"SUSTAINABILITY LEADERSHIP COMPASS: NAVIGATING THE DIGITAL–GREEN TRANSITION"

Research Paper

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"Abstract"

We developed and tested a new tool called the Sustainability Leadership Compass (SLC) to measure how well public companies integrate sustainability and digital technology into their leadership and governance practices. The SLC looks at 10 key indicators across four areas: Vision, Governance, Digital Integration, and External Validation. Using evidence directly cited from annual reports, companies receive a score from 0-10 that reflects what typical investors can easily find and verify. We tested the tool on 41 companies across Europe, North America, and Asia, spanning major industries. Our findings revealed a clear group of sustainability leaders, with European companies generally scoring highest. While we saw some industry patterns, these were less definitive in this initial study. For business leaders and practitioners, the SLC highlights common success factors like board oversight of ESG issues, sustainability-linked executive pay, third-party verification, and visible digital tools like dashboards and AI that drive results.

Keywords: Sustainability, Digitalization, Leadership, Governance, Corporate Strategy, Sustainability Leadership Compass (SLC)

1 Introduction

Two forces are reshaping large listed firms: sustainability and digitalization. The stakeholders are demanding ethical behaviour and true accountability. At the same time, technologies like AI, IoT devices, and data analytics are revolutionizing the manner in which companies operate as well as innovate. To stay competitive and make stakeholders satisfied, CEOs of major corporations need to embrace both digital innovation and sustainability in how they run their businesses. Integrating both is now a competitiveness requirement in today's business age (Hariyani et al., 2025; Capurro et al., 2023)

One common model for dealing with this integration is the European Union's notion of the concept of "twin transitions," or the simultaneous progress in digitalization and sustainability. This model positions the two dimensions as drivers of competitiveness and robustness (European Commission, 2023). Mainstream ESG ratings like DJSI and FTSE4Good focus on ESG scores; and they do not directly measure an organization's digital transformation. This gap shows through in the methodology they release (Sand P Global, 2025; FTSE Russell, 2025).

Larger publicly traded companies are increasingly integrating sustainability and digitalization in their leadership systems and governance systems to meet complex social and technological challenges. The successful integration of both relies on flexible leadership that ensures strategic cooperation, change in culture, and involvement of stakeholders. It further depends on the governance systems that ensure greater transparency and responsibility in both areas. Ongoing studies and case research cite the leadership's immense influence in this process of transformation and innovate governance enables organizations to meet sustainable digital futures.

1.1 Leadership's role in integrating sustainability and digitalization

Leadership has a crucial role in aligning initiatives for digitalization and sustainability. Literature shows that effective leadership facilitates sustainable digital transformation by the deployment of strategic planning, innovation culture, and change management (Hariyani et al., 2025). Leaders should be able to match the long-term aspect of sustainability goals to the constantly flowing and sometimes fleeting nature of digital innovation. Inspiring employees and experimentation encouragement and flexibility are highlighted as major practices. As both digitalization and sustainability become overarching strategic priorities, leaders should foster explicit visions which emphasize both areas (Petrov et al., 2023).

Examples show that successful transformations include cultural movements in the direction of increased collaboration and digital competency. This helps blur the lines across traditional business units and digital teams (Winig, 2016; GE Digital, 2016). The Predix initiative at GE, for example, shows how the injection of digital competency in industry can provide a means to meet sustainability goals by optimizing the effectiveness of operating processes and reducing environmental impacts.

1.2 Governance structures for sustainable digital integration

Corporate governance systems continue converging to incorporate appointed roles and committees addressing sustainability and digital transformation (Capurro et al., 2023). Institutions are rethinking how they obtain and demonstrate accountability, enhance transparency, and link digital governance and sustainability reporting (Velte, 2024; Yu and Hwang, 2024). Boards are receiving more urging to add environmental and digital experience to manage integrated strategies and corresponding risk (Yu and Hwang, 2024; Velte, 2024). As Capurro et al. (2023) proposed, fashion and food industry businesses are integrating governance systems incorporating digital and sustainability functions to catalyze beneficial influences on corporate communication and shareholder relations. Such governance transformations incorporate incentive systems aimed at inspiring worker support for sustainable digital projects and establishing new indexes for accountability that manage both realms.

1.3 Challenges and opportunities

A major challenge is aligning the typically-conflicting time horizons and goals among long-term sustainability and near-term digital innovation. The leadership needs to fulfil various and conflicting expectations by the investors, regulators, consumers, and employees who want more clarity for sustainability and quick response in digital projects (Petrov et al., 2023). The governance systems also need to respond to new risks arising through cybersecurity, data protection, and ethical AI in sustainable business models (NIST, 2023; OECD, 2023).

Despite such challenges, the integration process offers avenues to build organizational resilience, create new sources of revenue, and support company reputation through a demonstration of commitment toward sustainable development via digital capability. Recent research shows a connection between leadership and digital transformation and better green innovation and sustainability outcomes (Sun et al., 2025; Ching et al., 2022).

1.4 Research objective

The research aims to develop a simplified and verifiable measurement model called the Sustainability Leadership Compass (SLC) that will be pilot tested in different geographies and industries to gauge the effectiveness in differentiating leadership practices evident through annual reports.

2 Literature Review

Companies today need to navigate through a fundamental shift in how they need to conduct business, through two main movements: the pursuit for sustainability and the digital revolution. Under the sustainability domain, companies are being increasingly asked to get their act together, whether that is

decreasing their carbon footprint, treating workers with dignity, or giving back to the world. At the same time, they are not able to leverage new dominant technologies such as AI and big data to work smarter and faster. To major public company leaders, winning these changes is not an option but a survival necessity. They need to embed sustainability and digital transformation into the business DNA, from the boardroom to functioning day by day, if they want to satisfy shareholders and stay competitive (Hariyani et al., 2025; Capurro et al., 2023).

Companies are finding that strong leadership with a twin focus on sustainability and technological change is needed to achieve real environmental benefits as well as to keep one step ahead of technology innovation. Top-performing companies have leaders who genuinely care about the planet and will stand up to defend it. They regularly listen to employees, customers, and other stakeholders, invest in both green and digital options, and create an environment where new ideas can flourish.

We are seeing more big companies combine their environmental and digital efforts, rather than treating them as separate initiatives. This is appropriate since today's challenges require tackling both areas together. It works particularly well when leaders stay flexible, think long-term, help shift company culture, and keep everyone in the loop. Of course, clear oversight and responsibility for these efforts is essential, so everyone knows who's accountable for making progress. Ongoing studies highlight leadership's vital role in this dual transformation, with modern governance frameworks helping companies build sustainable digital futures.

2.1 Defining sustainability leadership in the digital-green context

Sustainability leadership entails the ability by individuals or organizations to achieve long-term value through the integration of economic, environmental, and social needs. This is particularly crucial when the environment and technology are rapidly changing (Sajjad et al., 2024). During the digital-green era, such leadership involves the application of digital technology and sustainable practices to drive innovation in pursuit of sustainable outcomes (Ching et al., 2022).

Leading such transformation entails specialized skills. They involve systems thinking, teamwork, strategic orientation, and innovation capacities. Leaders will also spur organizational transformation by fostering a culture focusing on ethics, stakeholder engagement, and resilience (Dreier et al., 2019). Models such as systems leadership focus on integrative perspectives. They foster partnerships, enhance teamwork, and reinforce accountabilities in the context of sustainable development goals (Adams, 2013).

The literature shows that top management is very important for including sustainability in company plans. When leaders are committed, they can link ideas to actions by balancing short-term goals with long-term sustainability targets. It is essential to engage with stakeholders, which means having real conversations with employees, regulators, suppliers, and communities to make sure company strategies meet social needs (Van Norren, 2020).

Making sustainability part of a company's strategy is not easy, despite its obvious benefits. Many employees and leaders push back against green initiatives, especially when the payoff is not immediately clear. It is also frustratingly difficult to measure exactly how sustainable our practices really are. But there are ways forward, we can adapt our management approach to be more flexible, set up clear metrics to track progress, and put money into both sustainable and digital solutions that help us achieve our environmental goals (Engert, Rauter and Baumgartner, 2016).

Integration among digital and green initiatives holds both promise and threat for leaders. The digital technologies namely artificial intelligence, big data analytics, and the Internet of Things (IoT) are today considered indispensable to sustainable business models, careful management of resources, and greater clarity in reporting on sustainability (Sajjad et al., 2024). Good leaders draw on the digital technologies

to develop new ideas while converting competitive advantage to long sustainable value (Ching et al., 2022).

The research shows that digital transformation and sustainability leadership offer the frameworks through which the competing needs for digitalization and sustainability may be balanced. Strong leadership support, the involvement of stakeholders and investment in flexible technology and culture are key in helping organizations be sustainable and robust (Van Norren, 2020; Adams, 2013).

2.2 Leadership's role in integrating sustainability and digitalization

Leadership has a critically significant function in aligning sustainability and digital technology initiatives. Literature exhibits how leadership influences sustainable digital transformation by means of strategic planning, change management, and the development of innovation environments (Hariyani et al., 2025). Leaders are called upon to balance the long-term nature of the sustainability goals and the rapid and often short-term nature of digital innovation. Good practices are inspiring the employees, challenging them to experiment, and staying flexible. As digital technology and sustainability become key strategic initiatives, leaders must create concise visions including both (Petrov et al., 2023).

Case studies demonstrate that successful transformations involve a culture shift to collaboration and enhanced digital abilities. This approach breaks down silos among conventional business units and digital organizations (Winig, 2016; GE Digital, 2016). For instance, the GE Predix initiative demonstrates how the inclusion of digital technologies in industry helps achieve environmental goals through increased effectiveness and diminished environmental destruction.

2.3 Governance structures for sustainable digital integration

Models of Corporate governance systems are adapting to the inclusion of explicit roles and committees dealing with digitalization and sustainability. Firms are redefining the duty, enhancing clarity, and connecting digital governance and sustainability reporting (Capurro et al., 2023). Boards are also urged to acquire blended skills in digital/IT and ESG to manage blended strategies and risk (Velte, 2024; Yu and Hwang, 2024). Capurro et al. (2023) observe that firms in the fields of fashion and food are applying governance patterns merging digital and sustainability roles that ease corporate communicative processes and stimulate stakeholders' involvement. Such governance reforms accommodate reward systems encouraging worker participation in sustainable digitalization and new standards of responsibility for both fields.

2.4 Potential challenges

A key struggle we face is bridging the gap between sustainability planning, which tends to look years or even decades ahead, and the fast-paced world of digital innovation, where teams often focus on quick wins as well as rapid development cycles. It is like trying to sync up two completely different rhythms: the patient, long-term view of environmental initiatives with the rapid pace of tech development. Leaders must respond to complicated expectations by investors, regulators, consumers, and employees for more disclosure on sustainability and rapid digital project decision-making (Petrov et al., 2023).

2.5 Research gap

Previous research has associated leadership, governance, and digital technology with sustainability, but we lack an open, replicable measure that brings together digitalization and ESG governance, is traceable to report pages of individual companies, and scales up from individual firm case studies. Indices such as DJSI/FTSE4Good are proxy measures of digital integration, and their inputs and weights are difficult to check. We offer a page-cited, binary index (SLC) and a cross-region pilot that demonstrates how evidence from annual reports separates companies on integrated leadership practices with low investor search costs.

3 Methodology

We developed a simple measurement tool called the Sustainability Leadership Compass (SLC). We tested it with large listed companies from different regions and sectors to see if there were clear signs of sustainability and digitalization in their annual reports. We used the SLC to check how well these big firms included sustainability and digitalization in their leadership and governance during the last reporting period. The SLC had ten yes/no indicators grouped into four areas. Vision looked at whether the CEO and CFO talked about sustainability and if the report made a clear connection between digitalization and sustainability. Governance checked if there was a board-level ESG/sustainability committee, if executive pay was linked to sustainability goals, and if non-financial/ESG data were reviewed by outside experts. Digital Integration examined if ESG/digital reporting systems were used and if there were digital projects that clearly showed sustainability benefits (like dashboards, AI/IoT). External Validation checked if the company received a CDP Climate grade A/A– and if the Science Based Targets initiative (SBTi) status showed "near-term targets set." Each indicator received a score of 0 or 1. The eight internal indicators gave a score between 0 and 8, and the two external indicators (CDP, SBTi) added up to 2 points, making a total SLC score from 0 to 10.

We intentionally selected 41 companies to permit comparison across various regions and industries in Europe, North America, and Asia. We examined significant industries such as Technology, Financials, Industrials, Consumer, Energy and Utilities, and Healthcare. Our aim was to obtain insight for comparison purposes, not to represent the entire population. We deliberately selected companies at various growth stages to observe how practices differ. English annual reports constituted the primary source for internal indicators. To keep our analysis consistent, we used the main annual report whenever possible. When that was not available, we looked at the next best similar option, whether that was an Integrated Annual Report, a Universal Registration Document, or SEC filings like Form 10-K or 20-F. We deliberately kept things simple by sticking to these core documents and avoided pulling in data from sustainability reports, company websites, or separate disclosures about compensation and governance, which would increase the complexity. This helped us make fair comparisons across the board.

If relevant content did not exist in the acceptable annual report, the respective indicator received a score of 0. This decision for our dataset considers the study as testing the SLC tool by enabling ease of comparability and accessibility comparison of annual reports across markets instead of attempting to count all different sustainability practices across various reports. Two coders, 1 and 0, were applied a binary coding technique to text located on some pages (such as CEO/CFO letters, strategy statements, governance sections, risk/assurance notes, and technology/digital narratives). When there were ambiguous cases, they were coded as 0 unless distinctly justified by the eligible text. Fields for external validation (CDP and SBTi) were introduced on the basis of compiled data and by fixed binary rules (CDP A/A– = 1; otherwise, 0; SBTi "near-term targets set" = 1; if not, 0).

We ran descriptive statistics (group means, standard deviations, and 95% CIs) and one-way ANOVA to establish whether mean internal scores varied by simplified industry sector and region. F statistics and degrees of freedom, right-tail p-values, and effect sizes calculated as η^2 were reported. Because the resulting group sizes were small and not equal, the ANOVA was viewed as exploratory and the results interpreted using CIs. The entire testing and calculated values were run using Excel formulas such that if one company-level value changed the whole statistics would be automatically re-calculated. One-way ANOVA tested mean internal score differences by region and industry sector in one test each (to avoid increasing Type I error) and F, df, right-tail p and η^2 were reported; because the groups were not equal the resulting ANOVA tests were viewed as exploratory and interpreted alongside 95% CIs.

4 Results

The 41-firm pilot test shows an average score of 5.66 out of 8. The total scores have a right-skewed distribution, see Figure 1, which means that the tool identified a clear level of leadership.

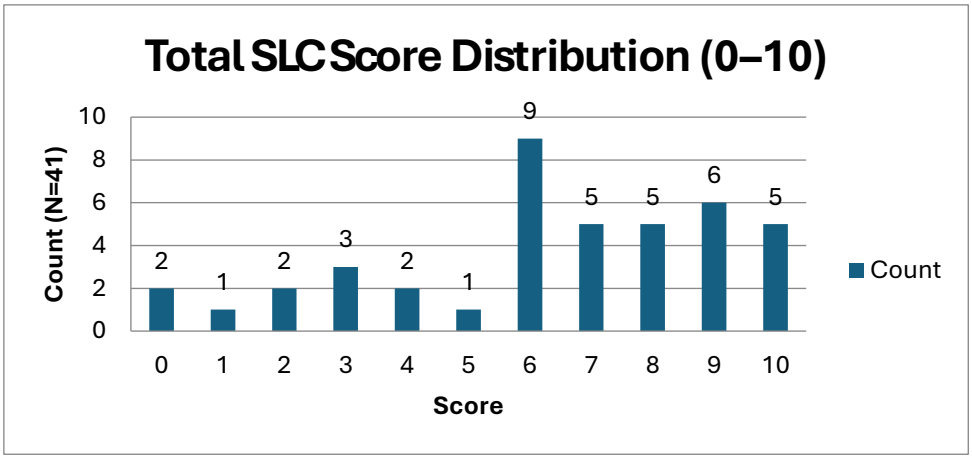

Figure 1. SLC score distribution.

Selective external validation occurred. Within the sample, 8/41 (19.5%) obtained CDP A/A–, 20/41 (48.8%) indicated SBTi "near-term targets set," and 6/41 (14.6%) had both; 22/41 (53.7%) possessed at least one of the two validations. The validations were concentrated in the European region (7/8 CDP A/A–; 10/20 SBTi-set), with the North American region contributing one CDP A/A– and eight SBTi.

In the industry categories, Technology, Industrials, and Energy and Utilities had stronger internal scores. This is because they tended to disclose board-level ESG supervision, pay tied to ESG, independent checks, and digital systems for sustainability outcomes in annual reports. Financials and Consumers were in the middle, with greater variability, while the lowest internal averages were for the Healthcare sector. Considering regions, the highest internal maturity belonged to Europe. North America was moderate but frequently lacked evidence on checks and pay tied to ESG in annual reports. Asia produced mixed outcomes, with good internal performers and less outside validations, see Figure 2.

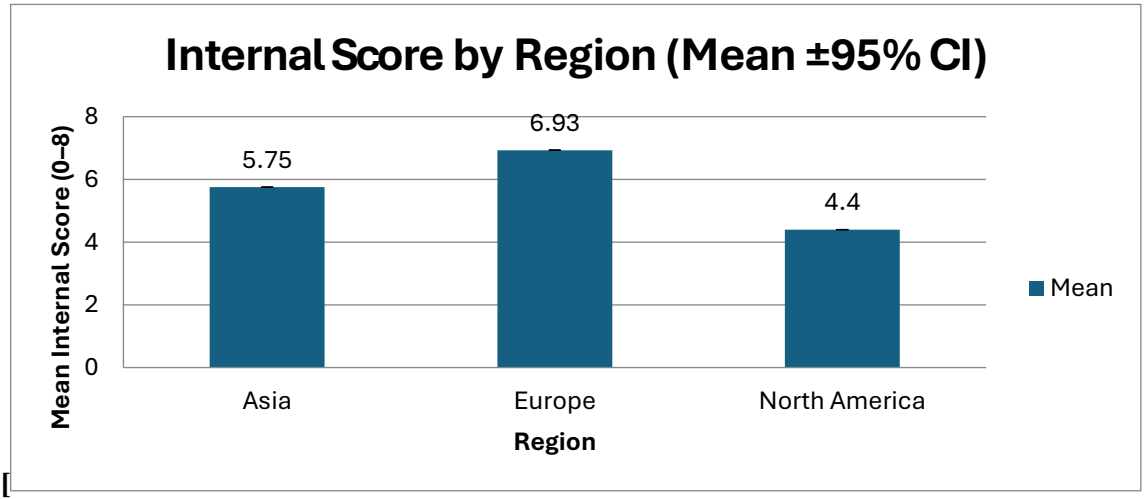

Figure 2. Internal Score by Region.

One-way ANOVA indicated that the, regional differences were statistically significant with a moderate effect size: $F(2,38) = 4.35$, $p = 0.020$, $\eta^2 = 0.186$ (Europe > Asia > North America). These results are consistent with the descriptive pattern in Figure 2 and the confidence intervals in Table 1.

Region	n	Mean	SD	95% CI Low	95% CI High
Asia	12	5.75	1.71	4.78	6.72
Europe	14	6.93	2.16	5.79	8.06
North America	15	4.40	2.80	2.98	5.82

Table 1. Descriptive statistics for the regions.

By contrast, the sectoral differences in internal means did not reach conventional significance for the one-way ANOVA: $F(5,35) = 1.64$, $p = 0.175$, $\eta^2 = 0.190$. Furthermore, sector comparisons should be read as exploratory in this pilot test, given unbalanced sample sizes, e.g., Healthcare $n = 4$, table 2. The wider 95% confidence intervals in small-*n* groups are consistent with the non-significant sector ANOVA and caution against strong sectoral claims.

Sector	n	Mean	SD	95% CI Low	95% CI High
Consumer	7	5.43	2.76	3.38	7.47
Energy and Utilities	4	7.00	0.82	6.20	7.80
Financials	10	5.50	1.78	4.40	6.60
Healthcare	4	2.75	2.63	0.17	5.33
Industrials	6	6.33	3.14	3.82	8.85
Technology	10	6.20	2.49	4.66	7.74

Table 2. Sectoral statistics. Sector comparisons are exploratory in this pilot study due to unbalanced sample sizes, estimates and CIs are reported for transparency.

The findings indicated there was a regional influence on internal SLC performance and the region leader was Europe. Sector differences did not achieve typical significance ($\alpha = 0.05$) in this sample, although complex and tech-leaning sectors had greater internal scores. Well-performing companies tended to demonstrate similar behaviour by CEOs and CFOs on sustainability matters, had board-level oversight on ESG matters, provided ESG-tied pay, received third-party assurance, and had visible digital systems in connection to sustainability outcomes; such internal predictors tended to complement accompanying external validations.

5 Discussion

These exploratory findings provide evidence for the SLC functioning as a discriminating screen in annual report reporting, with evident regional separation and directional (non-significant) sector patterns. Application of the SLC to a source-standardised sample dataset of annual-report evidence revealed significant dispersion in the practices of sustainability leadership. The sample mean internal score (5.66/8) and mean aggregate score (≈6.34/10) revealed that a considerable subset had ingrained the governance and digital enabling factors associated with credible leadership; ~27% achieved ≥9/10. The regional ANOVA result suggested that annual-report evidence maturity was higher in Europe (moderate effect size, $\eta^2 \approx 0.19$), and concordant with greater push by regulators and the predominance

in European reporting practices of assurance and ESG-related agendas. Although sectoral contrasts were not statistically significant, the ordering seen descriptively (Technology, Industrials and Energy and Utilities tended to score higher) consistent with the contexts in which digital instrumentation, operating KPIs and board-level monitoring become increasingly prevalent in mainstream reporting. Overall, the findings provide evidence to support the SLC's practical discriminant value, it is responsive to regional differences, while sector patterns are properly considered exploratory in this pilot.

The annual-vehicle protocol does not only limit sources; it also checks how easy it is for investors to access information. Many investors do not look at every extra filing or company website. Therefore, looking at the main annual report (or its equivalent) shows what a reasonable investor can learn without needing to read multiple documents. In this way, a zero on an internal indicator can show where the information is located and the effort needed by readers, instead of showing a complete lack of practice. From a management point of view, this means: even if more details are found in sustainability reports or other documents, companies should highlight the key points in the annual report itself, at least a short summary, like a brief paragraph and a reference, covering board-level ESG oversight, ESG-linked pay, assurance details, and the specific digital systems used to achieve sustainability goals. Moving SBTi status to "near-term targets set" and improving CDP performance (A/A–) makes credibility stronger when these key points appear in the main report.

This was a purposive sample for comparison only, not a count; the resulting trends do not represent market shares. Our convention only using reports in the last year was intentional: it emphasizes what the first-eyes investor sees first and ensures the data is comparable and easy to verify across locations. The flip-side is that companies that place ESG information primarily in stand-alone reports appear less prominent here; a zero may represent "not reported in the annual report" rather than "does not exist." We also employ simple yes/no flags to keep the score clear and repeatable and thereby eliminate complexity, such as assurance scope or pay mix depth. Finally, ANOVA outcomes are exploratory due to unbalanced groups; we also report 95% confidence intervals and effect sizes in addition to p-values. The external validations (CDP, SBTi) represent the status at the time they were obtained and are subject to change. Overall, these decisions facilitate easier investor access, consistency and verifiability while enabling future research to add more information or alternate document sensitivities.

6 Conclusion

We introduced and tested the Sustainability Leadership Compass (SLC) and found it intuitive to understand, reproduce, as well as useful for comparing annual-report information. The results show different practices and a clear pattern with Europe in the lead; sector patterns are more about direction and exploration. Our design focuses on annual reports to help investors: a zero can show where the information is from, not that there is no practice. In practice, companies should show—within the annual report—board-level ESG oversight, ESG-linked pay, independent checking, and the specific digital systems (like dashboards/AI/IoT) that lead to results, with SBTi/CDP helping to build trust. Limitations include focused sampling, only annual evidence, simple indicators, and exploratory ANOVA. Recommendations for future research include introducing a larger sample scope to test the model further, testing weighted/intensity measures and utilizing machine learning models.

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