Ethnic particularities, national cultural values, and diverse workspaces play a mediating role in the effects of blockchain adoption on finance and entrepreneurship

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Abstract: - The activities and initiatives of corporate culture in relation to corporate blockchain transformation are examined in this paper. For ESG performance to be successful, entrepreneurship must always be able to adapt to changes in technological agility. Additionally, the disruptive features of blockchain are especially helpful in regions like the Western Balkans (WB), where widespread fraud and racial and cultural disparities necessitate open and reliable business practices. Cultural, social, and DEI corporate initiatives are also a popular and effective practice at WB. Thus, the following query is posed: is there a relationship, in a mediating role, between the performance of Blockchain adoption (BCA) and corporate social and cultural initiatives? A dataset of 780 WB and EU companies was used to test a serial mediation model, and the research conceptual model was validated (CFA) and fit evaluated (SEM). When corporate social and DEI initiatives act as mediators, we discovered a statistically sound (significant, positive) correlation between BCA and ESG success performance, particularly in the innovation and integrity ESG performance success indicators. This study contributes to the body of knowledge on corporate blockchain transformation, particularly for businesses looking to diversify their assets and skill set by investing in new international markets. Additionally, it advances our knowledge of the "social impact," or the relationship between business transformation and socioeconomic performance, as it relates to DEI initiatives.

Key-Words: - Fintech, Finance, Entrepreneurship, Blockchain, Diverse Workspace, National Cultural Values, Ethnic Particularities, Structural Equation Modeling (SEM).

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1 Introduction

While commercial activities rely on fidelity, trust, and transparency between all involved parties, the foundation of entrepreneurship has traditionally been established on the fundamental issue of proof in transactions, [1], [2], [3], [4], [5], [6], [7], and [8]. This proof is provided by blockchain technology (BCT), a disruptive distributed ledger technology that reduces fraud and cyber hacking, facilitates knowledge and data sharing among stakeholders, introduces smart contracts, and eliminates brokers, agents, and middlemen, [9], [10], [11], and [12]. Because BCT uses cryptographic techniques to enable secure digital signatures and timestamping, it makes it more difficult for malicious actors to manipulate or forge digital assets or transactions, which fosters trust and transparent management, [13], [14], [15], [16], and [17]. Participants in the metaverse ecosystem benefit from increased faithfulness, trust, and confidence as a result, [18], [19], [20], [21], and [22]. As a result, entrepreneurship management now faces the challenge of corporate BC transformation, [23-30].

Evaluating performance progress is challenging due to the absence of standard metrics. As a result, companies frequently lack the tools necessary to access data and track information effectively and consistently, which raises concerns about trust in their earnings reports, [31-44]. The recently proposed ESG (Environmental, Social, Governance) entrepreneurship approach has the potential to generate value, assess performance, and report sustainability, according to, [22], [30], and [39]. Therefore, KPIs (Key Performance Indicators), [20],

[22], [24], [25], [35] are an alternative to ESG theory's performance success dimensions, which are applied as sustainable entrepreneurship performance (SEP) metric indicators, [27], [28], [34], [38], [41]. According to [22], [35] all KPIs are business metrics, but not all business metrics are KPIs. As a result, business model metrics measure and track productivity, efficiency, quality, and quantity, [28], [32], [33], [34], [35], [36], and [37]. Modern businesses thus require both BC technology and ESG business model metrics assessment, as stated by, [30], [35], and [39]. Therefore, according to [4], [6], and [28], blockchain adoption (BCA) should be evaluated using ESG performance success indicators to be transparent and trustworthy (entrepreneurship blockchain ESG compliance transformation).

BCT can offer unchangeable certification, automated reporting on commitments, and information about an organization's ESG performance tracking. Like this, businesses can keep an eye on quality, track products, and assess services along their supply chains, [6], [19], [26], [27], [29], [43], and [44]. The results obtained from the ESG metric indicators can then be stored on a blockchain, where all the data will be permanently stored. Smart contracts can then be used to share these unchangeable key ESG performance findings with stakeholders in a reliable, transparent, and effective manner, [30], [35]. A challenge for entrepreneurship management is the requirement for trust and transparency in ESG business model metrics and reporting, which reveals the role of BCT, [1], [3], [8], [15], and [28].

Moreover, BCT is linked to corporate social, cultural, and environmental activities as well as DEI (Diversity, Equity, Inclusion) initiatives because of traceability, autonomous agreement enforcement, and dependability (decentralization, transparency, visibility, and immutability), [3], [8], [11], [13], [16], and [17].

In the culturally and ethnically diverse Western Balkans (WB) region, this is especially important for preserving the origin's designation, which is an important form of geographical indication, [45], [46], [47], and [48]. The performance of BCA and SEP as determined by ESG success indicators (business model metrics) may therefore be significantly mediated by environmental, cultural, and social corporate activities as well as corporate culture DEI initiatives, [49-59]. Trust, openness, creativity, and integrity are necessary for ethnic affairs, equity and ethics issues, and corporate sustainability. BCT is therefore a crucial instrument in this field, [51], [52], [54], [55].

Additionally, companies may be held accountable for their environmental, cultural, and social activities as well as DEI initiatives using ESG performance success metrics for CSR, green, innovation, and integrity, [27], [49], [57], [59]. Additionally, using BCT visibility and traceability applications helps retailers deal with ethical and cultural differences, resolve problems, answer questions, and confirm the authenticity of their products, [53], [55], [57], [58]. For instance, in WB, if a local farmer recalls their milk product because of a flaw (e.g., filthiness), a vendor can use BCT to find and remove the impacted foods and products, [47], [48]. The origination and nomination of unique items, like regional food-related products, can be efficiently monitored and protected by BCT, [14], [15], [26], [38].

1.1 Research questions

Given the earlier discussion of the relationship between BCA and SEP, green corporate practices, and corporate culture, it is imperative to assess the reliability of these associations. Thus, this article's main goal is to evaluate the correlation's statistical significance by answering the following four research questions in light of the structural (inner) model fit assessment.

Through the mediating functions of corporate culture initiatives (CCI) and environmental, cultural, and social corporate activities (ECSA), the study seeks to investigate the relationship between blockchain adoption (BCA) and SEP. Four main questions serve as the research's compass. There are few empirical studies that look at the relationship between BCA and firm performance for a wide range of firms, and the theoretical mechanisms by which BCA influences firm performance are not well understood [18], [22], and [35].

This served as the inspiration for our initial RQ, "*Does BCA improve a firm's ESG performance?*". This inquiry investigates whether implementing blockchain technology directly improves a company's ESG performance metrics, including

financial, operational, quality, CSR, green, innovation, and integrity performance. By increasing supply chain efficiency and reducing operating costs, for instance, BCA can produce instant performance gains, [3], [4], [40], [41]. Adopting BCT, in our opinion, can also open more growth prospects for a business, which raises expectations for its performance in the future, [1], [6], [38]. According to [18], [19], [22], [24], and [28], the advantages of adopting BCT may vary depending on how successfully a business integrates BCT into its operations and the racial and cultural composition of the business environment in which it operates.

Thus, "*How do ECSA activities affect (mediate) the link between BCA and a firm's ESG performance?*" became the second RQ. This inquiry looks at whether a company's involvement in social, cultural, and environmental initiatives enhances the effect of BCT on ESG performance. In the case of a BCA, we specifically examine the relationship between a company's long-term ESG performance metrics and its intangible ECSA dynamism.

Furthermore, for the third RQ, "*How does CCI affect (mediate) the link between BCA and ESG performance?*" we examined the role of CCI initiatives as a mediator between BCA and SEP. This RQ focuses on the role of CCI initiatives, such as DEI, in enhancing the relationship between BCA and ESG performance.

To answer the fourth RQ, "*How do ECSA activities and CCI initiatives influence BCA impact on ESG performance?*" we finally looked at a chain mediation, in which the ECSA acted as an intervenor between CCI and SEP and the CCI acted as a mediator between BCA and SEP. This research question investigates how ECSA and CCI work together to mediate the relationship between BCA and ESG performance.

Utilizing the traditional Structural Equation Model (SEM) approach, we evaluated the structural model fit to determine the values of the standardized path coefficients (BCA to SEP via ECSA and CCI) to respond to these four RQ. Therefore, answering the following four RQs is the main goal of this article.

RQ1: Is BCA an effective channel to support SEP?

RQ2: Do ECSA activities mediate positively the relationship between BCA and SEP?

RQ3: Does CCI initiatives positively mediate the relationship between BCA and SEP?

RQ4: Are ECSA activities productive intervenors between CCI initiatives and ESG performance?

Additionally, the benefits of BCT may vary according to the firm's age (i.e., incorporation date), location, size, and nature of the business, [18], [22], [29], [30]. Through the CCI mediator factor, we aim to understand the indirect effects of the independent control variables (corporate features) of age, size, industry, and country of business on the ESG performance metrics of a company that has implemented BCT, [8], [19], [43], and [44].

1.2 Research purpose

[1], [3], [5], and [17] state that while the benefits and advantages of BCT in corporate management and entrepreneurship performance have received increasing attention in recent literature, the practical applications of BCT are still in their early stages. The incorporation of BCT into entrepreneurship as a means of enhancing ESG performance is not particularly highlighted in the literature that is currently available, [22], [27], [29], [30], and [35]. Using smart contracts, lowering fraud and cyberbanking, facilitating same-data and knowledge sharing, and minimizing cultural and ethnic disparities are just a few of the ways that this integration may help, [51], [52], [54], [56], and [58].

To fill this gap in literature, this study will investigate how BCT may contribute to sustainable entrepreneurial performance through the mediating role of green corporate activities and DEI initiatives. Additionally, it will explore ethnic variations and issues within the WB region, as well as cultural influences, [45], [47], [48], [53], [55], and [59].

As new democracies in a poor part of Europe with numerous corruption issues, entrepreneurship in WB developing nations faces numerous obstacles, including lack of trust, corruption, bureaucracy, and restrictions on international markets and loans [46], [47]. These limitations in entrepreneurship performance become more apparent when corporate strategy incorporates sustainability, according to [27], [34], [39], and [41]. Small and medium-sized businesses' (SMEs') BCA presents a major obstacle in this area, [18]. In WB, a study by [45-48] looked at how BCA affected business performance. According to the results, new businesses, as opposed

to established ones, see a greater impact on their performance because of implementing BCT. The use of cutting-edge technologies to address the internal economic problems of developing countries is clearly a natural tendency, [47].

Scholars like [49], [50], and [56] have studied the importance of cultural and ethical values in the context of corporate strategic planning in great detail. According to a recent study by [35], putting BCT into practice may influence a company's corporate management's operational facets. Financial performance and a diverse corporate workplace are positively correlated, according to [39], [41], and [48]. There is currently no published literature that examines the dynamics of BCT adoption on sustainable entrepreneurship performance, specifically considering the influence of national cultural values, ethnic characteristics, and diverse work environments, even though prior research has examined the impact of business coaching and training on various aspects of corporate functioning, [18], [25], [28], [44].

By putting forth a conceptual framework for researching these factors, this paper seeks to close this research gap. Adopting innovative strategies becomes increasingly important in the WB region the more opaque or vulnerable to corruption the situation is. Under these circumstances, BCT shows itself as a viable remedy for the problem of incorporating entrepreneurial performance into corporate management. The present study investigates the possible effects of BC's decentralized structure on organizational supervisory mechanisms, particularly regarding the connection between BCA and business performance. Based on the knowledge that the removal of middlemen and the unchangeable nature of data made possible by BCT may have an impact on organizational supervisory procedures, this assumption was made. In contrast, it is hypothesized that by promoting transparency and trust, the use of BCT as a framework for digital currency infrastructure may influence a company's operational efficiency.

By analyzing the effect of BCA on SEP within the framework of the ESG business success model, the study aims to fill a gap in the body of existing literature. Specifically, the study aims to: (i) assess the direct correlation between BCA and SEP (i.e., determine whether BCA directly improves ESG performance metrics); (ii) explore the mediating roles of ECSA (i.e., investigate how ECSA influences the relationship between BCA and ESG performance); (iii) analyze the mediating role of CCI (i.e., examine how DEI initiatives impact the link between BCA and ESG performance); (iv) evaluate the combined mediating effects of ECSA and CCI (i.e., assess how ECSA and CCI together influence the relationship between BCA and SEP); and (v) understand the role of corporate features as control variables (i.e., analyze how company age, size, type of industry, and geographic location affect the relationship between BCA and ESG performance).

In regions like the WB that are culturally and ethnically diverse, the study seeks to shed light on how BCT, when paired with CCI initiatives, can promote SEP. Thus, this work's main goal is to put forth a theoretical framework that investigates how BCT affects ESG corporate governance, paying particular attention to the mediating functions of ECSA and CCI. The results of this study may be useful to managers who use the ESG theory.

1.3 Paper's structure

This work is organized as follows in the sections that follow. The theoretical underpinnings of BCT and its effects on SEP (based on ESG metrics) are summarized in Section 2 (Theoretical foundation). Furthermore, the role of the CCI initiatives and the ECSA activities as mediators is examined. In Section 3 (Method), the paper discusses the conceptual framework, research methodology, data topics, and hypotheses related to the dynamics of adopting BCT. A thorough CFA and SEM analysis of the results is presented in Section 4 (Results), which also introduces the research instrument (questionnaire). Section 5 (Discussion) goes into a detailed discussion about the research findings. Lastly, this empirical investigation concludes with Section 6 (Conclusions).

2 Theoretical Foundation

2.1 BCA and SEP

According to the BC transformation concept for entrepreneurship, the BCA has the potential to drastically change organizational capabilities and processes, which will enhance value creation and improve firm performance, [12], [19], [40]. By improving the flexibility and agility of SEP, BCA can

give businesses a competitive edge that increases their potential earnings and provides a sustained competitive advantage, [32], [33], [40]. BCA dynamics and ESG/SEP metric indicators are therefore the two primary components of the suggested measurement model, [39], [48].

BCA dynamics. The seven indicators (BCT functionality dimensions) that our conceptual framework incorporates into the BCT adoption component strengthen the BCA dynamics (transparency, knowledge sharing, same-data sharing, smart contract utilization, cyber-hacking protection, fraudulence suspension, and fidelity-integrity-trust). TRA, DCE, KNS, SCU, IAB, FRS, and TAT are independent observed variables, according to our definition.

ESG/SEP metric indicators. We considered the three factors of ESG theory as a strategy for sustainable corporate practices. Hence, our corporate performance evaluation approach apart from the typical financial and operational practices and procedures (i.e., the *G* in ESG, governance criteria) considered the role of the environment like green corporate (i.e., the *E* in ESG; environmental criteria as an observed variable affected by corporate environmental disclosure activities as a responsibility to the society), and the role of the social initiatives like CSR (i.e., the *S* in ESG; social criteria as an observed variable affected by CCI activities), [39].

Relationship between BCA and CSR performance. According to the study, there is a favorable correlation between BCA and CSR performance, especially when ECSA and CCI initiatives are involved. This relationship can be explained in detail below:

(a) Direct impact of BCA on CSR performance

BCT offers features such as transparency, traceability, and immutability, which directly enhance CSR performance by enabling companies

- to ensure "transparency" (e.g., BCT provides a transparent and immutable record of transactions, allowing companies to demonstrate their commitment to ethical practices and accountability;
- to enhance "trust" (e.g., by ensuring data integrity and reducing fraud, BCT builds trust among stakeholders, including customers, employees, and communities); and
- to support "CSR initiatives" (e.g., BCT can track and verify CSR activities, such as donations, environmental impact, and social programs, ensuring that companies meet their commitments).

(b) Indirect impact through ECSA

ECSA activities act as a mediator between BCA and CSR performance. BCA strengthens CSR performance by:

- enabling companies to engage in social development activities (e.g., BCT facilitates the tracking and reporting of philanthropic and voluntary initiatives, ensuring their effectiveness and transparency);
- respect client and employee rights (e.g., BCT transparency and traceability help companies uphold consumer rights and ensure fair treatment of employees); and
- support local communities (e.g., BCT can be used to monitor and verify contributions to local communities, such as financial support for education or environmental sustainability projects).

(c) Indirect impact through CCI

CCI initiatives also mediate the relationship between BCA and CSR performance. BCA enhances CSR performance by:

- promoting diversity and inclusion (e.g., BCT can help ensure fair hiring practices and equitable treatment of employees, which aligns with CSR goals);
- fostering equity (e.g., BCT transparency can help companies demonstrate their commitment to equity and fairness in their operations); and
- encouraging inclusion (e.g., BCT can support initiatives that value cultural and ethnic diversity, contributing to a more inclusive corporate environment).

Findings. The study found that the relationship between BCA and CSR performance is statistically significant when mediated by ECSA and CCI. This suggests that BCA alone may not fully realize the potential for CSR performance improvement, but when combined with ECSA activities and CCI initiatives the impact is amplified.

Practical implications. Enhanced reporting (e.g., BCT enables companies to provide transparent and verifiable reports on CSR activities, improving stakeholder trust and engagement); improved accountability (e.g., immutable records ensure that companies are held accountable for their CSR commitments, reducing the risk of greenwashing or unethical practices); and strengthened community relations (e.g., by supporting local communities and

respecting cultural and social values, companies can use BCT to align their CSR efforts with broader societal goals).

In summary, BCA positively influences CSR performance by fostering "transparency", "trust", and "accountability", and its impact is further enhanced when combined with ECSA activities and CCI initiatives.

To rate a company's SEP performance, we outline seven ESG indicators as accounting and qualitative performance metrics: financial performance, operational performance, quality and supply-chain performance, CSR performance, green corporate performance, innovation performance, and integrity performance. Finally, we declare these seven SEP performance indicators as dependent observed variables represented by the symbols: FIP, OPP, QSP, CSR, GCP, IVP, and IGP.

According to the seven ESG performance metrics (dependent observed variables), BCA may show a positive correlation with SEP. As a result, the following initial hypothesis could be developed: "*BCA has a favorable influence on the performance of sustainable entrepreneurship.*" (i.e., an RQ1 domain statistical correlation that is positive).

2.2 ECSA as a mediator between BCA and SEP

Finding, assessing, and seizing opportunities in a company's external environment are critical elements [22], [48]. The human capital, routines, processes, and practices of businesses are all included in the intangible capital of the external environment, [35].

Companies with more intangible assets are more likely to successfully integrate BCT into their business operations and benefit from the many advantages it provides for commercial purposes in terms of agility, efficiency, and performance, [8]. It is commonly acknowledged that the acquisition and integration of new knowledge into a firm's existing knowledge base depends on intangible capital. Within this field, we identified ECSA activities as intangible assets, [58], [59]. Four metric entities (staff and laborer habits, clients and customs values, ethnic communities' customs, and power consumption reduction) and four independent observed indicators (SLH, CCV, ECC, and PCR) were used to define the ECSA activities. Furthermore, the facilitation of ECSA mediating can be improved by producing synthetic (artificial) data that mimics the features of real-world data, particularly for simulating social media events, [48].

Because ECSA intangible capital acts as a mediator, it is expected that BCA companies will benefit from better ESG performance success metrics. With the mediating role of ECSA, the second hypothesis could be stated as follows: "*The BCA has a positive impact on SEP performance.* " (a positive statistical correlation into the RQ2 domain).

2.3 CCI as a mediator between BCA and SEP

Corporate culture encompasses social norms, biases, and behavior culture. Additionally, many organizations that strive to be supportive of various groups of people, including people of different races, ethnicities, cultures, religions, abilities, education, genders, and sexual orientations, share the DEI dimensions of diversity, equity, and inclusion.

Corporate ethics, according to [51-59], have a big impact on product quality by encouraging a culture of honesty, responsibility, and dedication to excellence. The following are specific corporate ethics functionalities:

Commitment to standards: Ethical companies prioritize adherence to high-quality standards and regulations, ensuring products meet or exceed customer expectations.

Transparency: Ethical practices promote transparency in sourcing materials, manufacturing processes, and quality control, reducing the risk of defects or substandard products.

Employee morale and engagement: Ethical workplaces encourage employees to take pride in their work, leading to greater attention to detail and higher-quality outputs.

Customer trust: Ethical behavior builds trust with customers, motivating companies to maintain consistent product quality to uphold their reputation.

Accountability: Ethical companies take responsibility for their products, ensuring they are safe, reliable, and meet promised specifications.

Sustainability: Ethical organizations often adopt sustainable practices, which can enhance product quality by using better materials and processes.

Long-term focus: Ethical companies prioritize long-term success over short-term gains, investing in quality improvements rather than cutting corners.

In conclusion, corporate ethics establish a basis for responsible decision-making, which directly affects the caliber of goods and services and cultivates consumer loyalty and trust, [54], [57], [59].

Below are examples of how BCA influences CCI.

"Promoting transparency": BCT provides an immutable record of transactions and activities, ensuring transparency in hiring practices, employee benefits, and decision-making processes. For instance, a company can use BC to track and verify fair hiring practices, ensuring that recruitment is free from bias and discrimination.

"Building trust": BCT ability to ensure data integrity and prevent tampering builds trust among employees, customers, and stakeholders. For instance, a company can use BC to demonstrate its commitment to ethical practices by providing transparent records of CSR initiatives, such as donations or environmental impact.

"Encouraging diversity": BCT can support diverse hiring practices by ensuring that recruitment processes are fair and unbiased. For instance, a company can use BC-based systems to anonymize candidate information during hiring, reducing unconscious bias and promoting diversity.

"Fostering inclusion": BCT can help create an inclusive environment by valuing cultural and ethnic diversity. For example, a company can use BCT to track and reward employees for participating in multicultural activities, such as organizing cultural events or supporting local communities.

"Enhancing equity": BCT transparency can help ensure equitable treatment of employees. For instance, a company can use BCT to track and verify fair pay practices, ensuring that employees are compensated equally regardless of gender, ethnicity, or other factors.

"Strengthening accountability": BCT immutable records hold companies accountable for their commitments. For example, a company can use BCT to track its adherence to environmental sustainability goals, such as reducing carbon emissions, and sharing this information with stakeholders.

"Improving collaboration": BCT facilitates knowledge sharing and collaboration across diverse teams. For instance, a company can use BCT to create a shared platform for employees from different departments to collaborate on projects, ensuring that all contributions are recognized and valued.

"Supporting ethical practices": BCT can help enforce ethical behavior by providing a transparent system for monitoring compliance with corporate policies. For example, a company can use BCT to track adherence to anti-corruption policies and ensure fair competition.

By incorporating accountability, transparency, and trust into organizational procedures, BCA changes corporate culture. By encouraging ethical behavior, improving teamwork, and supporting DEI initiatives, it eventually creates a more inventive and inclusive workplace, [49], [53], [54]. These adjustments may result in better decision-making, increased employee engagement, and a more reputable company worldwide, [56], [57], [59].

Businesses that are inclusive, equitable, and diverse are better equipped to handle obstacles, attract top talent, and satisfy the demands of various clientele, [55]. "Diversity" refers to the awareness and comprehension of personal distinctions. The review of the literature demonstrates a correlation between business performance (e.g., Tobin's Q, return on equity/ROE, return on assets/ROA) and diversity. "Equality" refers to establishing a more equitable workplace by giving every employee the chance to maximize their potential. Diversity and equality are predicated on "Inclusion.". Creating a welcoming environment is a key component of inclusivity, [55], [57], [58]. Because businesses in the top quartile outperformed those in the fourth quartile by 39% in 2024, there is a compelling business case for ethnic and cultural diversity. Interestingly, ethnic diversity still has a higher chance of outperforming compared to gender diversity, [51], [52], [55], [57].

Following earlier research on dynamic business and market dynamics, [18], [19], and [21], we use the three DEI indicators as CCI dynamics because they can improve a company's visibility, performance, innovation functionality, and trust, and they can help organizations take advantage of opportunities in uncertain environments like the WB region, [47], [48]. Therefore, "diversity," "equity," and "inclusion" are defined as independent observed variables (D, E, I) and described as indicators in CCI initiatives in our conceptual framework.

As a result, the third hypothesis might be stated as follows: "*Corporate culture initiatives act significantly and positively as a mediator in the association between BCA and firm performance, specifically in terms of ROE, ROA, Tobin's Q, CSR, quality performance, green performance, innovation, and integrity*" (a positive statistical correlation into the RQ3 domain).

2.4 Research aim

The three hypotheses, as initially approached above, describe a positive correlation between the BCA and firm's performance as defined by the ESG theory. Hence, this study investigates, as the main research aim, the statistically significant correlation between BCA (considered as "*corporate blockchain transformation"*) and SEP in WB region and Eurozone experimental domain. Additionally, the intangible influence of both the ECSA activities, and the CCI initiatives is examined as a mediating factor between BCA dynamics and ESG performance success indicators.

Consequently, the main research aim is defined as "*Examine the impact of BCA on SEP, in compliance with the ESG business success model, through the mediating roles of ECSA activities and CCI initiatives.*"

3 Method

In this Section, we present the methodology and the statistical tools that will allow us to draw statistically significant conclusions about the impact of BCA on ESG performance success indicators. Subsequently, in the next Section ("Results") we will discuss real measurements from a questionnaire for companies located in EU and WB.

3.1 Questionnaire sampling design

We collected targeted corporate data from a questionnaire (refer to Appendix A for further details) which sampling design and construction followed the methodology outlined in previous studies, [60-66]. Additionally, it adhered to the guidelines provided by the University of Macedonia (Thessaloniki, Greece), which focuses on economic and social sciences.

3.2 Research methodology – CFA validity, and reliability & SEM fit assessment

We utilized the classical partial least squares structural equation model (PLS-SEM) method to analyze and evaluate the proposed conceptual path model (Figure 1). The PLS-SEM is a method for structural equation modeling that allows, in path models with latent constructs, the estimation of complex cause-effect relationships, [61], [62].

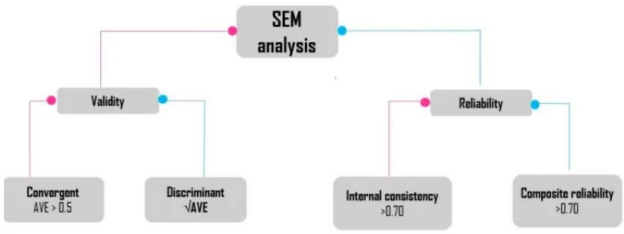


Fig. 1: SEM analysis (validity, reliability).
Source: created by the author

According to [64] PLS-SEM is a robust multivariate technique increasingly used in scientific research to examine and assess causal relationships among multiple variables. According to [61], [62] the PLS-SEM is indicated in cases where the phenomenon to be considered (e.g., BCA) is relatively new and an outer model needs to be introduced with many latent constructs and items (observed variables).

The PLS-SEM method encompasses two primary components: (a) the outer (measurement) model, which is employed to assess latent constructs and investigate the association between these constructs and their observable indicators (variables) as entities that are measurable with a battery of items; and (b) the inner (structural) model, which encompasses the relationships between the latent constructs and evaluates all hypothetical dependencies using path analysis for fit assessment.

Figure 2 presents the proposed outer model. In our theoretical concept design considerations, the BCA functions as reflective constructs are interchangeable and removing/adding an item does not change the conceptual BCA's domain. Additionally, the "BCA" reflective latent SEM construct operates as an independent variable, while the "SEP" formative latent SEM construct is a dependent one acting as a correlated mirror.

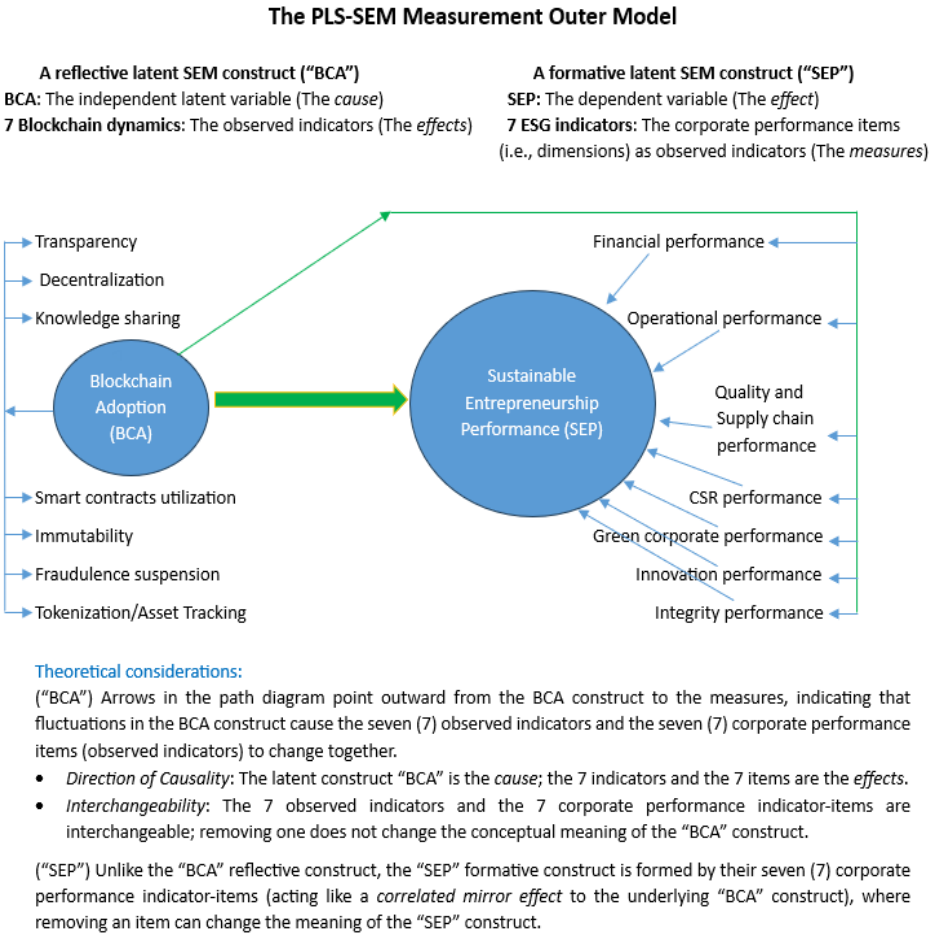


Fig. 2: The proposed PLS-SEM outer (measurement) model.
Source: created by the author

Path analysis (PA) and confirmatory factor analysis (CFA) are two validation analysis methods that are combined in SEM. CFA was created in the field of psychometrics and is used to estimate psychological constructs that are not readily apparent, like attitude and satisfaction. By creating path diagrams, PA, which has its roots in biometrics, is used to determine the causal relationships between variables. The SEM expands on PA's capabilities by allowing links to be established between latent variables. Rather than being directly observable, these latent variables are inferred by their impact on observable variables that are observed and documented, such as corporate dimensions, features, and BCT dynamics. These variables are typically measured using questionnaire/survey scale items as a set of response options for specific closed-ended performance questions.

3.3 Proposed conceptual model

We started a SEM methodology with control, latent, and observable variables for the suggested validation model "*BCA impact on ESG performance with ECSA and CCI mediation.*". In particular, the suggested model confirms the validity of the constructs, the consistency and coherence of the questionnaire (*reliability test*), the meaningful relationships between the latent-observed variables (*constructs reliability test*), and the constructs' distinctiveness (*validity test*). The path analysis of the suggested conceptual model with a double mediation is shown in Figure 3. The path analysis relationships have both direct and indirect effects. The company's common features, key features, and common types function as independent control variables, and ECSA and CCI act as mediators between the "BCA" and "SEP" SEM constructs.

Fig. 3: The proposed conceptual framework with path analysis. *Source: created by the author*

Company's common features: age, size, type of industry, and country.

Company's key features: separate legal entity, limited liability, artificial legal person, and incorporated association.

Company's common types: private limited company (restrictions on share transfer) and public limited company (shares can be publicly traded).

3.4 Abstract concepts, latent constructs, and observed SEM indicators

The establishment of an "*abstract concept"* is typically accomplished through a conceptual definition (e.g., definitions for BC functionality, SEP performance, ECSA activities functions, and CCI initiatives functions). Additionally, in the context of SEM, "*latent constructs*" pertain to the depiction of *abstract concepts* within a specified statistical model, and they are regarded as *latent SEM variables* (e.g., BCA, SEP, ECSA, and CCI) due to their unobservable nature and inability to be directly measured. *Latent constructs* possess qualities that cannot be quantified, yet their existence can be deduced by examining fluctuations in "*observable SEM indicators*" operated as metric entities or measures (e.g., seven BCA dynamics, seven ESG items, and ECSA and CCI features with measurement functionality), [35], [39].

Figure 4 displays, in the four ovals, the proposed four *latent constructs* designed for four *abstract concepts* and the relative *observed SEM indicators* operated as metric entities.

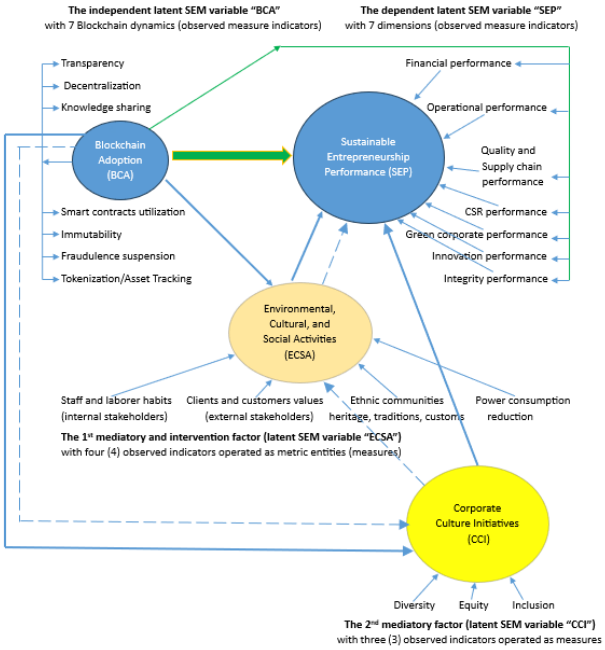


Fig. 4: PLS-SEM: The four latent constructs and their observed indicators. *Source: created by the author*

3.5 Conceptual model's evaluation

The proposed conceptual model's evaluation was achieved by performing descriptive statistics and outer model's validation (i.e., validity test for *accuracy* and reliability test for *consistency*). Particularly, we assessed the questionnaire's *consistency* and *coherence* (i.e., how distinct from one another the latent constructs and the observed SEM indicators are). Thus, the reflective outer model was tested for internal consistency reliability using Cronbach's a coefficient criterion as our preference vs. the composite reliability criterion because the topic under consideration is new and undocumented, [65]. Additionally, we considered composite and internal consistency reliability through the utilization of CFA analysis, which serves the purpose of verifying the unidimensionality of the proposed reflective model (see Table 4).

Subsequently, we considered constructs' validity (i.e., how meaningful the relationships between the latent constructs and the observed SEM variables being measured are). We accomplished constructs' validity by performing both convergent and

discriminant validity tests. Particularly, to establish that the constructs within the conceptual model are distinct from one another in an empirical sense, we conducted discriminant validity analysis (DVA) using the Fornell and Larcker criterion because the topic under consideration is new and undocumented (see Table 5).

In the context of the inner model, a statistical technique known as "path analysis" was employed to examine and evaluate the theoretical relationships posited by the conceptual model under consideration (see Table 6).

3.5.1 Descriptive statistics

3.5.1.1 Normality distribution statistics (Mean, Std, Median, Skew, Kurtosis)

We examined the statistical measures of normality distribution, including the mean, standard deviation, median, skewness, and kurtosis, [66]. Skewness and kurtosis statistics were utilized as measures to assess the adherence of a distribution to the normality assumption. *Skewness statistics* were employed to assess the symmetry of a distribution. In contrast, the *Kurtosis statistic* was employed to evaluate the extent of heaviness in the distribution tails. We detected that the research variables (latent and observed) distribution is normal as indicated by their skewness values falling within the range of -2 to 2, as presented in Table 3.

3.5.1.2 Multi-collinearity statistics (Tolerance, VIF) The statistical measures of multi-collinearity, namely tolerance and variance inflation factor (VIF), are also of interest in the conceptual model's assessment. The presence of multicollinearity in the independent variables dimensions was assessed by employing the variance inflation factor (VIF) and the tolerance variant statistics (Tolerance).

Table 3 shows the tolerance coefficient, lower than the threshold of 1, indicating an important level of multicollinearity. Additionally, the tolerance coefficient was higher than the significance level of 0.05, suggesting that the independent variables are not highly correlated. Furthermore, all three values of the VIF were observed to be less than the threshold of 10, indicating that multicollinearity is not a significant concern in the model.

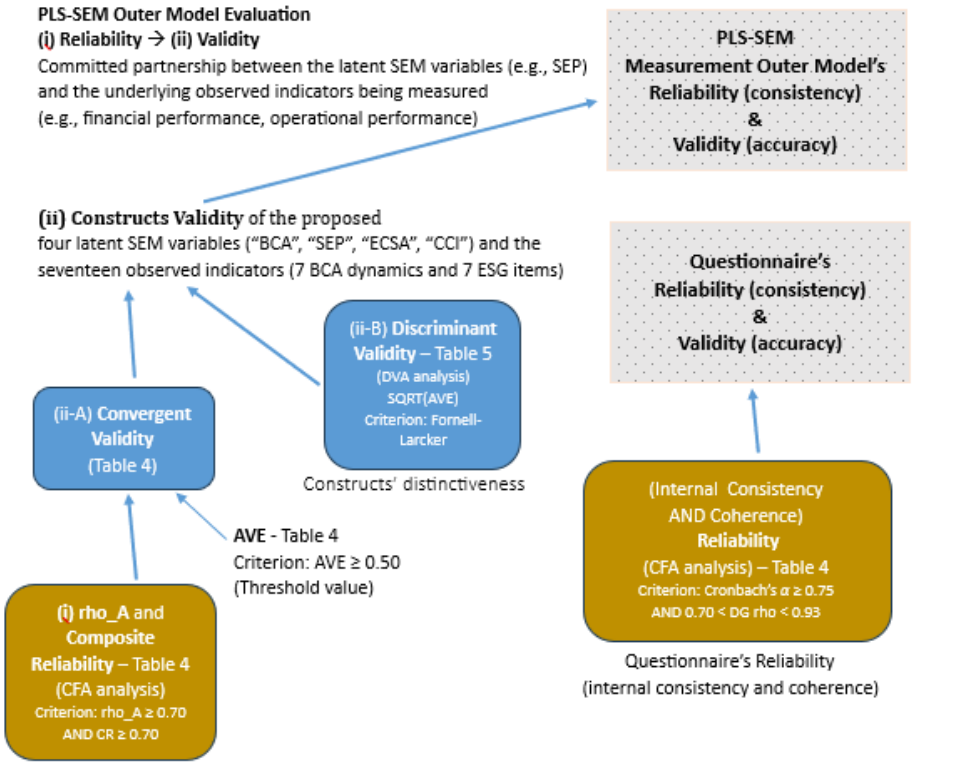
According to previous studies, [60], [61], and [64], if the findings indicate the absence of multi-collinearity among the various dimensions, this implies that multiple regression analysis is a suitable method for examining the research hypotheses.

3.5.2 Outer model's validation

The SEM method offers valuable tools for conducting preliminary assessments of differential validity and reliability of measurement instruments across diverse demographic cohorts. The consideration of *reliability* and *validity* is of utmost importance in research design, procedures organization, and findings presentation, particularly in the context of quantitative research.

The assessment of research quality involves the application of *reliability* and *validity* as principles about how well a method measures something. *Validity* refers to the accuracy of a measure (i.e., whether the results really do represent what they are supposed to measure), and *reliability* refers to the consistency of a measure (i.e., whether the results can be reproduced under the same conditions), [62], [64].

Figure 5 presents the reliability and validity tests under the proposed reflective outer SEM model.



Notes: *Consistency*, *Coherence*, and *Validity* are distinct but interrelated *concepts* used to evaluate the quality of arguments, questionnaires, SEM models, and research.

- **Consistency** refers to the absence of contradictions within a system or text, ensuring that all parts are uniform, stable, and reliable.
- **Coherence** refers to how well the parts of a whole fit together to make sense, often implying a deeper logical connection or a shared, unified theme.
- **Validity** refers to whether an argument's conclusion logically follows from its premises, or whether a measure accurately assesses what it is intended to measure.

Consistency vs. Coherence: An argument can be *consistent* (no contradictions) without being *coherent* (lacking a meaningful connection). *Coherence* often requires a higher standard of integration, moving beyond just the absence of conflict to a "connected whole".

Validity vs. Consistency: A valid argument must be consistent, but a consistent argument is not necessarily valid.
Research Context: In research, *consistency* often relates to *reliability* (consistent results over time), while *validity* indicates *accuracy*.

Fig. 5: Questionnaire's and conceptual model's reliability (consistency) and validity (accuracy).
Source: created by the author

3.5.2.1 Validity test

The degree to which the gathered or examined dataset appropriately captures the pertinent data is linked to the evaluation of the research tool (questionnaire) as a dataset's validity. Validity must thus be established, and in this case, the model validity of a reflective measurement. According to [60], validity is the degree of accuracy in test results. In the context of the chosen PLS-SEM analysis, this statistical method provides important evidence to support the correct interpretation of the results, [64], [66].

(A) Outer model's validity. Measurement validity is the extent to which a research methodology's data or results (e.g., questionnaire) faithfully capture the intended concept (e.g., SEP). To guarantee the usefulness and applicability of the research findings in a variety of contexts, validity in methods and results must be established. As a result, we investigated the reliability and reproducibility of the data collection techniques used (i.e., composite reliability). We performed the reflective measurement model's validation by assessing the construct validity for all constructs using CFA. Particularly, we investigated and evaluated the correlation between the four latent construct (BCA, SEP, ECSA, and CCI) and their corresponding 21 observed SEM indicators as measurement

determinants (7 BCA dynamics, 7 SEP dimensions, 4 ECSA indicators, and 3 CCI indicators).

CFA is a statistical method for evaluating latent variables that involves taking a latent construct out of a group of variables and figuring out which items have the most variance in common with it. CFA can also assist in standardizing the scale of various indicators, reducing the dataset's dimensions, and accounting for the data's innate correlations.

Construct validity refers to the degree to which a particular assessment accurately measures the underlying construct. It is about questionnaire soundness, i.e., how well a test measures the concept it was intended to evaluate. Therefore, in our SEM, construct validity examined the degree to which the set of 21 indicators accurately captures the conceptual idea ("BCA impact on ESG performance metrics") that cannot be measured directly.

Thus, we used construct validity, which is divided into two main categories (convergent validity and discriminant validity), to assess the evaluation's soundness. Documented evidence of these two types also supported construct validity.

(a) Convergent validity (CV), as measured by the average variance extracted (AVE), is an important aspect of assessing the validity of a measurement instrument in academic research. Convergent validity refers to the degree to which two measures that theoretically should be related, are in fact related. Criteria for convergent validity: Convergent validity pertains to the degree of correlation observed between the responses of distinct variables when evaluating a shared construct. Convergent validity is a statistical assessment that ensures the presence of a meaningful relationship between variables (e.g., CSR, innovation, integrity) and the underlying construct (e.g., SEP) being measured. Consequently, it is imperative for factors to exhibit a robust correlation with the underlying construct. To assess convergent validity, we evaluated the AVE value as the AVE technique is deemed suitable due to its ability to elucidate the extent to which items are jointly accounted for by constructs. To achieve validity, it is necessary for the AVE to have a value that is equal to or greater than 0.5.

(b) Discriminant validity (DV), also referred to as divergent validity, as a measure of validity was established to ascertain the distinctiveness of the constructs (e.g., BCA, SEP, ECEA, DEISI) and in SEM using PLS is usually evaluated by three informative approaches (criterions), the Fornell-Larcker, cross loading, and HTMT criterions. We chose the Fornell-Larcker criterion because the other two criterions are too sensitive to causal effects interpretation that does not fit in our traditional PLS-SEM case for evaluating a relatively new complex concept ("BCA impact on ESG performance metrics") with four latent constructs and 21 observed SEM indicators. DV examines the degree to which a latent construct shows distinctiveness from other latent variables in its capacity to predict the dependent variable, and it is crucial to ensure that all constructs exhibit empirical distinctiveness from one another. When evaluating the Fornell-Larcker criterion, [60], states that DV is present if the correlation coefficient values for each construct are less than the square root of their AVE value. As a result, in our approach, the AVE values of the constructs and the start of the correlations between the constructs provided proof that DV was present (see Table 5).

(B) Inner model's validity (fit assessment). A statistical method called path analysis was developed with the goal of evaluating the relationships between several variables quantitatively. PA was used to shed light on the causal relationships between the variables. Additionally, mediation (i.e., ECSA and CCI) is a frequently used component of PA that posits that a variable can influence an outcome both directly and indirectly by influencing another variable.

3.5.2.2 Reliability test

The concept of reliability pertains to the degree of consistency in measuring outcomes, as stated by [61], [63], and [64]. The measurement of reliability for any given dataset or construct can be categorized into three distinct forms, reliability of internal consistency, composite reliability, and reliability of external consistency:

(a) The reliability of internal consistency refers to the extent to which the items within a measurement instrument are consistent in measuring the same construct. This reliability can be assessed using

various methods, such as Cronbach's Alpha coefficient and CFA, [65].

The Cronbach Alpha coefficient was used as a measure of internal consistency and the Likert scale, widely recognized as the most employed method for assessing consistency, was adopted in our questionnaire. It is advisable that the level of reliability for an exploratory or pilot study should be at least 0.70 or higher. According to [64] and [65], reliability can be categorized into distinct levels based on the values obtained. An index of 0.90 and above is indicative of excellent reliability, while a range of 0.70-0.90 signifies high reliability. On the other hand, the range of 0.50-0.70 suggests moderate reliability, and values of 0.50 and below indicate low reliability.

(b) Composite reliability (CR) is a statistical measure used to assess the extent to which the variables that underlie constructs are effective in SEM and CFA is employed to assess the constructs' CR. The estimation of CR is derived from the analysis of factor loadings, as demonstrated by [15] and [153]. The build-reliability coefficient may exhibit a value exceeding 0.70. To attain construct reliability, it is necessary to have a value of CR ≥ 0.7.

(c) The reliability of external consistency evaluates the degree of consistency in the measurement of a variable across multiple applications or instances.

3.5.3 Conceptual model's validation and fit assessment

With respect to the above discussion, we performed the following validation and fit assessment process for the proposed "BCA impact on ESG performance metrics" conceptual model (see next Section "Results" for a detailed description).

(**A**) Descriptive statistics (normality distribution, multi-collinearity).

(**B**) Outer model's validity (accuracy) and reliability (consistency) test:

Step I. Questionnaire/research instrument's internal consistency reliability (Cronbach's alpha coefficient and Dillon Goldstein's rho). Cronbach's alpha coefficient and Dillon Goldstein's rho were used to evaluate the research instrument's consistency and coherence (see Table 4). As a rule of thumb Dillon-Goldstein's rho values higher than 0.70 suggest one-dimensionality and given that both indexes are larger than 0.7, it can be claimed that the research instrument (i.e., the questionnaire) has an acceptable reliability, [60], [61].

Step II. Construct reliability as indicated by the convergent validity (CR and AVE). The reliability of each construct and its scale items is acceptable when the composite reliability (CR) is ≥0.7 and the average variance extracted (AVE) is ≥0.5 (see Table 4).

Step III. Constructs' distinctiveness as measured by discriminant validity (SQRT(AVE)). The distinctiveness of the four constructs (BCA, SEP, ECSA, and CCI) is discovered by the DV analysis (see Table 5).

(**C**) Inner model's fit assessment. Inner model's assessment in SEM focuses on evaluating the significance and relevance of path coefficients, followed by the model's explanatory and predictive power:

Step IV. Research hypotheses assessment/construct paths (CP) (e.g., t-statistics, p-value). Results are reported in Table 6.

Step V. Research hypotheses assessment from measurement invariants through a control variable. Results are reported in Table 7.

Step VI. Comparative analysis (a) for the testing results of all the hypotheses (H01, H02, H03, and H04) as they projected on the seven success dimensions of the ESG model (financial success, agility success, quality success, social success, green success, innovation success, and integrity success); and (b) for the hypothesis H04 (the most successful setup) as it projected on the independent control variables of firm age, size, industry type, and country (see Table 8).

3.6 Research hypotheses

Study's primary hypothesis was developed as follows: *BCA has a statistically significant impact on ESG performance at the level (α≤0.05)*. A multiple linear regression analysis was performed to assess the main hypothesis. The predefined significance level (α) determines whether the null hypothesis (H0) is accepted or rejected. As the upper limit, a significance level (α) of 0.05 was selected. Therefore, a statistically significant effect will be seen when the level of significance is equal to or less than 0.05. On

the other hand, no statistically significant effect will be seen if the level rises above 0.05.

The primary hypothesis and the four RQ define the scope for the development of the main four hypotheses (H01, H02, H03, and H04) as follows:

First hypothesis: BCA governance strategy without ECSA activities, and CCI initiatives. The 1st hypothesis CP is defined as BCA → SEP and is formulated as follows: (H01) BCA has a positive impact on SEP.

Also, the following seven sub-hypotheses are proposed to further examine the BCT-SEP performance. H01a: In the H01 hypothesis CP, BCA has a positive impact on financial performance (FIP). H01b: In the H01 hypothesis CP, BCA has a positive impact on operational performance (OPP). H01c: In the H01 hypothesis CP, BCA has a positive impact on quality and supply chain performance (QSP). H01d. In the H01 hypothesis CP, BCA has a positive impact on CSR performance (CSR). H01e. In the H01 hypothesis CP, BCA has a positive impact on green corporate performance (GCP). H01f. In the H01 hypothesis CP, BCA has a positive impact on innovation performance (IVP). H01g. In the H01 hypothesis CP, BCA has a positive impact on integrity performance (IGP).

Additionally, considering the mediating role of the corporate ECSA activities, and the corporate CCI initiatives, the following three hypotheses and sub-hypotheses are proposed.

Second hypothesis: BCA governance strategy with environmental, cultural, and social activities. The 2nd hypothesis CP is defined as BCA → ECSA (mediator) → SEP and is formulated as follows: (H02) ECSA activities mediate positively in the relationship between BCA and SEP.

Also, the following seven sub-hypotheses are proposed to further examine the BCT-SEP performance when ECSA mediates. H02a: In the H02 hypothesis CP, BCA has a positive impact on financial performance (FIP). H02b: In the H02 hypothesis CP, BCA has a positive impact on operational performance (OPP). H02c: In the H02 hypothesis CP, BCA has a positive impact on quality and supply chain performance (QSP). H02d. In the H02 hypothesis CP, BCA has a positive impact on CSR performance (CSR). H02e. In the H02 hypothesis CP, BCA has a positive impact on green corporate performance (GCP). H02f. In the H02 hypothesis CP, BCA has a positive impact on innovation performance (IVP). H02g. In the H02 hypothesis CP, BCA has a positive impact on integrity performance (IGP).

Third hypothesis: BCA governance strategy with CCI initiatives. The 3rd hypothesis CP is defined as BCA → CCI (mediator) → SEP and is formulated as follows: (H03) CCI mediates positively in the relationship between BCA and SEP.

Also, the following seven sub-hypotheses are proposed to further examine the BCT-SEP performance when CCI mediates. H03a: In the H03 hypothesis CP, BCA has a positive impact on financial performance (FIP). H03b: In the H03 hypothesis CP, BCA has a positive impact on operational performance (OPP). H03c: In the H03 hypothesis CP, BCA has a positive impact on quality and supply chain performance (QSP). H03d. In the H03 hypothesis CP, BCA has a positive impact on CSR performance (CSR). H03e. In the H03 hypothesis CP, BCA has a positive impact on green corporate performance (GCP). H03f. In the H03 hypothesis CP, BCA has a positive impact on innovation performance (IVP). H03g. In the H03 hypothesis CP, BCA has a positive impact on integrity performance (IGP).

Fourth hypothesis: BCA governance strategy with ECSA activities, and CCI initiatives. The 4th hypothesis CP is defined as BCA → CCI (mediator) → ECSA (intervenor) → SEP and formulated as follows: (H04) ECSA activities intervened positively in the CCI mediating role between BCA and SEP.

Also, the following seven sub-hypotheses are proposed to further examine the BCT-SEP performance when CCI and ECSA mediate. H04a: In the H04 hypothesis CP, BCA has a positive impact on financial performance (FIP). H04b: In the H04 hypothesis CP, BCA has a positive impact on operational performance (OPP). H04c: In the H04 hypothesis CP, BCA has a positive impact on quality and supply chain performance (QSP). H04d. In the H04 hypothesis CP, BCA has a positive impact on CSR performance (CSR). H04e. In the H04 hypothesis CP, BCA has a positive impact on green corporate performance (GCP). H04f. In the H04 hypothesis CP, BCA has a positive impact on innovation performance (IVP). H04g. In the H04

hypothesis CP, BCA has a positive impact on integrity performance (IGP).

We also performed a hypothesis H04 assessment with the company's age, size, type of industry, and country as independent control variables (CP: BCA → CCI mediator → ECSA intervenor → SEP).

3.7 Final conceptual model

After the four latent constructs as latent SEM variables declaration, the 21 observed SEM indicators as metric entities clarification (see Subsection 3.4), and the research hypotheses definition (see Subsection 3.6), the final conceptual framework for evaluating the BCT adoption dynamics on ESG performance has been formulated (Figure 6).

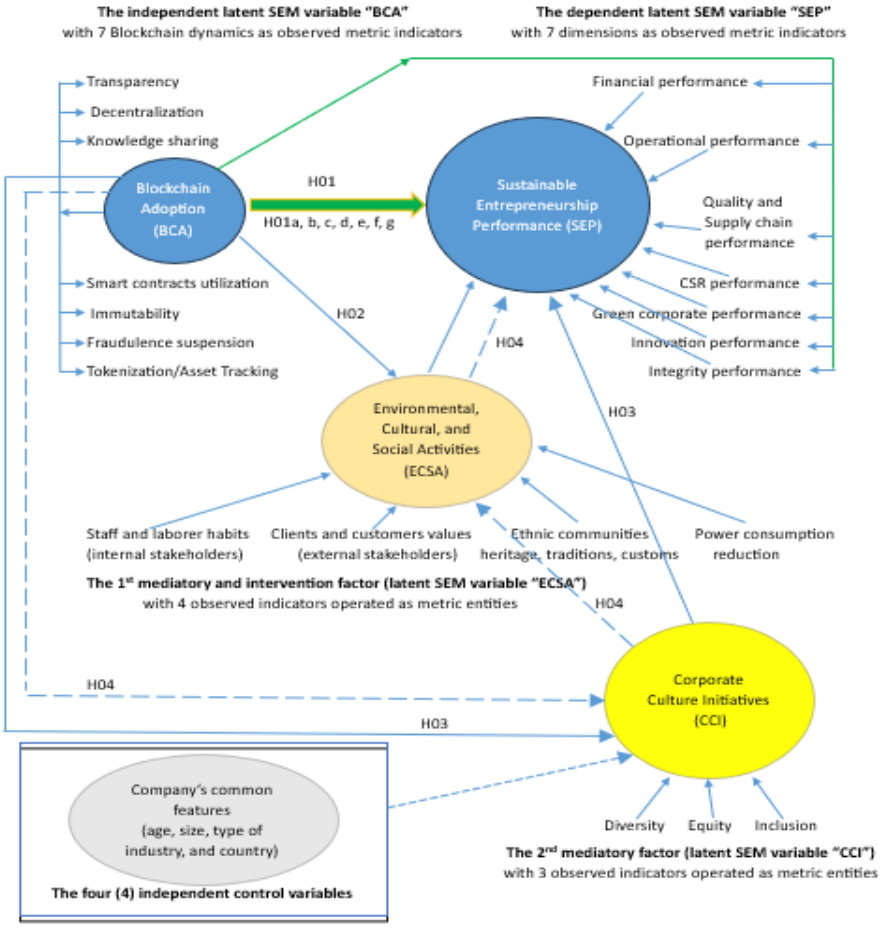


Fig. 6: The proposed conceptual model (path diagram in both "reflective" and "formative" measurement models). *Source: created by the author*

4 Results

4.1 Questionnaire formation

There were over 31,500 registered companies in the WB region and central Europe at the time, according to survey results, [47]. 4,500 businesses exhibiting a notable degree of technological innovation were chosen for our study. After that, 4,500 electronic questionnaires were sent to managers and CEOs using a convenience sampling technique (see Appendix). 780 of the 904 completed and returned questionnaires were considered valid and included in the analysis after any outliers were eliminated. PA and the "Smart PLS" software, which was selected for its capacity to examine causal relationships between several variables, were used to test the research hypotheses. According to the demographic data provided by the participants, it has been discovered that most of them had an academic degree in ICT, making up 64.88% of the overall population. Moreover, 57.82% of the participants had accumulated a substantial amount of management

experience, indicating a satisfactory level of expertise. Furthermore, 53 participants (6.79%) had experience in DevSecOps[1], while 98 participants (12.56%) had experience in DevOps[2] (Table 1).

To establish the outer model's validity (accuracy) and reliability (consistency) we conducted tests to assess the reliability of the questionnaire (Table 4) and the latent constructs (*convergent validity*/Table 4 and *discriminant validity*/Table 5). The analysis encompasses a sample period ranging from January 1st to February 28th, 2025. In total, the dataset used for the BC analysis consists of 780 observations spanning in multiple years. These observations pertain to firms operating in 13 countries (8 WB and 5 EU). The firms in the dataset are classified into eight industries based on the 2-digit Global Industry Classification Standard (GICS) classification. These eight industries are grouped in "AI-Data centers & Financials", "Supply-chain & Utilities", "Industrials & Agriculture", and "Tourism & Hospitality". The questionnaire addressed only corporate management and consisted of two parts. In part A' we are asking for information about the company's features, economic performance, investments in BCA, and various management data. The questionnaire's part B' is composed of four sections addressing the four sectors (see Appendix for further details).

Following Table 1 presents detailed demographic information of the questionnaire respondents.

Table 1. Executive demographic data and profile

Participants	Number
Managers	472
CEO	177
Presidents	131
ICT education	506
DevOps experience (years > 5)	98
DevSecOps experience (years > 5)	53
Management experience (years >10)	451

4.2 Conceptual model's elements

In our experimental evaluation study, the control and latent variables, and the observable SEM indicators were defined as follows:

• Independent control variables: The company's common features CA, CS, CTI, and CGA (Table 2).

• Latent SEM variables ("constructs"): BCA, SEP, ECSA, and CCI (Table 3).

• Observed SEM indicators: 7 BCA dynamics (TRA, DCE, KNS, SCU, IAB, FRS, and TAT), 7 SEP dimensions as ESG indicators (FIP, OPP, QSP, CSR, GCP, IVP, and IGP), 4 ECSA indicators (SLH, CCV, ECC, and PCR), and 3 CCI indicators (D, E, and I) (Table 2, and Figs. 2 & 6).

Subsequently, the questionnaire's validity and reliability were tested.

Table 2. The independent control variables

Company's common features Control variable	**Number**
Company's Age (CA)	
New (≤ 10 years)	480
Old	150
Company's Size (CS)	
Startup	198
SME	240
Large	192
Company's Type of industry (CTI)	
AI-Data centers & Financials	292
Supply-chain & Utilities	123
Industrials & Agriculture	179
Tourism & Hospitality	186
Company's Geographic Area/Country (CGA)	
Albania	22
North Macedonia	34
Kosovo	18
Bosnia and Herzegovina	72
Montenegro	56
Serbia	67
Croatia	83
Slovenia	78
Greece	82
Netherlands	83
Belgium	69
Luxembourg	31
Germany	85

4.3 Descriptive statistics

The evaluation of the suggested PLS-SEM model is related to descriptive statistics (mean, standard deviation, median, skewness, and kurtosis). The descriptive statistics for the complete sample are shown in Table 3. The *t-test* is then used to compare the means of the characteristics to test for equality. For each comparison, the corresponding *β-value* and *p-value* are given (see Table 6). Since PLS-SEM does not assume multivariate normality, it is not strictly necessary to discuss skewness, kurtosis, and normality testing. However, we decided to keep these diagnoses for practical reasons related to the conceptual framework fit assessment (inner model evaluation results; Section 4.5/Table 6) and make it clear that they are reported for descriptive completeness rather than as a requirement for model estimation, [60-66].

Table 3. Descriptive statistics for the full sample (n=780)
Constructs statistics, dimensions, and distribution and collinearity statistics

Latent SEM Variables (main Constructs)	**Observed Indicators** (BCT dynamics & ESG dimensions)	**Distribution statistics** Mean	Std	Median	Skew	Kurtosis	**Collinearity** Tolerance	VIF
Blockchain Technology Adoption (BCA)	Transparency (TRA)	3.70	1.44	3	-0.88	0.76	0.578	1.813
	Decentralization (DCE)	3.25	1.31	3	-0.83	0.80	0.522	2.232
	Knowledge Sharing (KNS)	3.12	1.44	4	-0.89	0.77	0.507	1.803
	Smart Contracts Utilization (SCU)	4.84	1.34	3	-0.94	0.54	0.540	2.230
	Immutability (IAB)	4.22	1.22	4	-0.79	0.88	0.511	1.734
	Fraudulence Suspension (FRS)	2.91	1.47	3	-0.84	0.93	0.544	2.235
	Tokenization//Asset Tracking (TAT)	3.23	1.43	4	-0.80	0.88	0.550	1.709
Sustainable Entrepreneurship Performance (SEP)	Financial Performance (FIP)	4.09	1.34	4	-0.88	-0.04	0.544	2.231
	Operational Performance (OPP)	3.80	1.37	3	-0.95	0.72	0.588	1.809
	Quality & Supply-chain Performance (QSP)	4.33	1.41	3	-0.81	0.69	0.546	2.233
	CSR Performance (CSR)	4.42	1.36	4	-0.81	-0.08	0.582	1.722
	Green Corporate Performance (GCP)	3.98	1.29	3	-0.85	0.25	0.545	2.239
	Innovation Performance (IVP)	3.50	1.12	4	-0.77	0.68	0.512	2.182
	Integrity Performance (IGP)	3.87	1.65	4	-0.83	0.64	0.588	2.091
Environmental, Cultural, and Social Activities (ECSA)	Staff and Laborer Habits (SLH)	3.77	1.03	3	-0.52	0.55	0.606	1.922
	Clients and Customers Values (CCV)	4.29	1.11	4	-0.58	0.67	0.543	2.230
	Ethnic Communities Customs (ECC)	4.33	1.10	4	-0.48	0.61	0.583	1.866
	Power Consumption Reduction (PCR)	4.45	1.09	3	-0.68	0.70	0.544	2.230
Corporate Culture Initiatives (CCI)	Diversity (D)	4.08	1.33	4	-0.81	0.78	0.550	2.008
	Equity (E)	4.13	1.33	4	-0.79	0.72	0.563	2.105
	Inclusion (I)	4.12	1.46	3	-0.83	0.76	0.609	2.092
	Control Variables Company's common features							
	Company's Age (CA)	6.21 years (mean)*						
	Company's Size (CS)	SME*						
	Company's Type of Industry (CTI)	AI-Data centers*						
	Company's Geographic Area (CGA)	Bosnia and Herzegovina*						

(Source: created by the author) Questionnaire data under a 5-point Likert scale ranging from "strongly disagree" (1) to "strongly agree" (5).
* Most of companies polled were "New" (mean age=6.21 years), "SME" (company's size), "AI-Data centers" (industry), from "Bosnia & Herzegovina".

4.4 Outer model's validity and reliability assessment (CFA analysis)

CR and Dillon-Goldstein's rho (rho_A) are statistical measures used to assess the reliability and internal consistency of latent constructs. These metrics help determine whether the observed SEM indicators, as the metric entities within a construct, are consistent in measuring the same underlying concept. In the context of BCA and its impact on corporate culture, CR and rho_A can be used to evaluate the reliability of observed SEM indicators such "trust", etc.

Composite Reliability (CR). CR measures the internal consistency of an observed SEM indicator, ensuring that these indicators are reliable and consistently related to the latent construct. A CR value of >0.70 is considered acceptable, while values above 0.90 indicate excellent reliability.

Example: For the observed SEM indicator "transparency", CR might be calculated based on survey items such as "*Managers and employees have access to products and services transparently*" and "*Departments coordinate transparently.*" If the CR is 0.85, it indicates high reliability, meaning the survey items consistently measure "transparency".

Dillon-Goldstein's rho (rho_A). Dillon-Goldstein's rho (rho_A) is another measure of internal consistency reliability, often preferred over Cronbach's alpha in SEM because it accounts for the actual factor loadings of the indicators. A rho_A value of 0.70 or higher suggests good reliability.

Example: For the observed SEM indicator "diversity", rho_A might be calculated based on survey items such as "*Diverse workspaces positively impact entrepreneurship performance*" and "*Diverse employee groups provide support and reward in terms of customs and traditions.*" If rho_A is for instance 0.78, it indicates that the observed SEM indicator is reliable and the survey items are consistent in measuring "diversity".

In our study, CR and rho_A were used to validate the reliability of BCA-related observed SEM indicators. The results showed that all indicators had acceptable reliability, with CR and rho_A values exceeding 0.70, confirming the internal consistency of the outer model. Particularly, in our study, observed SEM indicators such as "transparency", "trust", "diversity", "equity", and "inclusion" demonstrated high reliability, indicating that BCA positively impacts corporate culture by fostering these values. The high reliability of these indicators suggests that BCT can effectively support CCI initiatives and improve corporate governance.

4.4.1 Questionnaire's reliability (internal consistency reliability)

The internal consistency reliability of the questionnaire was assessed using CFA. The outer model's testing, as indicated by the Cronbach's alpha value, yielded results of ≥ 0.800. This finding aligns with [153] minimum requirement of 0.8 (Table 4).

4.4.2 Constructs validity as indicated by convergent validity (CV)

Construct validity is strongly associated with construct CV which is associated with CR and AVE. Hence, initially, the CR and the AVE values were computed and utilized to assess the CV of all latent constructs and observed SEM indicators.

According to [61], [62] and [64] the criteria for establishing CV are met when the CR is equal to or greater than 0.7 and the AVE is equal to or greater than 0.5. Subsequently, after the CV assessment, the construct reliability was estimated for all latent constructs separately. Table 4 indicates that construct validity has been established for all latent constructs and their observed SEM indicators. Hence, in our study, we detect a meaningful relationship between the latent constructs and the underlying observed SEM indicators being measured.

4.4.3 Constructs distinctiveness validity as estimated by discriminant validity (DV)

While the degree of correlation was measured using a correlation coefficient, specifically Pearson's r, a discriminant validity assessment (Fornell-Larcker criterion) is carried out by examining the correlation matrix between the constructs. The square root of AVE and the latent variable correlations (off-diagonal correlation coefficients) were compared using the Fornell-Larcker criterion. Specifically, each construct's highest correlation with any other construct was found to be less than the square root of its AVE, [153], [154]. The findings, reported in Table 5, demonstrate the extent to which the research discriminant validity is deemed acceptable, [132], [136], [161]. For the IGP-FIP, IGP-OPP, and IGP-GSP observed SEM indicators pairs a small dispute was found. Nevertheless, the negative differences are too small (0.798 - 0.812 => -0.14; 0.766 - 0.774 => -0.08; and 0.794 - 0.805 => -0.11 respectively) and disregarded (see Table 5).

The bolded values on Table 5's diagonal line represent the square roots of the AVE values. As a measure of discriminant validity, the square roots of the AVE values show a higher correlation between the paired observed SEM indicators. It's also crucial to remember that the off-diagonal correlation between the two variables used as predictors

shouldn't be greater than 0.90. The findings presented in Table 5 plainly demonstrate that all the measurements pertaining to DV have been satisfied and therefore the discriminant validity was achieved, [64]. Hence, all the conceptual model's observed SEM indicators were found discriminant.

4.5 Inner model's fit assessment (SEM analysis)

4.5.1 Inner model's evaluation results

Inner model's evaluation results achieved on the pooled data are presented in Table 6. Based on these results, 21 out of the 28 research hypotheses were confirmed with statistical significance at a level below 0.05. Particularly, the findings support the H01 hypothesis for a direct, significant, and positive impact of BCA governance strategy on SEP for three of the seven ESG success dimensions (financial, agility, and quality success) as follows: H01a (β = 0.401, p-value < 0.05), H01b (β = 0.398, p-value < 0.05), and H01c (β = 0.211, p-value < 0.05). Hypotheses H01d (social success), H01e (green success), H01f (innovation success), and H01g (integrity success) were not verified.

For hypothesis H02 (indirect, significant, and positive impact of BCA governance strategy on SEP through the mediating role of ECSA), the results verified hypotheses H02a (β = 0.405, p-value < 0.05), H02b (β = 0.377, p-value < 0.05), H02c (β = 0.210, p-value < 0.05), H02d (β = 0.266, p-value < 0.05), and H02e (β = 0.242, p-value < 0.05). Hypotheses H02f (innovation success), and H02g (integrity success) were not verified.

For hypothesis H03 (indirect, significant, and positive impact of BCA governance strategy on SEP through the mediating role of CCI), the results verified hypotheses H03a (β = 0.401, p-value < 0.05), H03b (β = 0.390, p-value < 0.05), H03c (β = 0.287, p-value < 0.05), H03d (β = 0.299, p-value < 0.05), H03f (β = 0.298, p-value < 0.05), and H03g (β = 0.331, p-value < 0.05). Hypothesis H03e (green success) was not verified.

Finally, for hypothesis H04 (indirect, significant, and positive impact of BCA governance strategy on SEP through the intervening role of ECSA on the mediating role of CCI), the results verified all hypotheses as follows: H04a (β = 0.365, p-value <0.05), H04b (β = 0.352, p-value < 0.05), H04c (β = 0.222, p-value < 0.05), H04d (β = 0.243, p-value < 0.05), H04e (β = 0.329, p-value < 0.05), H04f (β = 0.290, p-value < 0.05), and H04g (β = 0.383, p-value < 0.05).

Note: 21 of the 28 research hypotheses were determined to be statistically significant at a 95 percent confidence level based on the *p-value* (<0.05) and t-statistic values shown in Table 6. The results of the hypothesis testing show that a corporate governance approach for BCT transformation positively affects the success dimensions of the ESG model, particularly when the corporate culture encourages CCI initiatives and ECSA activities.

Regarding the four control variables that remain consistent throughout the study (CA, CS, CTI, and CGA), we found that any influence of the BCA on ESG performance is not affected by the company's incorporated age (CA) and size (CS). Additionally, as regards the type of industry (CTI) and the geographical area/country (CGA) of activity of the enterprise, we found that even the H04 setup (BCA → CCI mediator →ECSA intervenor → SEP) does not create significant results in the case of "Industrial & Agriculture" (CTI item) and "Kosovo" (CGA item). We believe this is due to the particularities of the "*Industrial & Agriculture*" industries which do not favor cultural and social activities, as well as the fact that in the case of "*Kosovo*", the intense ethnic differences do not allow BCA to function smoothly.

Table 7 presents the research hypothesis H04 evaluation results from measurement invariants through the four control variables CA, CS, CTI, CGA, and their 22 scale items (2 items for the two age options, 3 for the three company sizes, 4 for the four types of industry, and 13 for the thirteen countries).

Table 4. Confirmatory Factor Analysis (CFA) for Questionnaire and SEM Constructs Reliability and Validity

Main Constructs (latent SEM variables)	**BCA dynamics, SEP dimensions, ECSA items, and CCI controls** (observed indicators)	**Questionnaire's Reliability[1] & Validity** Items (Quest.)	Cronbach's alpha[2]	DG rho[3]	Validity	**SEM Constructs Reliability & Validity[8]** Rho_A[4], Composite Reliability (CR)[5] Average Variance Extracted (AVE)[6] Convergent Validity (CV)[7] (**Rho_A** and **CR**) + **AVE** → **CV**			
Blockchain Technology Adoption (BCA)	Transparency (TRA)	3	0.762	0.798	Yes!	0.779	0.822	0.684	Established
	Decentralization (DCE)	1	0.730	0.809	Yes!	0.754	0.771	0.666	Established
	Knowledge Sharing (KNS)	3	0.760	0.821	Yes!	0.783	0.827	0.578	Established
	Smart Contracts Utilization (SCU)	5	0.779	0.782	Yes!	0.799	0.833	0.667	Established
	Immutability (IAB)	1	0.770	0.854	Yes!	0.799	0.842	0.690	Established
	Fraudulence Suspension (FRS)	3	0.833	0.720	Yes!	0.845	0.863	0.563	Established
	Tokenization/Asset Tracking (TAT)	1	0.779	0.881	Yes!	0.822	0.850	0.612	Established
Sustainable Entrepreneurship Performance (SEP)	Financial Performance (FIP)	4	0.702	0.730	Yes!	0.755	0.809	0.637	Established
	Operational Performance (OPP)	5	0.848	0.855	Yes!	0.881	0.895	0.587	Established
	Quality & Supply-chain Performance (QSP)	4	0.779	0.798	Yes!	0.809	0.823	0.630	Established
	CSR Performance (CSR)	6	0.778	0.899	Yes!	0.797	0.822	0.736	Established
	Green Corporate Performance (GCP)	5	0.759	0.728	Yes!	0.784	0.799	0.698	Established
	Innovation Performance (IVP)	4	0.766	0.712	Yes!	0.788	0.809	0.644	Established
	Integrity Performance (IGP)	4	0.749	0.877	Yes!	0.790	0.809	0.708	Established
Mediator and Intervenor: Environmental, Cultural, and Social Activities (ECSA)	Staff and Laborer Habits (SLH)	5	0.879	0.841	Yes!	0.892	0.899	0.774	Established
	Clients and Customers Values (CCV)	5	0.839	0.892	Yes!	0.850	0.866	0.831	Established
	Ethnic Communities Customs (ECC)	5	0.766	0.821	Yes!	0.795	0.820	0.796	Established
	Power Consumption Reduction (PCR)	4	0.800	0.817	Yes!	0.829	0.839	0.821	Established
Mediator: Corporate Culture Initiatives (CCI)	Diversity (D)	3	0.790	0.897	Yes!	0.822	0.839	0.878	Established
	Equity (E)	3	0.703	0.910	Yes!	0.754	0.790	0.802	Established
	Inclusion (I)	3	0.788	0.895	Yes!	0.804	0.833	0.831	Established

[1] Research instrument's (in our case the "questionnaire") *reliability* refers to the degree of *consistency* exhibited by research findings over time and their ability to accurately reflect the entire target population under investigation. Put simply, if a study's findings can be replicated using a comparable methodology, then the research instrument (in our case the "questionnaire"), can be considered reliable. *Internal Consistency* ≈ *Reliability* (to the extent that *reliability* offers *consistent* results over time).

[2] **Cronbach's Alpha** coefficient evaluates the *internal consistency* (*reliability*) of an assessment (e.g., questionnaire) with acceptable values ranging from 0.70 to 0.90 (according to [153], [154], and [161]).

[3] As a rule of thumb **Dillon-Goldstein's rho** (**DG rho**) values higher than 0.70 and lower than 0.93 suggest unidimensionality (according to [153], [154], [160], and [161]).

[4] **Rho_A** coefficient values between 0.80 and 0.90 indicate an acceptable *reliability* (according to [154]).

[5] **Composite Reliability** (CR) indicates reliability if its value is ≥ 0.70 (the threshold value according to [154] and [161]).

[6] **Average Variance Extracted** (AVE) indicates reliability if its value is ≥ 0.50 (the threshold value according to [154] and [161]).

[7] **Convergent Validity** (CV) is acceptable when CR≥0.70 and AVE≥0.50 (according to [154]).

[8] **SEM Constructs Validity** establishment is indicated by Convergent Validity (CV) and Discriminant Validity (DV) (according to [161]).

Table 5. Discriminant Validity Analysis (DVA) – The correlation matrix among the observed SEM indicators

	TRA	DCE	KNS	SCU	IAB	FRS	TAT	FIP	OPP	QSP	CSR	GCP	IVP	IGP	SLH	CCV	ECC	PCR	D	E	I
TRA	**0.827**																				
DCE	0.762	**0.816**																			
KNS	0.670	0.723	**0.760**																		
SCU	0.733	0.783	0.691	**0.817**																	
IAB	0.644	0.795	0.703	0.764	**0.831**																
FRS	0.741	0.692	0.700	0.761	0.673	**0.750**															
TAT	0.749	0.700	0.709	0.770	0.681	0.678	**0.782**														
FIP	0.767	0.717	0.725	0.785	0.698	0.695	0.703	**0.798**													
OPP	0.653	0.703	0.712	0.773	0.685	0.682	0.690	0.707	**0.766**												
QSP	0.645	0.790	0.704	0.765	0.787	0.674	0.682	0.698	0.685	**0.794**											
CSR	0.779	0.732	0.741	0.800	0.812	0.709	0.718	0.735	0.722	0.712	**0.858**										
GCP	0.775	0.728	0.737	0.796	0.809	0.706	0.714	0.731	0.718	0.709	0.746	**0.835**									
IVP	0.715	0.770	0.709	0.736	0.740	0.746	0.755	0.773	0.739	0.750	0.739	0.775	**0.802**								
IGP	0.700	0.754	0.663	0.721	0.734	0.731	0.740	0.812	0.774	0.805	0.773	0.769	0.713	**0.841**							
SLH	0.811	0.754	0.6663	0.731	0.827	0.661	0.739	0.733	0.730	0.757	0.830	0.777	0.709	0.796	**0.880**						
CCV	0.805	0.759	0.668	0.726	0.739	0.736	0.745	0.762	0.749	0.740	0.778	0.789	0.719	0.802	0.871	**0.912**					
ECC	0.809	0.790	0.660	0.729	0.766	0.730	0.756	0.767	0.691	0.788	0.784	0.756	0.722	0.808	0.799	0.803	**0.892**				
PCR	0.802	0.733	0.755	0.791	0.809	0.688	0.740	0.792	0.696	0.702	0.802	0.780	0.702	0.804	0.872	0.872	0.862	**0.906**			
D	0.709	0.763	0.729	0.703	0.769	0.671	0.688	0.720	0.707	0.782	0.779	0.730	0.786	0.791	0.825	0.872	0.802	0.883	**0.937**		
E	0.801	0.788	0.721	0.723	0.774	0.744	0.733	0.759	0.721	0.761	0.809	0.811	0.762	0.798	0.811	0.852	0.870	0.821	0.834	**0.896**	
I	0.792	0.765	0.729	0.738	0.782	0.703	0.775	0.761	0.703	0.742	0.818	0.801	0.705	0.815	0.877	0.873	0.840	0.852	0.869	0.835	**0.912**

Table 6. Inner Model's evaluation - The conceptual framework fit assessment results

Hypothesis	Constructs Path	Estimate (β>0.100)	Std. error	t-statistics (> 1.96)	*p*-value (<0.050)	Result	Decision
H01	**BCA → SEP**						
Blockchain adoption governance strategy without environmental, cultural, and social activities and corporate culture initiatives							
H01a	BCA → FIP (financial)	0.401	0.033	6.001	0.012	Significant	Accepted
H01b	BCA → OPP (agility)	0.398	0.029	6.102	0.021	Significant	Accepted
H01c	BCA → QSP (quality)	0.211	0.048	5.968	0.039	Significant	Accepted
H01d	BCA → CSR (social)	0.291	0.032	6.008	0.092	Insignificant	
H01e	BCA → GCP (green)	0.209	0.030	6.032	0.088	Insignificant	
H01f	BCA → IVP (innovation)	0.167	0.044	5.903	0.102	Insignificant	
H01g	BCA → IGP (integrity)	0.088	0.025	6.022	0.162	Insignificant	
H02	**BCA → ECSA (mediator) → SEP**						
Blockchain adoption governance strategy with environmental, cultural, and social activities							
H02a	BCA → ECSA → FIP	0.405	0.033	6.044	0.020	Significant	Accepted
H02b	BCA → ECSA → OPP	0.377	0.020	6.109	0.029	Significant	Accepted
H02c	BCA → ECSA → QSP	0.210	0.042	5.921	0.035	Significant	Accepted
H02d	BCA → ECSA → CSR	0.266	0.031	6.055	0.043	Significant	Accepted
H02e	BCA → ECSA → GCP	0.242	0.039	6.122	0.030	Significant	Accepted
H02f	BCA → ECSA → IVP	0.170	0.044	5.772	0.093	Insignificant	
H02g	BCA → ECSA → IGP	0.081	0.061	6.005	0.133	Insignificant	
H03	**BCA → CCI (mediator) → SEP**						
Blockchain adoption governance strategy with corporate culture initiatives (diversity, equity, and inclusion)							
H03a	BCA → CCI → FIP	0.401	0.050	6.012	0.010	Significant	Accepted
H03b	BCA → CCI → OPP	0.390	0.022	6.006	0.029	Significant	Accepted
H03c	BCA → CCI → QSP	0.287	0.066	5.661	0.042	Significant	Accepted
H03d	BCA → CCI → CSR	0.299	0.041	6.432	0.033	Significant	Accepted
H03e	BCA → CCI → GCP	0.102	0.035	6.001	0.080	Insignificant	
H03f	BCA → CCI → IVP	0.298	0.059	5.900	0.032	Significant	Accepted
H03g	BCA → CCI → IGP	0.331	0.048	5.705	0.033	Significant	Accepted
H04	**BCA → CCI (mediator) → ECSA (intervenor) → SEP**						
Blockchain adoption governance strategy with environmental, cultural, and social activities, and corporate culture initiatives							
H04a	BCA→CCI→ECSA→FIP	0.365	0.051	6.200	0.022	Significant	Accepted
H04b	BCA→CCI→ECSA→OPP	0.352	0.029	6.043	0.032	Significant	Accepted
H04c	BCA→CCI→ECSA→QSP	0.222	0.088	5.721	0.045	Significant	Accepted
H04d	BCA→CCI→ECSA→CSR	0.243	0.032	7.222	0.044	Significant	Accepted
H04e	BCA→CCI→ECSA→GCP	0.329	0.043	6.098	0.047	Significant	Accepted
H04f	BCA→CCI→ECSA→IVP	0.290	0.051	5.767	0.024	Significant	Accepted
H04g	BCA→CCI→ECSA→IGP	0.383	0.042	5.882	0.018	Significant	Accepted

Table 7. Conceptual framework fit assessment:
Hypothesis H04 evaluation results with the company's age, size, type of industry, and country as control variables (CP: BCA → CCI mediator →ECSA intervenor → SEP)

BCA → CCI mediator →ECSA intervenor → SEP	H04	Estimate (β>0.100)	Std. error	t-statistics (> 1.96)	*p*-value (<0.050)	Results	Decision
	New (<10years)	0.308	0.602	6.177	0.028	Significant	Accepted
	Old	0.330	0.588	6.403	0.032	Significant	Accepted
	Startup	0.442	0.556	6.043	0.039	Significant	Accepted
	SME	0.397	0.630	6.599	0.046	Significant	Accepted
	Large (>€40M or employees>100)	0.404	0.632	5.980	0.038	Significant	Accepted
	AI-data centers or Financials	0.290	0.488	5.144	0.025	Significant	Accepted
	Supply-chain or Utilities	0.305	0.343	6.092	0.034	Significant	Accepted
	Industrials or Agriculture	0.122	0.499	6.775	0.209	Insignificant	
	Tourism or Hospitality	0.251	0.543	5.161	0.040	Significant	Accepted
	Albania	0.129	0.343	4.297	0.043	Significant	Accepted
	North Macedonia	0.288	0.487	5.004	0.032	Significant	Accepted
	Kosovo	0.056	0.383	4.402	0.164	Insignificant	
	Bosnia and Herzegovina	0.332	0.418	5.711	0.039	Significant	Accepted
	Montenegro	0.190	0.426	6.229	0.022	Significant	Accepted
	Serbia	0.209	0.381	5.084	0.048	Significant	Accepted
	Croatia	0.285	0.493	6.243	0.039	Significant	Accepted
	Slovenia	0.362	0.408	6.988	0.041	Significant	Accepted
	Greece	0.340	0.520	5.202	0.049	Significant	Accepted
	Netherlands	0.432	0.522	6.722	0.033	Significant	Accepted
	Belgium	0.656	0.532	6.190	0.035	Significant	Accepted
	Luxembourg	0.369	0.451	5.443	0.042	Significant	Accepted
	Germany	0.320	0.419	6.651	0.044	Significant	Accepted

4.5.2 Comparative analysis on hypotheses testing

Lastly, we conducted a comparative analysis (i) for the testing results of all the hypotheses (H01, H02, H03, and H04) as they projected on the seven success dimensions of the ESG model (financial success, agility success, quality success, social success, green success, innovation success, and integrity success); and (ii) for the hypothesis H04 (most successful setup) as it projected on the company's age, size, type of industry, and country as independent control variables (Table 8).

Table 8. Comparative analysis on hypotheses testing results ("Yes" for β > 0.100 with p-value < 0.050)

Impact of Blockchain Adoption (BCA) on Sustainable Entrepreneurship Performance (SEP)							
	(A) ESG* model success dimensions						
	Financial Success	Agility Success	Quality success	Social success	Green success	Innovation success	Integrity Success
BCA governance strategy without ECSA activities and CCI initiatives	Yes	Yes	Yes	No	No	No	No
BCA governance strategy with ECSA activities	Yes	Yes	Yes	Yes	Yes	No	No
BCA governance strategy with CCI initiatives	Yes	Yes	Yes	Yes	No	Yes	Yes
BCA governance strategy with ECSA activities and CCI initiatives	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	(B) Application domain						
	Firm's Age	Firm's Size	Company's type of industry				
BCA governance strategy with ECSA activities, and CCI initiatives	Significant impact of BCA on SEP regardless of company's age	Significant impact of BCA on SEP regardless of company's size	Significant impact was found regardless of the company's type of industry apart from "*Industrials and Agriculture*" due to particularities of the industry which are not favorable environmental activities and social initiatives. Company's geographic area (country) Significant influence was found regardless of state entity with the "*Kosovo*" exception due to businesses exposure to region's strong ethnic issues.				

* A framework called environmental, social, and governance (ESG) is used to evaluate an organization's performance on a range of sustainability and ethical issues. In those areas, it also offers a means of quantifying business risks and opportunities.

5 Discussion

Contribution: Previous studies on BCA do not demonstrate the impact and influence of corporate culture, and social and ethnic diversities on SEP as postulated in our hypotheses H02 (indirect impact through ECSA), H03 (indirect impact through CCI), and H04 (indirect impact through ECSA and CCI). Our statistically sound findings validate relative correlation and therefore contribution to corporate BC transformation literature. A diverse workforce fosters the production of creative ideas and contributions. Additionally, when a company has a diverse workforce, its employees have a greater range of skills, experiences, and viewpoints. As a result, this increases the possibility of increased productivity. Working together, people from different backgrounds and cultures can express themselves more creatively.

The results of this study offer significant new insights into the relationship between corporate culture and business performance. Additionally, it

helps us better understand how cultural and ethnic diversity affects the connection between socioeconomic performance and the transformation of business culture (social impact). Through this study, we can better understand how companies from emerging markets use their operational resources, including national cultural values and ethnic specificities, to generate strong financial results. Therefore, emerging markets must rely on intangible managerial and labor resources to promote and capitalize on service innovation to effectively compete on a global scale against well-established firms from developed countries.

Results: In the case of both ECSA and CCI mediation, the results showed that BCA had a statistically significant impact on all seven SEP dimensions as ESG indicators. This is interpreted because of the Western Balkans' multicultural environment and serves as a reminder to management to increase the company's participation in CCI and ECSA initiatives. Given that only three ESG indicators -financial, agility, and quality success- show a direct, significant, and positive impact of BCA on SEP, this finding is especially noteworthy. Not surprisingly, these findings supported earlier reports, [22], [35], and [39].

In contrast, the ECSA mediation's significant, positive impact includes more social and green success ESG indicators, but it still leaves out innovation and integrity ESG success indicators, unlike earlier studies, [48]. In line with [18] and [24], but in contrast to the findings of previous research by [23] and [27], the CCI mediation has a significant, positive impact on all ESG success indicators, apart from the green one. Additionally, our study's findings about supply chain transparency, BC transparency, and supply chain performance show that the flaws noted by [21] and [26], like inefficiency and the lack of privacy and standardization, may be viewed differently within supply chains, [6], [19], and [27].

Findings: Regardless of the size or age of the incorporated company, the indirect effect of BCA on SEP through the mediation of ECSA and CCI was confirmed for all hypotheses. However, businesses in the "*Industrials and Agriculture*" industries (CTI indicator) and the "*Kosovo*" country (CGA indicator) did not show a notable, positive impact. This validation supports [49], [53], and [59], but it contradicts earlier research in that the firm's "type of industry" has no bearing on how its technological, industrial, and agricultural transformation affects SEP, [48].

We estimate that this is because of the unique operating conditions of the agricultural and industrial enterprises, which are not conducive to cultural and social activities, as well as the fact that the differences between different ethnic groups and religions in Kosovo have become more pronounced in recent years. This validation is somewhat consistent with earlier research on the "company's geographic area" (CGA indicator), [22], [48]. It is noteworthy (a significant finding) that, apart from the "Kosovo" cases, BCA has an impact on ESG success indicators in all WB enterprises when the ECSA variable (intervention) is added. This is seen as a response to the multicultural environment at WB and serves as a prompt to the management to increase the company's participation in ECSA and CCI initiatives.

Significance: Additionally, we discovered that transparency, knowledge-sharing capabilities, and stakeholder trust all have a significant impact on entrepreneurship performance (statistically significant results). Business processes are impacted by BCT due to its potent features. By removing middlemen and information invariance and fostering transparency in businesses that function in areas where the shadow economy is prevalent, such as the WB case, BC has an impact on the corporate governance mechanism, [48], [59]. Consequently, BCA has both direct and indirect effects on corporate performance (through ECSA activities and CCI initiatives), and BC can be introduced as one of the factors influencing a company's regulatory and control mechanism. Therefore, corporate managers can enhance their financial and operational performance by utilizing BC as a digital currency platform and information distribution tool.

Limitations: Due to conceptual and empirical limitations, our findings should be interpreted cautiously. According to [45] and [47], many WB companies believe that BCT does not provide enough returns to justify the costs of replacing their current systems. This parameter may reduce the reliability of our results. Additionally, the research was limited to WB and central EU firms, and the sample's cultural and contextual characteristics may have affected the findings. Comparative research in countries and regions with different cultural, religious, and political differences would yield undocumented and unpredictable perspectives on corporate BC transformation.

The present study takes a limited organizational perspective on innovation. However, [17], [18], and [29] argue that to improve innovation capabilities, companies should adopt a comprehensive approach that encompasses multiple forms of innovation. The various forms of innovation encompass process, organizational, and marketing innovation, as well as the interrelation among these diverse types, [49]. In addition, the conceptual scope of the research, which

focuses on the ESG performance success indicators in a BCA context, is adequate for testing our hypotheses, [22], [35]. Nevertheless, it is important to recognize that the narrow focus of this study may hinder the applicability of the results to different areas of research and settings. In our research, the concept of "innovation" was examined as a concise dimension of success in the realm of ESG factors, but it is commonly classified into four categories: basic, sustaining, breakthrough, or disruptive, as described by [35], and [39].

Additionally, “countries” (control variable) are frequently categorized as either emerging or developed beyond their spatial determination as in our study (World Bank and Central Europe). The limitations of these conceptual simplifications may constrain the scope of our findings, as different approaches and definitions could have led to different relationships and outcomes, [45], [46], [47].

In our study, the latent constructs of BCA, SEP, ECSA, and CCI are conceptualized as global variables. They are assessed as unified entities comprising multiple items, without considering the potential implications of subcomponents. For instance, in the case of ECSA, the waste to energy process involves the conversion of non-recyclable waste materials into usable heat, electricity, or fuel through various processes such as combustion, gasification, pyrolysis, anaerobic digestion, and landfill gas recovery. Similarly, factors contributing to power consumption reduction can encompass circuit activity, current frequency, transition time, capacitive load, voltage, leakage current, and peak current. Additionally, the spatiotemporal dimension should be considered when examining ECSA cultural activities, as they are strongly associated with specific locations and calendar events, [22], [39].

Global cultural diversity: The development of AI gives rise and functionality to global environmental, cultural, and social initiatives that directly impact the global cultural ecosystem, while the indirect impact of global cultural diversity on ESG performance metrics has been observed in various studies, [48]. Particularly, international clients from culturally diverse countries, like refugees in WB, may influence corporate innovation and integrity ESG metrics because cultural differences between the stakeholders affect entrepreneurial behavior, [49]. Moreover, the significance of corporate culture becomes evident during periods of significant transformations or economic recessions, [59]. A strong DEI-friendly corporate environment helps a company adapt faster and weather these issues, giving employees confidence in their future. Thus, companies from culturally restricted countries should consider DEI compliance when internationalizing to gain a competitive edge.

6 Conclusions

This paper explores the BCA on SEP within the framework of ESG metrics, focusing on the mediating roles of ECSA and CCI. BCT enhances transparency, trust, and efficiency in business operations by reducing fraud, enabling secure data sharing, and automating processes through smart contracts. The study uses a PLS-SEM model to analyze data from 780 companies in the WB and the EU. The research includes CFA and path analysis to validate the conceptual model and hypotheses.

BCA directly impacts financial, operational, and quality performance but has limited direct effects on other ESG indicators like social, green, innovation, and integrity performance. ECSA and CCI act as significant mediators, amplifying BCA's impact on all seven ESG indicators. The combined mediation of ECSA and CCI yielded the most significant positive impact on SEP across all ESG dimensions. The impact of BCA on SEP is not significantly influenced by company age or size but varies by industry type and geographic location. For example, industries like "Industrials and Agriculture" and countries like Kosovo showed limited positive impact due to specific cultural and operational challenges.

The study highlights the importance of integrating BCT with ECSA and CCI initiatives to enhance ESG performance. It emphasizes the role of cultural and ethnic diversity in fostering innovation, trust, and productivity in diverse work environments. The study acknowledges limitations such as conceptual simplifications, regional focus on WB and EU, and the lack of temporal data. Future research is recommended to explore broader contexts, multi-factor interventions, and additional dimensions of ESG indicators.

The research contributes to the literature on corporate BC transformation, emphasizing the social impact of BCA and its role in improving corporate governance and sustainability in culturally diverse regions. The paper provides valuable insights for managers and policymakers in leveraging BCT and cultural initiatives to achieve sustainable entrepreneurship and ESG success.

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The authors equally contributed in the present research, at all stages from the formulation of the problem to the final findings and solution.

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The authors have no conflicts of interest to declare that are relevant to the content of this article.

Appendix: The Research Questionnaire

Part A' - Basic Questions

5-point Likert scale questionnaire (Strongly Disagree, Disagree, Neither Agree nor Disagree, Agree, Strongly Agree)

1. Company's age New (≤10 years) Old

2. Company's size Startup Large enterprise SME (annual sales turnover ≤ €40M or employing no more than 100)

3. Company's type of industry

AI-data centers & Financials Supply-chain & Utilities Industrials & Agriculture Tourism & Hospitality

4. Company's geographic area (country)

Albania North Macedonia Kosovo Bosnia and Herzegovina Montenegro Serbia Croatia
Slovenia Greece Netherlands Belgium Luxembourg Germany

5. Company's Revenue/Earnings/EBITDA growth rate last 5 years:

≤5% ≤0% 0%-5% 5%-10% ≥ 10%

6. My company invested resources in Blockchain technology adoption in the last 4 years:

≤ €20.000 €20.001 - €80.000 €80.001 – 100.000 ≥ €100.001

7. Our company's production and activities require the use of Blockchain technology:

Strongly disagree Disagree Neither agree nor disagree Agree Strongly agree

8. Management

University education in ICT DevOps experience >5 years
Management experience >10 years DevSecOps experience >5 years

Part B' - Constructs and survey scale items (set of answer options for closed-ended questions)

5-point Likert scale questionnaire (Strongly Disagree, Disagree, Neither Agree nor Disagree, Agree, Strongly Agree)

(B1) Blockchain Technologies Adoption (latent SEM variable "BCA")

Transparency (TRA)

· Blockchain technology is used in our company based on the principle of transparency (corporate, stakeholders).
· In our company managers and employees have access to products and services in a transparent way.
· In our company, all departments coordinate with each other transparently.

Decentralization (DCE)

· Blockchain technology's decentralization functionality eliminates central authorities by distributing control among network nodes, reducing risks of manipulation.

Knowledge Sharing (KNS)

· Blockchain technology's knowledge-sharing dynamics were regarded in our company as the best practice in the industry (skill, care, diligence, prudence, efficiency, foresight, standards, practices, methods, procedures, and timelines).
· In our company the management uses quality and knowledge data for strategies, plans, and decisions.
· In our company, the management provides quality and knowledge data to the personnel regularly.

Smart Contracts Utilization (SCU)

· Our company utilizes smart contracts to provide decentralized authorization for constrained IoT devices.
· Smart contracts utilization makes our company's process more efficient and secure (invoicing process automation).
· Smart contracts utilization makes our company's process more efficient and secure (payments process automation).
· The company departments operate an inter-departmental smart contracts framework.
· Our company provides smart contract development frameworks as software tools that support ICT personnel with pre-written code and templates to streamline the process of creating and deploying smart contracts on intranet BC networks.

Immutability (IAB)

· Blockchain technology's immutability functionality ensures that once data is recorded, it cannot be altered, deleted, or updated, creating a permanent, audit-friendly, and secure record.

Fraudulence Suspension (FRS)

· The adoption of Blockchain technology and smart devices in our company significantly improves the compliance measures of the trading system and effectively avoids fraud.
· Blockchain technology's fraudulence suspension dynamics enable us to deploy an enforcement fine-mapping strategy for financial penalties and fines.

· Blockchain technology helps us to address fraud issues in the corporate Emission Trading Scheme and to improve its efficacy with a reputation system.

Tokenization/Asset Tracking (TAT)

· Blockchain technology's tokenization/asset tracking utility enables the digitization and secure tracking of diverse assets, including cryptocurrency, intellectual property, and supply chain items.

(B2) Sustainable entrepreneurship Performance (latent SEM variable "SEP")

Financial performance (FIP)

· We expect an increase in growth in financial performance (sales, profit margin of sales, ROI, and market share).
· We expect an increase in revenue.
· We expect an increase in earnings.
· We expect an increase in EBITDA.

Operational performance (OPP)

· We expect an increase in growth in operational performance (operational cost improvements, services, product quality).
· Our company's ICT intranet allows us to inspect and track critical corporate processes.
· I believe that Blockchain fits the size of the company.
· I believe that Blockchain technology is affordable for our corporate operational scale.
· Our corporate management supports Blockchain adoption.

Quality and Supply-chain performance (QSP)

· We expect an increase in growth in supply-chain performance (supply-chain visibility, transparency, product safety, and supply-chain management with spatial functionalities e.g., best-route, vehicle fleet supervision).
· Our company's quality management is focused on excellence and can rapidly adjust production in response to customer.
· We are disciplined and continuously seek exceptional products and quality results.
· Our supply-chain has a fast and reliable client and customer response time.

CSR performance (CSR)

· We expect an increase in growth in CSR performance (voluntary initiatives, philanthropic activities).
· Our company provides financial support to local educational institutions.
· Our company respects client and customer consumer rights beyond the legal requirements.
· Our company facilitates the employees to improve their quality of life.
· Participation in social development activities is always our company's priority.
· My company offers equal opportunities to all employees regardless of their nationality or ethnicity.

Green Corporate performance (GCP)

· We expect an increase in growth in green corporate performance (green management system certifications, green management strategies, green processes, principles of codes of practice sustainability rating indices).
· Our company's management is highly committed to following green-friendly policies and methods.
· Our company's management ensures that production and corporate activities minimize their environmental impact.
· We always take initiatives to raise awareness about sustainability and environment (like Net-Zero carbon target by 2040).
· We are always in touch with new EU environmental directives and redesign our products accordingly.

Innovation performance (IVP)

· We are a pivotal leader in innovation building upon our expertise.
· Our advancements provide the foundation for the next-generation products.
· Our products and corporate activities enable our clients to transfer their ideas into reality.
· Our services and initiatives help our clients achieve creative solutions, profitability, and sustainability.

Integrity performance (IGP)

· We are trustworthy and operate ethically and transparently.
· Integrity is the foundation of our corporate culture and anti-corruption policy.
· We are authentic, competing legally and fairly, and complying with the regulations and rules.
· We always avoid conflicts of interest and obey our Code of Business Conduct.

(B3) Corporate Environmental, Cultural, and Social Activities (latent SEM variable "ECSA")

Staff and Labor Habits (SLH)

· Multicultural activities in our company help staff and laborers to have a better business understanding and increase service quality performance (multicultural day, arts, music dance parties).
· Ethnical-oriented initiatives in our company help staff and laborers to have a better business understanding and increase product quality performance (fairness and equity in interpersonal and professional relationships and in corporate activities).
· Our company's ethical behavior respects the dignity, diversity, and rights of our stakeholders, employees, and customers.
· In our company the projects are developed using cross-functional teams in a collaboration environment.
· In our company new concepts, products, and services are encouraged by staff collaboration and adopted effectively.

Clients and Customers Values (CCV)

· Multicultural activities in our company improve understanding and relations with clients and customers.
· Ethnical-oriented initiatives in our company accept any form of clothing and literature.
· Our company's ethnic behavior respects religious values and beliefs.

· National cultural values are always the corporate's preferences for managing external clients and customers.
· In our company ethnic particularities like customs, practices, or food and diet are not a thing.

Ethnic Communities Customs (ECC)

· Multicultural activities by local people are always welcomed in our company.
· Ethnical-oriented initiatives in our company accept the local community's traditional art in the form of music, dance, etc.
· Our company's ethnic behavior respects the local community's traditions and religious attitude.
· National cultural values and heritage are always corporate preferences for managing local community challenges.
· In our company ethnicity is not an issue.

Power Consumption Reduction (PCR)

· We are committed to environmental sustainability.
· Our company is taking steps to reduce the environmental impact of corporate operations.
· We always monitor corporate performance on emissions, waste, energy, and water to preserve resources and decrease cost.
· Our company encouraged initiatives to fight climate change.

(B4) Corporate Culture Initiatives (Diversity, Equity, Inclusion) (latent SEM variable "CCI")

Diversity (D)

· In our company the diverse workspace has a positive effect on entrepreneurship performance. We recognize the importance of gender, color, ethnic, and sex diversity.
· The diverse corporate workspace in our company helps us to have a better understanding of the company's master plan.
· The diverse employee groups (LGBTQ+, women, minorities) in our company provide support and reward in terms of customs, heritage, and traditions.

Equity (E)

· Equity and multicultural activities in our company help us to have a better business understanding and increase service quality performance (multicultural day, arts, music dance parties).
· The equity behavior in our company respects the dignity and rights of our stakeholders, employees, and customers.
· Our cultural equity explicitly appraises the unique cultures of heterogeneous communities and supports their existence.

Inclusion (I)

· Inclusion and ethnic-oriented initiatives in our company help us to have a better business understanding and increase product quality performance (honesty and equity in interpersonal and professional relationships and in corporate activities).
· Our company's work environment makes every employee feel valued.
· Our company acknowledges all kinds of differences and how these differences contribute to corporate culture and business.