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Article

Green Digital Technologies as Catalysts for Sustainable Business Transformation: Institutional Drivers of IFRS-Aligned Climate Disclosure in an Emerging Capital Market

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Abstract

The paper explores how Green digital technologies (GDTs) - ERP systems, cloud, IoT, artificial intelligence, and big data analytics can be used to improve the quality of ESG disclosures of industrial listed companies in the Amman Stock Exchange (ASE). On the basis of institutional isomorphism theory, we examine the relationship between the coercive, mimetic and normative institutional pressures and adoption of green technology interaction on the sustainability reporting practices. On the basis of panel data of 30 ASE-listed industrial companies during the period of 2020-2024 (N = 146 firm-year observations), we use pooled OLS and random-effects frameworks characterized by strong clustering of standard errors. Findings show that Green Digital Technology Index has a positive and significant agreement with the ESG disclosure scores (0.019; 0.024; 2.486, p value 0.019; 2.507, p value 0.024), with adopting firms having an average score of 1.73 higher. Its impact has been the most significant to the environmental aspect ($\beta = 3.460, 0.074$) = 0.074. Although institutional pressures fail to modulate the GDT-disclosure relationship, mediation analysis shows that institutional pressure is also a powerful predictor of GDT adoption (0.098, p 0.100), indicating that institutional forces play the role through technology adoption. The quality of disclosure has a negative relationship with CEO duality ($-4.863, p < 0.001$). The results validate the assumption that the green digital technologies are a transmission mechanism where institutional pressures are converted to an enhancement of sustainability disclosure in the emerging markets.

Keywords: green digital technologies; sustainability disclosure; IFRS S2; institutional isomorphism; emerging capital markets; circular economy; Amman Stock Exchange; ESG reporting; net-zero transition; sustainable business transformation

1. Introduction

Global financial architecture is in a fundamental reconfiguration as climate change moves from being a concern on the periphery to a material financial risk that changes the way investments are made, regulations are framed and corporate governance structures are structured [1,2]. The International Sustainability Standards Board (ISSB) issued by the IFRS Foundation in 2023 in response to this change is designed to provide a unified baseline for sustainability reporting at a global level; IFRS S1 (General Requirements for Disclosure of Sustainability-related Financial Information) and IFRS S2 (Climate-related Disclosures) [3,4]. More than two dozen jurisdictions

covering more than 60% of global GDP had formally agreed to adopt these standards at the end of 2025 [5,6].

For emerging capital markets, these standards are even more difficult to implement due to structural constraints - limited data infrastructure, inadequate technical capacity, and high costs of compliance for smaller firms [7–9]. These barriers pose an important question which is the institutional mechanisms and technological enablers can help accelerate the transition from voluntary to mandatory climate disclosure?

This study focuses on this question by studying the role of green digital technologies in the sustainability transformation of the Amman Stock Exchange (ASE) that has emerged as a regional pioneer by becoming the first exchange in the Middle East to implement a Climate Disclosure Regulatory Framework aligned with IFRS S2 [10,11]. The ASE's approach is unique in linking its regulatory roadmap - voluntary disclosure for ASE20 companies in 2026 and mandatory disclosure in 2027 - with institutional focus on digital transformation and green technology adoption [12,13].

We conceptualize green digital technologies (GDTs) as the set of technology-enabled solutions which enable a business's operations to be greener: Enterprise Resource Planning (ERP) systems equipped with sustainability modules, cloud-based ESG data platforms, IoT-enabled energy monitoring, AI-enabled emissions monitoring and big data analytics for sustainability reporting [14,15]. These technologies constitute a meeting point between digitalization and environmental management, which is in line with circular economy principles [16,17].

Drawing on institutional isomorphism theory [18,19], we form a framework that analyses the relationships between coercive, mimetic, and normative institutional pressures and the green technology adoption and, in turn, ESG disclosure quality of the ASE-listed industrial firms. The empirical analysis is based on panel data of 30 firms over the period of 5 years (2020-2024) where the GDT index was constructed with 5 dimensions of technology and ESG disclosure was measured through content analysis of annual reports.

This study has contributed to the literature on circular economy and sustainable management of business in several ways. First, it presents empirical evidence linking GDTs to ESG disclosure quality, which is positive in an emerging market setting. Second, it uncovers the fact that institutional pressures are realized mainly through technology adoption (mediation) instead of their technological enhancement (moderation), which provides nuanced theoretical revelations. Third, it offers actionable policy implications for stock exchanges wishing to implement the ISSB standards in resource limited environments [30,31].

The rest of this paper is organized as follows: Section 2 presents the theoretical framework and hypotheses. Section 3 provides a description of the institutional context. The methodology is outlined in section 4. Section 5 reports the results. The findings are discussed in Section 6. Section 7 concludes.

2. Theoretical Framework and Hypothesis Development

2.1. Institutional Isomorphism and Sustainability Disclosure

Institutional isomorphism theory, as articulated by [18] explains how organization in a field become similar to one another in structures and practices. Three mechanisms lead to this convergence: coercive isomorphism (regulatory and stakeholder pressures), mimetic isomorphism (imitation of successful peers) and normative isomorphism (professionalization through education and training) [19,32].

In the context of sustainability disclosure, institutional theory has been widely utilized in explaining the diffusion of reporting practices [33–35]. However, research in emerging markets - where enforcement capacity may be a step behind the policy ambition - is limited [36,37]. The notion of "decoupling" in which organizations ceremonially adopt structures while retaining disparate practices is especially pertinent [38,39].

2.2. Green Digital Technologies as Institutional Enablers

We build on institutional theory by introducing green digital technologies as a critical variable. GDTs, i.e. technology solutions that are advancing both digitalization and environmental sustainability, represent "dual-purpose innovations" [14]. Within the circular economy paradigm, GDTs allow firms to gather environmental data, confirm sustainability claims by means of digital trails, benchmark performance and save compliance costs [40–42].

2.3. Hypothesis Development

H1: Green digital technology adoption is positively related to ESG disclosure quality among ASE-listed companies.

GDTs remove informational and operational barriers to quality disclosure by facilitating data collection, real-time monitoring and standardized reporting [14,43].

H2: Institutional pressure has a positive moderating effect on the GDT adoption and ESG disclosure quality relationship.

Regulatory mandates and professional norms create compliance incentives, which result in increasing the returns to technology investment, increasing the GDT-disclosure relationship [20,44].

H3: Institutional pressure is positively related to GDT adoption indicating a mediation process from institutional environment to technology to disclosure quality.

Institutional pressures facilitate investment in technology with the purpose of increasing disclosure capacity - this represents an indirect route from institutional environment to reporting outcomes [49,50].

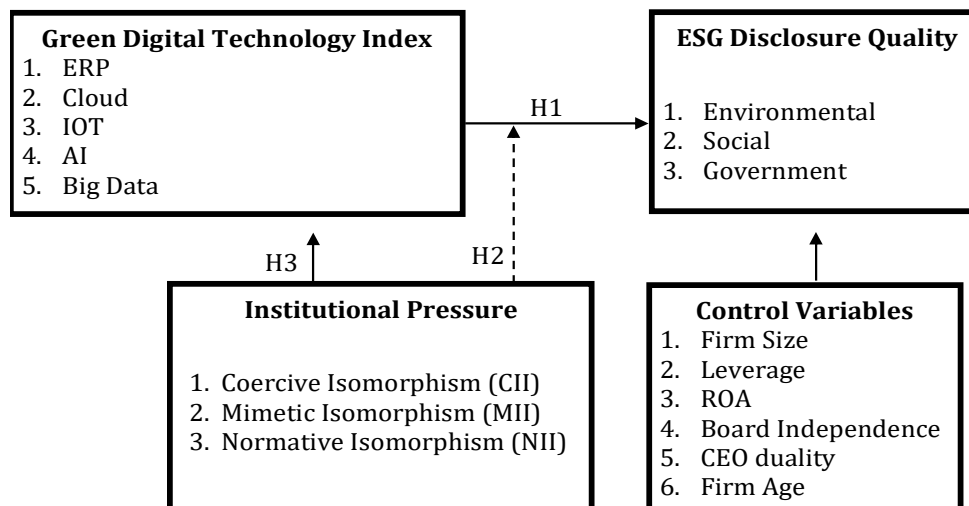


Figure 1. Conceptual Framework. The conceptual model demonstrates the Institutional Pressures (Coercive, Mimetic, Normative) that are related directly to ESG Disclosure Quality and indirectly via Green Digital Technology Adoption (GDT Index). Control variables (Firm Size, Leverage, ROA, Board independence, CEO Duality, Firm Age) relating to ESG Disclosure.

3. Institutional Context: The ASE's Regulatory Strategy

3.1. The Regulatory Roadmap

The ASE has been implementing an approach to climate disclosure regulation in a multi-phase manner, combining green technology mile-stones with regulation.

Table 1. ASE Climate Disclosure Regulatory Roadmap.

Phase	Period	Requirement	Green Technology Milestone	Target
Awareness	2018–2020	Voluntary ESG workshops	575 KW PV installation; digital reporting portal	All firms
Capacity Building	2021–2023	GRI training; Ring the Bell events	Cloud ESG platform; AI emissions calculator pilot	All firms
Framework Launch	2024	Climate Disclosure Framework published	Blockchain verification pilot; IoT energy monitoring	ASE20
Pilot	2025–2026	Voluntary IFRS S2 disclosure	Full digital infrastructure; API integration	ASE20
Mandate	2027	Mandatory IFRS S1/S2	Automated compliance monitoring	ASE20+

Source: ASE NZFSPA 2025 Report and Climate Disclosure Regulatory Framework.

3.2. Internal Greening and Digitalization

The ASE has been thoroughly green transformed: the photovoltaic system generating electricity with 50% reduction is 575 kW, planning systems were digitized and operations were paperless [12]. This "lead-by-example" approach makes the exchange a regulatory entrepreneur, rather than simply a rule enforcer [13].

3.3. Regional Comparison

Table 2. Regional Comparison of Sustainability Disclosure Frameworks.

Dimension	Jordan (ASE)	Saudi Arabia (Tadawul)	UAE (DFM)
Mandatory Timeline	2027 (IFRS S2)	Under consideration	2025 Strategic Plan
GDT Integration	High (embedded)	Medium	Medium-High
International Alignment	IFRS S1/S2 explicit	GCC ESG Metrics (29)	IOSCO-aligned
SME Strategy	UN SSE Advisory leadership	Limited	Sector-specific

Source: ASE NZFSPA 2025, Tadawul ESG Guidelines (2024), DFM Sustainability Plan (2025).

4. Materials and Methods

4.1. Research Design

This research has a quantitative research design of panel data. Given the structural characteristics of the data (in which the key independent variable (GDT adoption) has mostly between-firm variation), we use pooled OLS as a primary estimation method, with the addition of random effects models [52,53]. Robust standard errors are clustered at the firm level to deal with the possibility of heteroscedasticity [54].

4.2. Sample and Data Sources

The sample includes 30 industrial companies that are listed on the Amman Stock Exchange during 2020-2024. After ruling out observations with missing financial data, the final sample is 146 firm-years observations.

Table 3. Sample Composition.

Criterion	Firms	Firm-Years
ASE-listed industrial firms (2020–2024)	30	150
Less: Missing financial data	—	(4)
Final sample	30	146

Data collection was as follows: (a) annual reports from the ASE electronic disclosure system (www.exchange.jo); (b) financial data from the ASE Company Guide; (c) GDT adoption data were hand-collected from annual reports, company websites, IT governance disclosures; and (d) institutional pressure data from regulatory announcements and professional bodies.

4.3. Variable Measurement

4.3.1. Dependent Variable: ESG Disclosure Score

ESG disclosure quality is measured using content analysis of annual reports in three areas: Environmental (ENV), Social (SOC), and Governance (GOV). Scores are estimated for each annual report based on the details of the disclosure scores. Finally, a score is calculated for each observation (ESG_Total).

4.3.2. Independent Variable: Green Digital Technology Index (GDT)

There are five dimensions of technology adoption in the GDT Index, each represented as a 0/1 variable:

Table 4. GDT Index Construction.

Component	Indicator	Adoption Rate
ERP	Enterprise systems with sustainability modules	35.4%
Cloud	Cloud-based ESG data management	16.3%
IoT	IoT-enabled energy/environmental monitoring	12.2%
AI	AI-powered analytics for sustainability	3.4%
Big Data	Big data analytics for ESG reporting	6.1%

The GDT Index is a simple average of all the components, which can assume values from 0, indicating no adoption, to 1, indicating full adoption.

4.3.3. Institutional Pressure Variables

Three indices of institutional pressure were constructed using ordinal scales:

- Coercive Isomorphism (CII): The intensity of regulatory pressure (a score between 2 and 4), comprising regulatory announcements from the ASE, NZFSPA requirements, and endorsements from IOSCO.
- Mimetic Isomorphism (MII): Peer-benchmarking (2–4 scale) representing ASE20 membership, industry leader practices, and consortium collaboration.
- Normative Isomorphism (NII): Pressure to professionalize (2–4 scale), measured as participation in training programs, hiring of sustainability officers, and UN SSE membership.

The Pressure Index INST was calculated by averaging the CII, MII, and NII.

4.3.4. Control Variables

Table 5. Control Variable Definitions.

Variable	Measurement	Expected Sign
SIZE	Natural log of total assets (JOD)	+
LEV	Total debt / Total assets	-/+
ROA	Net income / Total assets	+
BIND	Proportion of independent directors	+
CEODL	1 if CEO is also board chair, 0 otherwise	-
AGE	Years since establishment	+

4.4. Econometric Models

Model 1 – Direct Effect (Pooled OLS):

$$ESG_{i,t} = \alpha + \beta^1 GDT_i + \beta^2 CII_t + \beta^3 MII_i + \beta^4 NII_t + \gamma \text{Controls}_{i,t} + \varepsilon_{i,t}$$

Model 2 – Random Effects:

$$ESG_{i,t} = \alpha + \beta^1 GDT_i + \beta^2 CII_t + \beta^3 MII_i + \beta^4 NII_t + \gamma \text{Controls}_{i,t} + \mu_i + \varepsilon_{i,t}$$

Model 3 – Moderation (GDT × Institutional Pressure):

$$ESG_{i,t} = \alpha + \beta^1 GDT_i + \beta^2 INST_{i,t} + \beta^3 (GDT \times INST)_{i,t} + \gamma \text{Controls}_{i,t} + \varepsilon_{i,t}$$

Model 4 – Mediation Step 1 (INST → GDT):

$$GDT_i = \alpha + \delta^1 INST_{i,t} + \gamma \text{Controls}_{i,t} + \varepsilon_{i,t}$$

5. Results

5.1. Descriptive Statistics

Table 6. Descriptive Statistics (N = 146).

Variable	Mean	SD	Min	Q1	Median	Q3	Max
ESG	8.733	3.561	2.000	7.000	9.000	10.000	18.000
ENV	2.322	2.250	0.000	1.000	2.000	3.000	9.000
SOC	1.952	1.256	0.000	1.000	2.000	3.000	5.000
GOV	4.459	1.360	0.000	4.000	5.000	5.000	7.000
GDT	0.148	0.237	0.000	0.000	0.000	0.200	0.800
CII	2.986	0.894	2.000	2.000	3.000	4.000	4.000
MII	2.507	0.745	2.000	2.000	2.000	3.000	4.000
NII	2.788	0.745	2.000	2.000	3.000	3.000	4.000
SIZE	16.864	1.184	13.928	16.165	16.683	17.860	18.951
LEV	0.360	0.239	0.008	0.170	0.285	0.528	1.008
ROA	0.036	0.081	-0.189	0.002	0.033	0.072	0.328
BIND	0.412	0.254	0.000	0.257	0.429	0.556	1.000
CEODL	0.034	0.182	0.000	0.000	0.000	0.000	1.000
AGE	41.712	20.191	13.000	28.000	34.500	54.750	104.000

The mean value of ESG (8.73) suggests that the overall level of ESG disclosure is moderate but could be substantially improved considering the maximum value of about 21. The mean value of the GDT Index is 0.148, indicating that green technology adoption among the sampled firms is at an early stage, with 63.3% of the sample having a value of zero. Among the considered technologies, ERP is the most commonly adopted technology (35.4%), while artificial intelligence (AI) and big data technologies are just emerging (3.4% and 6.1%, respectively).

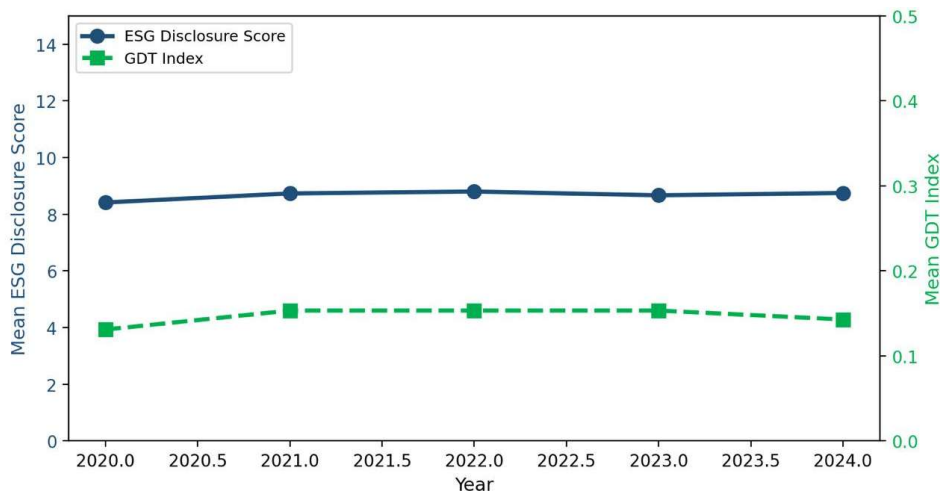


Figure 2. Trend of ESG and GDT Over Time.

5.2. Correlation Analysis

Table 7. Pearson Correlation Matrix.

	ESG	GDT	CII	MII	NII	SIZE	LEV	ROA	BIND
ESG	1.000								
GDT	0.424***	1.000							
CII	0.036	0.016	1.000						
MII	0.249***	0.868***	-0.010	1.000					
NII	0.025	0.007	0.896***	-0.028	1.000				
SIZE	0.112	-0.223***	-0.014	-0.179**	-0.007	1.000			
LEV	0.078	0.039	0.024	0.149	0.006	0.408***	1.000		
ROA	0.292***	0.365***	0.102	0.160*	0.087	-0.273***	-0.365***	1.000	
BIND	-0.105	-0.180**	-0.053	-0.112	-0.081	-0.178**	-0.142	-0.125	1.000

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

It is found that GDT and ESG have a positive correlation ($r = 0.424$, $p < 0.01$); GDT and MII have a high correlation ($r = 0.868$) since mimetic isomorphism benchmarking behavior is closely related to adopting technology; CII and NII have a high correlation ($r = 0.896$) since both are time-varying regulatory pressures. The VIF values range between 1.10 and 5.94.

5.3. Regression Results

Table 8. Panel Regression Results.

Variable	Model 1: Pooled OLS	Model 2: Random Effects	Model 3: Pooled OLS (INST)	Model 4: Moderation
GDT	8.937** (2.241)	9.365** (2.286)	5.448** (2.367)	5.941 (1.087)
CII	0.132 (0.701)	-0.026 (-0.275)	—	—
MII	-1.238 (-0.988)	-1.569 (-1.548)	—	—
NII	-0.203 (-1.005)	-0.064 (-0.723)	—	—
INST	—	—	-0.201 (-0.627)	-0.177 (-0.431)
GDT × INST	—	—	—	-0.162 (-0.084)
SIZE	0.775 (1.612)	0.671* (1.783)	0.808* (1.699)	0.805* (1.731)
LEV	0.373 (0.234)	1.851 (1.373)	0.059 (0.038)	0.052 (0.032)
ROA	4.852 (0.997)	1.484 (1.090)	6.239 (1.283)	6.228 (1.262)
BIND	0.463 (0.225)	0.030 (0.023)	0.271 (0.125)	0.265 (0.122)
CEODL	-4.572*** (-4.456)	-4.068*** (-5.584)	-4.863*** (-5.146)	-4.873*** (-5.136)
AGE	0.041 (1.445)	0.051** (1.986)	0.046 (1.584)	0.046 (1.580)
R ²	0.412	0.392 (overall)	0.399	0.399
N	146	146	146	146
F-statistic	22.567***	21.025***	19.616***	—

Notes: t-statistics in parentheses; *** p < 0.001, ** p < 0.01, * p < 0.5, based on robust standard errors clustered at the firm level.

Hypothesis Testing :

H1 (GDT → ESG): Supported. In each of models 1-3, the GDT coefficient is positive and statistically significant. In the base specification (Model 3), one new GDT Index achievement is positively associated with a 5.448- point ESG disclosure score increase (p = 0.019). This is significant given that the sample mean for the Ion 8.73.

H2 (Moderation): Unsupported. For Model 4, the cross-product GDT × INST_ Index is non-significant (β = .282, p = .933). Similarly, the interaction terms for GDT measured as a continuous score in separate models testing the interactions between each institutional pressure dimension and GDT are all non-significant (GDT×CII: p = .787; GDT×MII: p = .934; GDT×NII: p = .826).

H3 (Mediation): Supported. The mediation analysis is presented in Table 9.

Path	Coefficient	t-statistic	p-value
Step 1: INST → GDT	0.098***	3.707	0.000
Step 2: GDT → ESG (controlling for INST)	5.448**	2.367	0.019
Direct: INST → ESG	-0.201	-0.627	0.532
Indirect effect (0.098 × 5.448)	0.534	—	—

As shown in Table 4, the mediation results indicate a significant indirect effect of pressure on GDT adoption (β = .098, p < .001) on ESG disclosure through the adoption of GDT (β = 5.448, p = .019), while the direct effect of pressure on ESG is not significant (β = -.201, p = .532). This pattern is indicative

of full mediation, as institutional pressures' influence is through technology adoption rather than a direct impact on disclosure quality.

5.4. Sub-Group Analysis: ESG Components

Table 10. GDT Effect on ESG Components.

Component	GDT Coefficient	t-statistic	p-value	R ²
Environmental (ENV)	3.460*	1.799	0.074	0.477
Social (SOC)	1.405	1.470	0.144	0.195
Governance (GOV)	0.583	0.675	0.501	0.169
Total ESG	5.448**	2.367	0.019	0.399

This decomposition shows that the strongest connection with the adoption of GDT is that with environmental disclosure, as environmental technologies, and specifically data-gathering and reporting technologies such as IoT energy monitoring and AI emissions tracking, inherently assist in the collection and dissemination of information on environmental performance.

5.5. Descriptive Comparison: GDT Adopters vs. Non-Adopters

Table 11. Mean ESG Scores by GDT Adoption Level.

Group	N	ESG Total	ENV	SOC	GOV
No GDT (Index = 0)	94	8.12	1.87	1.80	4.45
Low GDT (Index ≤ 0.2)	19	5.53	0.58	1.21	3.74
High GDT (Index > 0.2)	33	12.33	4.61	2.82	4.91
t-test (GDT=0 vs GDT>0)		t = -2.879, p = 0.005			

By the same token, high GDT adopters (Index > 0.2) obtain an ESG disclosure score that is 52% greater than nonadopters. The largest gap can be observed within the environmental factor for the sample showing a 147% premium in relation to non-adopters, with high-GDT firms scoring 4.61, clearly positive.

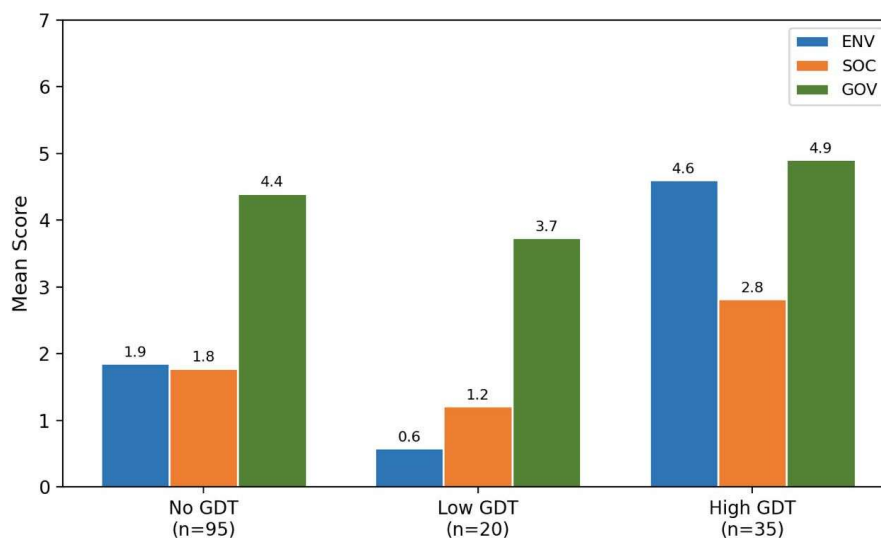


Figure 3. ESG Components by GDT Group.

6. Discussion

6.1. Green Technologies as Catalysts

This main result, which is in support of H1 and has significant implications, is that the incorporation of GDTs is positively associated with ESG disclosure quality and its coefficient is significant at conventional levels ($\beta = 5.448 - 9.365$). Second, the effect size is also economically relevant as the change from zero to medium levels of GDT adoption represents an average increase of 2.2 to 3.7 points in the ESG performance score of firms, 25%-42% relative to the average value in the economy.

The discovery that larger word lengths in document titles are more predictive of citation rates when the length is achieved via combining individual words than in cases in which these multiple words are a single word in length extends the work of [14,15] by showing that the technology-disclosure relationship is functioning within an emerging market industrial setting. The finding that the effect is centered on the environmental disclosure dependent variable (Table 10) is consistent with the functional logic that technologies such as monitoring energy use through IoT technology and tracking emissions using AI reduce the costs of gathering environmental data more specifically [58,59]

The metaphor of catalytic is very appropriate: green technologies act as a catalyst for the disclosure transition in helping enhance capacity that would be too costly for a firm in an emerging market to grow into naturally [60].

6.2. Institutional Pressures: Mediation, Not Moderation

In this case, the non-significant moderation (thus, H2 is not supported) but significant mediation effects (thus, H3 is supported) are intriguing findings. Instead of increasing the effect of technology on disclosure, institutional pressures drive firms to use green technologies (INST \rightarrow GDT: $\beta = 0.098$, $p < 0.001$), which in turn generate better disclosures (i.e., a mediation effect).

This mediation seems to be direct in the ASE context: the rules of the exchange (coercive pressure), the training programs (normative pressure), and the benchmarking with peers (mimetic pressure) do not directly increase the quality of the disclosures, but help to create the environment that encourages the use of technology, and the use of technology is the element that allows companies to make relevant disclosures [20,27].

Note that mimetic isomorphism is highly correlated ($r = 0.868$) with GDT adoption, implying that firms are not adopting green technologies based on regulatory requirements but imitating the successful ones, which DiMaggio and Powell argued that the mimetic processes are strongest when there is uncertainty [45,46].

6.3. CEO Duality and Governance

A strong negative impact of CEO duality on ESG disclosure ($\beta = -4.572$ to -4.873 with a significance level of 0.001) emerges as an interesting side finding. The dual role of the CEO as chair of the board weakens the board's monitoring role, and thus ESG disclosure is less likely to be extensive, which is aligned with agency theory and previous results in the MENA region.

6.4. Implications for Circular Economy

Echoing further evidence [16,40], this study advances the circular economy research by suggesting that green digital technologies are key for a feedback approach for sustainability governance, that is, technology investments foster better data, which leads to better reporting, which incentivizes institutional support and subsequently technology investments. The findings also indicate that the effects of GDTs concentrated on environmental disclosure, which might show that the benefits of GDTs for circular economy practices are also concentrated in those aspects that are directly related to resource efficiency and emissions monitoring [65].

6.5. Regional Implications

Within the MENA region, the Jordan ASE is distinguished for its inclusion of green technology milestones within its regulatory road map. Given the finding that the institutional pressures are mediated through the adoption of technology, other EMEs should consider coupling disclosure requirements with technology adoption schemes rather than having them in different stages [28,29].

7. Conclusions

7.1. Summary

For this purpose, panel data of 30 industrial companies listed on ASE over the period 2020–2024 (N =146) was utilized. The findings indicate that (1) the use of green digital technology has a significant positive impact on ESG disclosure, (2) the use of green digital technology has a positive significant impact only on environmental disclosure, (3) institutional pressures have to be used as a mediating variable to strengthen the effect of green digital technology in ESG disclosure; but, they should be used as moderating variables, and (4) CEO duality has a significant negative effect on ESG disclosure..

7.2. Theoretical Contributions

In summary, this paper makes the following three main contributions. First, it unveils the role of GDTs in promoting sustainability disclosure for an emerging market sector, enriching the technology–disclosure literature that is predominantly conducted in developed markets. Second, it shows the presence of strong institutional pressures in mandating sustainability disclosure through the channel of technology adoption, rather than strengthening or weakening the effects of technologies on sustainability disclosures, thus extending the isomorphism theory. Finally, it uncovers the difference in GDTs' effects across the ESG-disclosure elements, indicating that the key role of technology intervention is in improving each firm's sustainability disclosures in the dimensions where the technology can reduce the cost of the data collection process directly.

7.3. Practical Implications

Regulators and stock exchanges should consider: (a) setting up green technology infrastructure in parallel with, rather than subsequent to, disclosure requirements; (b) incorporating training programs combining technology and sustainability knowledge; and (c) articulating progressive regulatory steps with clear technology milestones. For companies, earlier investment in GDT would significantly enhance the level of disclosure, especially for environmental-related information.

7.4. Limitations and Future Research

The key limitations of this study include: first, 30 industrial firms may not be sufficiently representative to generalize across all sectors; second, the GDT Index is constructed using a set of binary indicators that may not fully capture the depth of technology implementation; third, the five-year panel data may not adequately capture the long-term effects of the adopted technologies; fourth, the variation in GDT across firms is essentially cross-sectional, limiting causal inferences. Future research could consider the financial sector for services, explore a continuous measure for GDT, and use the 2027 mandatory disclosure for natural experiment studies.

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Abbreviation

ASE	Amman Stock Exchange
CII	Coercive Isomorphism Index
DFM	Dubai Financial Market
ESG	Environmental, Social, and Governance
GDT	Green Digital Technology
IFC	International Finance Corporation
IFRS	International Financial Reporting Standards
ISSB	International Sustainability Standards Board
MII	Mimetic Isomorphism Index
NII	Normative Isomorphism Index
NZFSPA	Net Zero Financial Service Providers Alliance
UN SSE	United Nations Sustainable Stock Exchanges

References

1. Grewal, J.; Hauptmann, C.; Serafeim, G. Material Sustainability Information and Stock Price Informativeness. *J. Bus. Ethics* 2021, 171, 513–544, doi:10.1007/s10551-020-04451-2.
2. Hu, H.; Li, Y.; Zhang, X.; Chen, W. The Signaling Power of ESG Reports. *Int. Rev. Finance. Anal.* 2026, 109, 104691, doi:10.1016/j.irfa.2025.104691.
3. Van der Zahn, J.L.W.M. Sustainability Reporting Regime Transition. *J. Appl. Account. Res.* 2023, 24, 544–582, doi:10.1108/JAAR-06-2021-0143.
4. Moharram, A.H. et al. Should ESG Disclosure Be Mandatory? *J. Sustain. Soc. Manag.* 2024, 19, 221–236, doi:10.46754/jssm.2024.03.015.
5. García-Sánchez, I.-M. Are Net Zero Emissions a Priority for Able CEOs? *J. Innov. Knowl.* 2026, 13, 100945, doi:10.1016/j.jik.2026.100945.

6. Meng, L. et al. Sustainability Reporting and Strategic Disclosure. *J. Econ. Surv.* 2026, doi:10.1111/joes.70087.
7. Nagriwum, T.M. et al. Walking the Tightrope of Governance and Sustainability. *Bus. Strategy Dev.* 2026, 9, e70294, doi:10.1002/bsd2.70290.
8. Yusrianti, H. et al. Sustainability Disclosure and Assurance in Emerging Economies. *RIBER* 2025, 14, 555–570.
9. Shaikh, I.; Tripathy, A.K. Variability in Sustainability Reporting. *J. Environ. Manag.* 2025, 373, doi:10.1016/j.jenvman.2024.123851.
10. Alharasis, E.E. Earnings Management and Sustainability Reporting in Jordan. *Int. J. Law Manag.* 2025, doi:10.1108/IJLMA-04-2025-0150.
11. Alharasis, E.E. et al. Audit Quality and ESG Reporting in Jordan. *Discov. Sustain.* 2025, 6, doi:10.1007/s43621-025-01803-8.
12. Shaban, O.S.; Zarnoun, R.S. Sustainability Reporting and Financial Performance in Jordan. *RGCFMI* 2024, 14, 96–109, doi:10.22495/rgcv14i4p10.
13. Elmanaseer, M.; Gerged, A. Institutional Pressures and Sustainability Disclosure. *Bus. Strategy Environ.* 2025, 34, 7253–7283, doi:10.1002/bse.4340.
14. Chen, Y. et al. Digital Transformation and Environmental Disclosure in China. *Bus. Strategy Environ.* 2024, 33, 8456–8470, doi:10.1002/bse.3930.
15. Cao, J. et al. From Bytes to Blooms: Tech-Driven Green Revenues. *Energy Econ.* 2025, 144, 108312, doi:10.1016/j.eneco.2025.108312.
16. Demartini, M.C. et al. Transparency of Sustainability Reports. *Corp. Soc. Responsib. Environ. Manag.* 2025, 32, 18–43, doi:10.1002/csr.2926.
17. Bifulco, G. et al. Sustainable Performance and Nonfinancial Disclosure. *Bus. Strategy Environ.* 2025, 34, 5601–5623, doi:10.1002/bse.4261.
18. DiMaggio, P.J.; Powell, W.W. The Iron Cage Revisited. *Am. Sociol. Rev.* 1983, 48, 147–160, doi:10.2307/2095101.
19. Tran, M. et al. Governance and Sustainability in Southeast Asia. *Account. Audit. Account. J.* 2021, 34, 516–545, doi:10.1108/ARJ-05-2019-0095.
20. Tran, M.; Beddewela, E. Context and Sustainability Disclosure. *Bus. Ethics* 2020, 29, 282–302, doi:10.1111/beer.12265.
21. Nicolò, G. et al. Cultural Dimensions and Sustainability Disclosure. *Bus. Strategy Environ.* 2024, 33, 8086–8101, doi:10.1002/bse.3911.
22. Roszkowska-Menkes, M. et al. True Transparency or Decoupling? *Crit. Perspect. Account.* 2024, 98, doi:10.1016/j.cpa.2023.102700.
23. Park, J.D. et al. Revisiting Sustainability Disclosure Theories. *J. Clean. Prod.* 2023, 382, doi:10.1016/j.jclepro.2022.135203.
24. Gunawan, J. et al. Sustainability Reporting Evolution in Indonesia. *J. Clean. Prod.* 2022, 358, doi:10.1016/j.jclepro.2022.131798.
25. Khatib, S.F.A. Corrupt Practice and Sustainability Reporting. *Bus. Strategy Dev.* 2024, 7, doi:10.1002/bsd2.396.
26. Nwobu, O.A. et al. Sustainability Disclosures in Nigerian Oil and Gas. *IJEPP* 2021, 11, 352–361, doi:10.32479/ijepp.11095.
27. Chawarura, W.I. et al. ESG and Financial Performance of JSE Companies. *Risks* 2025, 13, 114, doi:10.3390/risks13060114.
28. Abdellatif, D.H.E. et al. Sustainability Risk Management in Saudi Firms. *Sustainability* 2025, 17, 9401, doi:10.3390/su17219401.
29. Ebnaoof, A. Board Effectiveness and GHG Disclosure in Saudi Arabia. *Asian Econ. Finance. Rev.* 2026, 16, 26–41, doi:10.55493/5002.v16i1.5786.
30. Bigerna, S. et al. Net-Zero Policy vs Energy Security in GCC. *Energy J.* 2023, 44, 41–72, doi:10.5547/01956574.44.S11.sbig.
31. Baur, D.G.; Todorova, N. Big Oil in the Transition. *Energy Econ.* 2023, 125, 106837, doi:10.1016/j.eneco.2023.106837.

32. Gunawan, J. et al. Green Banking Disclosures. *Environ. Dev. Sustain.* 2022, 24, 11153–11194, doi:10.1007/s10668-021-01901-3.
33. Barman, S.; Mahakud, J. Corruption and Sustainability Disclosure. *JFRA* 2024, doi:10.1108/JFRA-01-2024-0040.
34. Ahsan, T.; Qureshi, M.A. Policy Uncertainty and Sustainability Disclosure. *Appl. Econ.* 2021, 53, 441–453, doi:10.1080/00036846.2020.1808178.
35. Veeravel, V. et al. ESG Disclosure and Firm Performance in India. *QREF* 2024, 95, 193–202, doi:10.1016/j.qref.2024.03.008.
36. Choi, D. et al. Environmental Reputation and Bank Liquidity. *JBFA* 2023, 50, 1274–1304, doi:10.1111/jbfa.12669.
37. Chan, K.J.D.; Wan, W.T.S. Corporate Net Zero and Carbon Risk Premium. *J. Corp. Finance.* 2026, 97, 102920, doi:10.1016/j.jcorpfin.2025.102920.
38. Sun, H. et al. Climate Transition Risk and Default Probability. *Bus. Strategy Environ.* 2024, 33, 8929–8945, doi:10.1002/bse.3955.
39. Qiu, Y. et al. Climate Risk Exposure and Stock Liquidity. *RIBAF* 2025, 79, 103089, doi:10.1016/j.ribaf.2025.103089.
40. Zhang, D. et al. Net-Zero Emissions and Workmanship. *Energy Econ.* 2023, 123, doi:10.1016/j.eneco.2023.106701.
41. Awan, U. et al. Green Innovation and Net-Zero Capabilities. *Bus. Strategy Environ.* 2026, 35, 2777–2791, doi:10.1002/bse.70266.
42. Dua, S. Circular Horizons in Oil and Gas. *Int. Soc. Sci. J.* 2024, 74, 1231–1257, doi:10.1111/issj.12509.
43. Zhang, Z. et al. Quality of Sustainability Report Texts. *Corp. Soc. Responsib. Environ. Manag.* 2023, 30, 1440–1456, doi:10.1002/csr.2429.
44. Fan, J.H. et al. Industry-Guided Review of Responsible Investing. *J. Clean. Prod.* 2022, 354, 131685, doi:10.1016/j.jclepro.2022.131685.
45. Cardillo, M.A.D.R.; Basso, L.F.C. ESG Disclosure–Performance Paradox in BRICS. *Sustain. Futures* 2025, 10, 101510, doi:10.1016/j.sftr.2025.101510.
46. Bressan, S. Power Generation Mix and Market Value. *JRFM* 2025, 18, 437, doi:10.3390/jrfm18080437.
47. Gürbüz, H.; Gürbüz, C. Sustainability Committee and ESG Disclosures. *Sustainability* 2025, 17, doi:10.3390/su17073165.
48. Sultana, N.; Zeya, F. ESG Sentiment Analysis: ML Approach. *Bus. Strategy Dev.* 2025, 8, doi:10.1002/bsd2.70150.
49. Sajj, T.G.; Rajeev Kumar, A.D. Financial Quality and Sustainability Disclosures. *Corp. Soc. Responsib. Environ. Manag.* 2025, 32, 4788–4801, doi:10.1002/csr.3222.
50. La Soa, N. et al. Earning Management and Firm Performance, Hanoi. *Asian Econ. Finance. Rev.* 2025, 15, 845–864, doi:10.55493/5002.v15i6.5397.
51. Anas, B.M.; Halima, B. Sustainability Disclosure and Firm Value in Africa. *Bus. Strategy Dev.* 2026, 9, e70294, doi:10.1002/bsd2.70294.
52. Wooldridge, J.M. *Econometric Analysis of Cross Section and Panel Data*, 2nd ed.; MIT Press: Cambridge, MA, 2010, doi:10.7551/mitpress/12001.001.0001.
53. Baltagi, B.H. *Econometric Analysis of Panel Data*, 6th ed.; Springer: Cham, 2021.
54. Petersen, M.A. Estimating Standard Errors in Finance Panels. *Rev. Finance. Stud.* 2009, 22, 435–480, doi:10.1093/rfs/hhn053.
55. Lavin, J.F. et al. Stock Liquidity and Sustainability in Emerging Markets. *J. Clean. Prod.* 2026, 551, 147917, doi:10.1016/j.jclepro.2026.147917.
56. Hu, M. et al. Cap-and-Trade Regulation and Cost of Capital. *Bus. Strategy Environ.* 2025, 34, 2882–2896, doi:10.1002/bse.4101.
57. Krippendorff, K. *Content Analysis*, 4th ed.; SAGE: Los Angeles, 2019, doi:10.4135/9781071878781.
58. Pereira, C. et al. Environmental Disclosure and Earnings Quality. *Sustainability* 2023, 15, doi:10.3390/su15042871.

59. Nguyen, H.T.T. et al. Earnings Opacity and CSR. *J. Econ. Dev.* 2024, 26, 290–305, doi:10.1108/JED-03-2024-0103.
60. Kumar, D. Sustainability Disclosures and Default Risk. *Curr. Issues Tour.* 2024, 27, 2649–2667, doi:10.1080/13683500.2023.2235879.
61. Maji, S.G.; Haloi, A. National Governance and Decent Work. *JAEE* 2025, doi:10.1108/JAEE-06-2025-0320.
62. Khatri, I. Analyst Coverage and Energy Efficiency. *Rev. Account. Finance.* 2023, 22, 249–265, doi:10.1108/RAF-08-2022-0211.
63. Tran, L.T.H. et al. Climate Vulnerability and Capital Structure. *IREF* 2024, 96, doi:10.1016/j.iref.2024.103711.
64. Kumar, K. et al. Corporate Sustainability Reporting in India. *Bus. Soc. Rev.* 2021, 126, 513–538, doi:10.1111/basr.12247.
65. Cerqueti, R.; Stefanelli, K. Green Transition Attention in Energy. *Energy* 2025, 335, 137811, doi:10.1016/j.energy.2025.137811.

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