings were given for management commitment and social policies. However, practices related to reporting, monitoring, and the formal structuring of ESG activities are less developed. Consequently, the sample studied shows a discrepancy between management's declared commitment to sustainable development and the extent to which ESG has been institutionalized as a formal management system.

4.3. Implementation of Sustainable Production Practices

Sustainable manufacturing practices show higher scores in areas primarily related to operational efficiency and compliance with regulatory requirements. The highest average scores are found in the indicators related to workplace health and safety ($M = 4.22$), energy efficiency ($M = 4.08$), and waste reduction ($M = 3.94$). Lower values are observed for circular practices ($M = 2.98$), emissions control ($M = 3.26$), supplier requirements ($M = 3.16$), and the implementation of clean technologies ($M = 3.12$). Therefore, it can be argued that enterprises are more advanced in the implementation of measures of a direct operational and regulatory nature. Practices requiring a more comprehensive transformation in the value chain remain less developed.

Table 4 summarizes the data on integrated production practices in the operations of companies in the "Manufacturing" sector.

Table 4. Assessment of sustainable production practices

Indicator	Average Value	Standard Deviation	Interpretation
Energy efficiency measures are implemented	4.08	0.81	High level
Waste reduction measures are implemented	3.94	0.89	High level
Resource optimization practices are implemented	3.88	0.86	High level
Emissions control measures are implemented	3.26	1.10	Moderate level
Circular economy practices are implemented	2.98	1.14	Moderate level
Clean technologies are implemented	3.12	1.09	Moderate level
Workplace health and safety are ensured	4.22	0.73	Very high level
Staff training is conducted	3.74	0.97	High level
Sustainability requirements are applied to suppliers	3.16	1.05	Moderate level
Overall index of sustainable production practices	3.58	0.74	High level

Source: Original research.

The data in Table 4 are consistent with the conclusions, indicating that there are differences in the extent to which individual practices are implemented among manufacturing companies. Variation in some of the indicators points to inconsistencies in the implementation of sustainable practices. On the other hand, those practices that are directly linked to internal production discipline are more widespread. In contrast, more complex sustainable practices related to circularity and the transformation of supply chain relationships remain less prevalent. This suggests potential for further development and expansion of their scope in terms of sustainability. The most common ESG and sustainable practices implemented in the manufacturing sector are presented in Figure 2.

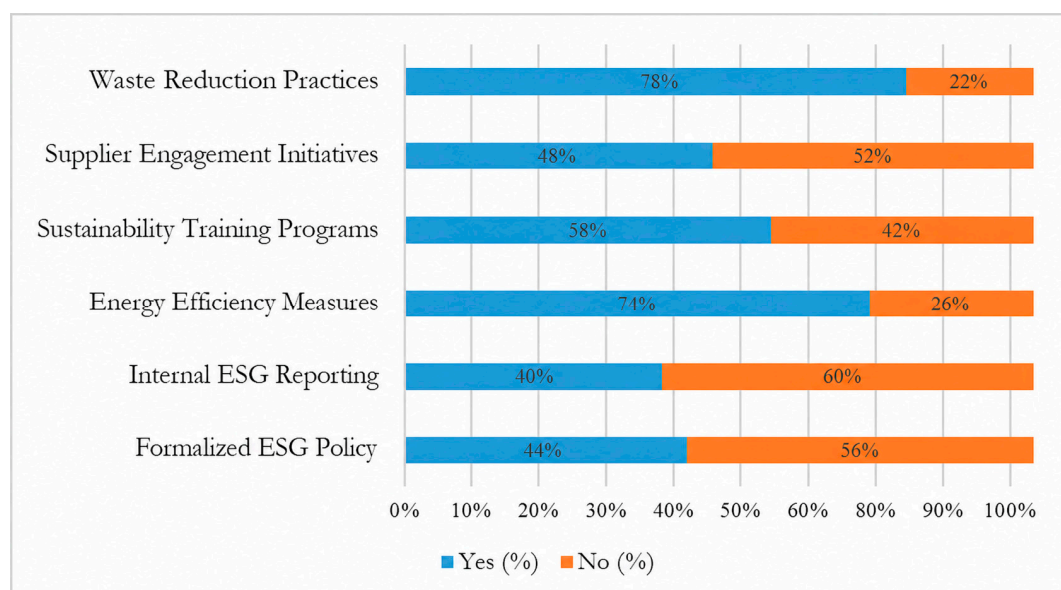


Figure 2. Percentage of companies implementing ESG and sustainable practices (%). Source: Author's own research.

The survey results indicate that energy efficiency and waste reduction measures are widespread. Formal ESG policies and internal ESG reporting are significantly less common. This means that companies in the “Manufacturing” sector are more likely to implement practices with a direct impact than to develop a comprehensive ESG system. Thus, at the sectoral level, there are more measurable and actionable measures than strategic and ESG reporting mechanisms.

4.4. Differences by Company Size in ESG Integration and Sustainable Production Practices

A descriptive and comparative analysis was conducted to evaluate differences in ESG integration and sustainable production practices among companies of small, medium, and large sizes. The observed differences in mean values across size categories are not interpreted as evidence of a causal relationship between company size and ESG integration or sustainable production practices but only as a descriptive pattern.

Table 5 shows a consistent upward trend in the descriptive comparison, with large companies reporting higher average values than medium-sized and small companies.

Table 5. Comparative analysis of ESG integration and sustainable production practices by company size

Category	Comparison Indicator	Types of Companies			Maximum Mean Difference
		Small	Medium	Large	
ESG Integration	ESG Policies	2.67	3.35	3.79	1.12
	Senior Management Commitment	3.54	3.95	4.28	0.74
	ESG Reporting	2.48	3.10	3.60	1.12
	Internal Procedures	2.73	3.22	3.58	0.85
	Overall ESG Integration Index	3.01	3.46	3.91	0.90
Sustainable manufacturing practices	Energy Efficiency	3.72	4.11	4.38	0.66
	Waste Reduction	3.61	4.02	4.21	0.60
	Emissions Control	2.88	3.24	3.70	0.82
	Circular Practices	2.41	3.01	3.46	1.05

Clean Technologies	2.58	3.18	3.70	1.12
Overall Sustainable Manufacturing Practices Index	3.19	3.58	3.98	0.79

Source: Original research.

Although the descriptive results presented in Table 5 indicate differences across company-size categories, comparisons of mean values alone are insufficient to establish their statistical significance. Therefore, a one-way analysis of variance was conducted, and the results are presented in Table 6.

Table 6. Formal statistical test of differences between small, medium, and large companies using one-way analysis of variance

Indicator	Average Value (M)			F (2, 147)	p	η^2	Interpretation
	Small Companies	Medium Companies	Large Companies				
ESG Policies	2.67	3.35	3.79	11.82	<0.001	0.139	significant effect
Senior Management Commitment	3.54	3.95	4.28	7.28	0.001	0.090	moderate effect
ESG/Non-Financial Reporting	2.48	3.10	3.60	11.19	<0.001	0.132	moderate to significant effect
Internal Procedures	2.73	3.22	3.58	7.21	0.001	0.089	moderate effect
Overall ESG Integration Index	3.01	3.46	3.91	17.92	<0.001	0.196	significant effect
Energy Efficiency	3.72	4.11	4.38	8.31	<0.001	0.102	moderate effect
Waste Reduction	3.61	4.02	4.21	5.73	0.004	0.072	moderate effect
Emissions Control	2.88	3.24	3.70	6.78	0.002	0.084	moderate effect
Circular Practices	2.41	3.01	3.46	10.90	<0.001	0.129	moderate to significant effect
Clean Technologies	2.58	3.18	3.70	13.97	<0.001	0.160	significant effect
Overall Index of Sustainable Production Practices	3.19	3.58	3.98	15.28	<0.001	0.172	significant effect

Note: M = arithmetic mean on a five-point Likert scale, F = statistic from a one-way analysis of variance, p = level of statistical significance, η^2 = effect size. Source: Original research.

The results of the one-way analysis of variance indicate a statistically significant relationship between company size and the extent of ESG integration and sustainable production practices. Statistically significant differences were observed between small, medium, and large companies for all examined indicators. The most significant differences were observed in the overall ESG integration and sustainable production practices indexes, as well as in ESG policies, reporting, circular practices, and clean technology adoption. These results show that larger companies have more formalized ESG policies and more advanced sustainable production practices. However, the interpretation should be limited to a statistical relationship between company size and the indexes under consideration. No causal conclusion can be drawn about whether size directly leads to higher ESG integration. It is more plausible that size reflects a broader organizational, administrative, financial, and expert capacity to implement and maintain structured ESG strategies.

4.5. Challenges and Opportunities in ESG Integration

An empirical analysis was conducted to identify the main challenges and opportunities facing ESG integration. The study covers some of the key factors influencing the process of implementing ESG practices in companies in the “Manufacturing” sector. The aggregated results are presented in Table 7.

Table 7. Empirical analysis of the main challenges and opportunities for ESG integration.

Category	Factor	Average Value	Interpretation	Rank
Challenges	Lack of financial resources	4.18	High level	1
	Lack of expertise	3.96	High level	2
	Limited administrative capacity	3.74	High level	3
	Insufficient regulatory clarity	3.22	Moderate level	4
	Low internal motivation	2.88	Moderate level	5
	Limited market pressure	2.74	Moderate level	6
	Overall challenge index	3.45	High level	-
Opportunities	Better compliance with regulatory requirements	4.12	High level	1
	Improved image and reputation	4.06	High level	2
	Increased efficiency	3.98	High level	3
	Access to new markets and partners	3.84	High level	4
	Improved stakeholder relations	3.76	High level	5
	Reduced risk	3.68	High level	6
	Overall Opportunity Index	3.91	High level	-

Source: Original research.

In terms of challenges, the highest-rated factors are a lack of financial resources ($M = 4.18$), a lack of expertise ($M = 3.96$), and limited administrative capacity ($M = 3.74$). Lower, yet still relevant, scores are for insufficient regulatory clarity, weak internal motivation, and limited market pressure. In fact, manufacturing companies perceive ESG integration as a challenge related to limited resources and a lack of expertise, rather than as a matter of organizational will and attitudes.

Further, respondents reported the highest scores for better compliance with regulatory requirements ($M = 4.12$), improving image and reputation ($M = 4.06$), and increasing efficiency ($M = 3.98$). Although companies in the “Manufacturing” sector associate ESG with regulatory compliance requirements, in the long term they report internal and external organizational benefits. Consequently, companies perceive ESG not only as an obligation but also as a means of enhancing legitimacy, organizational effectiveness, and strategic sustainability.

4.6. Reliability of the Scales

As part of the empirical analysis, the internal consistency of the multi-item scales used was assessed. These scales are used to measure the main research components: ESG integration, sustainable production practices, challenges to ESG integration, and potential

opportunities. The reliability of the scales was assessed using Cronbach's alpha (α), which is widely used in similar empirical studies. It allows for determining the degree of internal consistency among the indicators used in the study.

The results of the analysis are presented in Table 8.

Table 8. Reliability of the scales used.

Scale	Number of Indicators	α	Interpretation
ESG Integration	8	0.87	Very good reliability
Sustainable Production Practices	9	0.84	Very good reliability
Challenges to ESG Integration	6	0.79	Good reliability
Potential Opportunities	6	0.82	Very good reliability

Source: Original research.

Good to very good internal consistency was found for all scales used. The highest value was observed for the ESG integration scale ($\alpha = 0.87$), indicating a high degree of consistency among the indicators. Similar results were reported for the scales on sustainable production practices ($\alpha = 0.84$) and potential opportunities ($\alpha = 0.82$). The lowest value, though still within acceptable limits, was recorded for the challenges scale ($\alpha = 0.79$). For the purposes of this study, it can be considered reliable. All values obtained exceed the generally accepted threshold of $\alpha = 0.70$. This confirms the possibility of aggregating the indicators into indexes. This creates the necessary methodological foundation for subsequent analysis of the interrelationships between the main research components.

4.6.1. Theoretical Rationale for Aggregated Index Construction

The indexes are treated as aggregate management indicators with theoretical grounding, rather than as hidden (latent) theoretical concepts requiring confirmatory factor analysis. This methodological approach stems from the nature of the phenomena being studied. ESG integration encompasses various, yet complementary, organizational components, including policies, management commitment, responsibilities, objectives, procedures, stakeholder engagement, reporting, and human resources (HR) policies. Similarly, sustainable production practices include operational and organizational dimensions such as energy efficiency, waste management, resource optimization, emissions control, circular practices, clean technologies, healthy and safe working conditions, training, and supplier requirements.

For this reason, the indexes were used as theoretically grounded aggregate indicators of the extent of ESG and sustainable production practices, rather than as scales intended to reveal a latent factor structure. The validity of the aggregated indexes is supported by their theoretical rationale and the clear correspondence between the selected measures and the defined aggregated indicators. Internal consistency was assessed using Cronbach's alpha, confirming the reliability of the scales. The reliability is therefore not treated as a standalone criterion, but as one element within a broader, theoretically grounded framework for index construction.

4.6.2. Common-Method Bias Risk

Since the data were collected using a single survey instrument and are based on respondents' self-reports, the risk of common-method bias cannot be completely excluded. To mitigate this risk, procedural measures were implemented during data collection: the survey was anonymous, the questions were phrased neutrally, the thematic sections were structured separately, and the respondents were individuals in management or expert roles who were familiar with the companies' internal policies, production practices, and reporting processes. However, the results should be interpreted as data provided by the

companies, rather than as performance indicators verified by external sources. For this reason, all conclusions are formulated as relationships rather than as cause-and-effect relationships.

Following confirmation of the scales' reliability, a correlation analysis was conducted using Pearson's correlation coefficient (r), with the summarized scales treated as quasi-interval variables. The purpose of the analysis is to examine the relationship between ESG integration and sustainable production practices. The results are presented in Table 9.

Table 9. Relationship between ESG integration and sustainable production practices

Indicator	ESG Integration	Sustainable Manufacturing Practices
ESG Integration	1.000	0.58 **
Sustainable Manufacturing Practices	0.58 **	1.000

Source: Original study. Note: ** $p < 0.01$.

The results of the analysis revealed a moderate, positive, and statistically significant correlation between ESG integration and sustainable production practices ($r = 0.58$, $p < 0.01$). This indicates that companies with higher ESG integration index scores generally report higher sustainable production practice scores. However, the identified relationship is correlational and does not allow for causal conclusions. To support the analysis and present the correlation in regression format, a simple linear regression model was applied. Its purpose is to evaluate the extent to which the ESG integration index is statistically related to the sustainable production practices index within the study sample. This model does not change the focus of the study and does not introduce a causal interpretation.

The results of the simple linear regression analysis are presented in Table 10.

Table 10. Simple linear regression model for the statistical relationship between ESG integration and sustainable production practices.

Variable	Non-Standardized Coefficient	Standard Error	Standardized Coefficient	t -Statistics	p -Value
Constant	1.695	0.223	-	7.59	<0.001
ESG Integration Index	0.543	0.063	0.580	8.66	<0.001

Note: Model Summary: $R^2 = 0.336$; adjusted $R^2 = 0.332$; $F(1, 148) = 75.03$; $p < 0.001$. Dependent variable: Sustainable Production Practices Index. Source: Original study.

The non-standardized coefficient shows the expected change in the dependent variable when the independent variable changes by one unit. The standardized coefficient shows the strength of the relationship.

The results of the simple linear regression model indicate a positive, statistically significant relationship between ESG integration and sustainable production practices. The non-standardized coefficient shows that an increase of one unit in the ESG integration index is related to a rise of approximately 0.54 units in the sustainable production practices index. The standardized coefficient, $\beta = 0.580$, indicates a moderate to strong positive relation between the two indexes.

The model explains approximately 33.6% of the variation observed in the sustainable production practices index. These results suggest that ESG integration is significantly related to sustainable production practices within the studied sample. Due to the cross-sectional design of the study and the use of self-reported survey data, conclusions can only be made about the existence of a statistical relationship.

4.7. Overall Assessment of the Indexes

To highlight certain aspects of the relationship between “ESG practices and sustainable production”, four indexes have been developed. They reflect the level of ESG integration, sustainable production practices, as well as the challenges and opportunities associated with them. The results, summarized in Table 11, allow for a comprehensive assessment of the studied areas.

Table 11. Summary of the average values of the indexes.

Index	Range of Possible Values	Actual Average
ESG Integration	1.00–5.00	3.47
Sustainable Manufacturing Practices	1.00–5.00	3.58
Challenges	1.00–5.00	3.45
Opportunities	1.00–5.00	3.91

Source: Original research.

In summary, ESG integration and sustainable production practices are at a relatively high level in the studied companies, but with clear differences between the individual components. Those aspects directly related to management commitment, human resources policies, energy efficiency, waste reduction, and workplace safety are more developed. Less developed remain ESG policies, reporting, circular practices, supplier requirements, and the adoption of clean technologies. In addition, company size emerges as an important differentiating factor. Meanwhile, a moderate correlation is observed between ESG integration and sustainable production practices.

5. Discussion

The results provide a clear representation of the integration of ESG criteria and sustainable production practices within the surveyed companies. Overall, there is a relatively high degree of both ESG integration and the implementation of sustainable production practices. However, the breakdown by individual components shows that the process is not uniform and does not progress with equal intensity across all areas. This inconsistency is particularly significant because it shows that ESG does not function as a unified system, but rather as a set of partially developed managerial, social, and production practices.

Such an interpretation is consistent with some academic research, according to which sustainability in companies often develops in stages and asymmetrically. Consequently, it is easier to implement practices with direct operational or reputational implications than complex internal management and reporting systems [11,13]. The study found that higher scores were reported regarding senior management commitment and human resources policies, while lower scores were for ESG policies, internal procedures, and reporting. This suggests that companies may be more inclined to initially view ESG as a value and/or management philosophy rather than as a fully structured system with clear monitoring and disclosure mechanisms. This perspective is logically consistent with some research in the field of ESG integration. These studies demonstrate that the lack of internal procedures, clear responsibilities, and sustainable mechanisms for non-financial reporting often hinders the transformation of ESG from an intention into a stable organizational practice [13,15]. The survey data show that sustainable production practices also exhibit internal differentiation. Practices related to energy efficiency, waste reduction, occupational health and safety, and staff training are more widely adopted. In contrast, lower scores are observed for circular practices, clean technologies, emissions control, and supplier requirements. In this context, practices that require a deeper transformation of the production model, technological investments, or a reorganization of supply chain relationships are

found to be less developed [57]. This view corresponds with contemporary understandings of sustainable production, according to which it is a multifaceted process. Its more complex dimensions are more difficult to implement compared to basic measures for resource and production discipline [9,10].

The analysis shows a clear upward trend. The large companies reported higher scores on both the overall ESG integration and sustainable production practices indexes. This result suggests that organizational size is related to greater administrative, financial, and expert capacity for implementing formal policies, procedures, reporting mechanisms, and technological solutions. This interpretation aligns with research indicating that larger companies tend to have more advanced ESG systems and greater reporting transparency [45,47]. They also face stronger pressure from regulators, customers, suppliers, and financial institutions. However, these results should not be interpreted as evidence that the size determines ESG integration or sustainable production practices. More accurately, size is an organizational characteristic that may correspond to resources, expertise, reporting infrastructure, and participation in extensive value chains.

In terms of barriers, the results highlight a lack of financial resources, a lack of expertise, and limited administrative capacity as the primary challenges. In this context, the challenges to ESG integration are not primarily perceived as a matter of unwillingness or a lack of strategic understanding, but rather as a problem of resource availability and professional training. The prevailing view in the literature is that the transition to sustainable management and production models requires more than just compliance with regulatory requirements. It requires knowledge, internal organizational capabilities, and management infrastructure. And these are often in short supply, especially in smaller enterprises [11,15].

With regard to opportunities and incentives, the results show that companies in the manufacturing sector associate ESG integration with both regulatory requirements and improvements in corporate image, increased efficiency, and better stakeholder relations. It is worth noting here that ESG is not perceived solely as an externally imposed obligation, but also as a potential source of organizational benefits. On the one hand, ESG reports address transparency and accountability requirements. On the other hand, they are viewed in the academic literature as a tool for better governance, building trust, and identifying strategic opportunities [15].

The study found a relationship between ESG integration and sustainable production practices. This indicates that companies with more developed ESG policies, internal procedures, reporting, and stakeholder engagement more frequently implement sustainable production practices to a greater extent [9,13]. This finding is consistent with the perception that ESG can function as a management framework through which sustainability principles are incorporated into a company's internal processes. These results should be interpreted as an interrelated development of ESG integration and sustainable production practices within the companies studied without claiming that one variable directly causes the other.

From a practical standpoint, the results allow us to identify three levels of interpretation. First, the findings that are directly supported by the data show that ESG integration and sustainable production practices are not equally developed, with higher values observed among large companies. Second, the theoretical interpretation suggests treating ESG as a management framework that supports structured sustainability initiatives within companies. Third, the practical implications emphasize the importance of having different support policies for companies of various sizes and capacities. This differentiation is important because empirical findings should not be interpreted as recommendations or broader theoretical conclusions. While the data support the presence of differences and relationships, practical recommendations should be understood as conclusions derived from the analysis rather than as proven cause-and-effect relationships.

Limitations of the Study

This study has several limitations that should be considered when interpreting the results. First, the sample was selected through purposive sampling and voluntary participation. Therefore, the results cannot be generalized to all manufacturing companies in Bulgaria. Second, data were collected via self-report questionnaires, creating a risk of social response bias because respondents may present their companies' ESG and sustainable manufacturing practices in a more favorable perspective. Third, the cross-sectional design of the study does not allow for the establishment of causal relationships. Fourth, since ESG integration and sustainable manufacturing practices were measured using the same survey instrument, the risk of common-method bias could not be completely excluded. Finally, the study does not use externally verified indicators, such as actual data on emissions, energy consumption, certifications, audited ESG reports, or investments in sustainable technologies. Given these limitations, the results should be interpreted as empirical indications of the relationship between ESG integration and sustainable production practices within the studied sample, rather than as evidence of a causal effect or a nationally representative assessment of the entire manufacturing sector. Future research should employ broader samples, objective operational indicators, longitudinal designs, and models that control for variables such as firm age, ownership, export orientation, industrial sub-sector, and the presence of non-financial reporting.

6. Conclusions

This study aimed to evaluate the extent of ESG integration in the Bulgarian manufacturing companies and to examine its relationship with sustainable production practices. The analysis focused on the extent to which companies in the "Manufacturing" sector adopt and integrate environmental, social, and governance practices not merely as an external requirement for compliance and accountability. Concurrently, the study examines the extent to which these practices are embedded in internal management processes related to production activities, stakeholder relations, and the transition to more sustainable models.

The results indicate a relatively high but internally uneven level of both ESG integration and sustainable production practices. On the one hand, companies demonstrate greater readiness in terms of senior management commitment, employee policies, energy efficiency, waste reduction, and workplace health and safety. On the other hand, formalized ESG policies, internal procedures, non-financial reporting, circular practices, supplier requirements, and the adoption of clean technologies remain less developed. This suggests that ESG integration in the manufacturing sector is developing more as a gradual and partially institutionalized process rather than as a fully established management system.

A comparative analysis by company size reveals that large companies in the study sample report higher scores in terms of both overall ESG integration and sustainable production practices. These results are consistent with the perception that organizational capacity, resource availability, and the potential for a higher degree of formalization are linked to more advanced ESG initiatives. However, these results should be interpreted as an indication of an association rather than a causal effect.

Given the importance of sustainable production practices, it is particularly significant that a positive relationship was found between ESG integration and these practices. This finding supports the research hypothesis that a greater extent of ESG integration is linked to a greater implementation of sustainable production practices [9,13,15]. However, due to the cross-sectional design of the study and the self-reported nature of the data, the results should not be interpreted as indicating a cause-and-effect relationship.

Future studies should expand the scope of the analysis in several directions. First, by including a larger and more broadly sector-diversified sample. Second, by using a different research design that allows for tracking changes in ESG integration and sustainable production practices over time. Third, by combining survey data with objective indicators of non-financial reporting, investments in sustainable technologies, and actual environmental and social outcomes. Such an approach would allow for a deeper understanding of both the internal management approach of ESG integration and its actual relationship with production sustainability.

In summary, the results indicate that ESG integration can be viewed as a relevant management approach related to sustainable production practices in the Bulgarian manufacturing companies studied. To further develop this role, ESG should be understood not only as a reporting tool but as a management approach that integrates strategic priorities, internal processes, production practices, and stakeholder relations.

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Institutional Review Board Statement: Ethical review and approval were waived for this study because the research was based on anonymous survey data collected from professionals and organizational representatives, without involving sensitive personal data, medical intervention, or experiments involving human participants.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The aggregated data supporting the study's findings are presented in the article. Data at the level of individual survey responses are not publicly available due to confidentiality considerations regarding the participating companies and the anonymous nature of the survey.

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Appendix A. Survey Instrument and Measurement

Table A1 presents the structure of the survey instrument and the relationship between the individual indicators and aggregate indexes used in the empirical analysis. The table improves transparency by illustrating how the individual survey statements correspond to the results presented in the main part of the study.

Table A1. Structure of the survey instrument and measurement of aggregate indexes.

Aggregate Index	Indicator/Survey Statement	Scale
ESG Integration	The company has integrated ESG policies.	1–5
	Senior management is committed to ESG integration.	1–5
	The company has clearly defined ESG responsibilities.	1–5
	The company has established specific ESG goals and priorities.	1–5
	There are internal procedures in place to monitor ESG practices.	1–5
	Mechanisms for stakeholder engagement are maintained.	1–5
	ESG/non-financial reporting is a common practice.	1–5
	Social policies are implemented in human resources management.	1–5
Sustainable Production Practices	Energy efficiency measures are being implemented.	1–5
	Measures are being implemented to reduce waste.	1–5
	Resource optimization practices are implemented.	1–5
	Emissions control measures are being implemented.	1–5
	Circular economy practices are implemented.	1–5
	Clean technologies are being implemented.	1–5
	Healthy and safe working conditions are ensured.	1–5
	Staff training is being conducted on topics related to sustainability.	1–5
Challenges	Sustainability requirements apply to suppliers.	1–5
	The lack of financial resources hinders ESG integration.	1–5
	A lack of expertise hinders ESG integration.	1–5
	Limited administrative capacity hinders ESG integration.	1–5
	A lack of regulatory clarity hinders ESG integration.	1–5
	Low internal motivation hinders ESG integration.	1–5
Opportunities	Limited market pressure makes ESG integration difficult.	1–5
	ESG integration improves compliance with regulatory requirements.	1–5
	ESG integration is associated with a better image and reputation.	1–5
	ESG integration is associated with increased efficiency.	1–5
	ESG integration is linked to access to new markets and partners.	1–5
	ESG integration is linked to improved relationships with stakeholders.	1–5
	ESG integration is linked to risk reduction.	1–5

Appendix B. Additional Statistical Tests of Group Differences and the Main ESG–SPP Relationship

This section provides a summary of the additional statistical tests that support the descriptive results in the main text by providing a formal assessment of group differences and the relationship between ESG integration and sustainable production practices. The table illustrates the analytical purpose of the additional tests and explains how they are connected to the results presented in the main text.

Table A2. Relationship between descriptive results and additional statistical tests.

Additional Test	Purpose of the Analysis	Interpretation
One-Way Analysis of Variance	It examines whether the differences between small, medium, and large enterprises are statistically significant.	Supports a more precise interpretation of differences in size without making causal assumptions.
Simple Linear Regression Model	It assesses the statistical relationship between the ESG integration index and the sustainable production practices index.	Complements correlation analysis and limits the conclusion to a relationship within the study sample.

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