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FULL LENGTH ARTICLE

Workforce Sustainable Technology Leadership: A Cross-Country Measurement Model for Human Resources, Leadership, and Sustainable Business

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ABSTRACT

Sustainable business transformation is usually described as a technology problem, a leadership problem, or a human-resource problem. In practice, it is all three. This paper develops a cross-country analytical model that links workforce capability, responsible digital leadership, and sustainable operating capacity into a single diagnostic framework. A curated public-indicator extract was prepared from World Bank World Development Indicators, Worldwide Governance Indicators, and labour-market indicator definitions, covering 41 economies with recent values for internet use, R&D intensity, advanced workforce capacity, female senior management, renewable-energy reliance, carbon pressure, governance effectiveness, and digital skills. The proposed Workforce Sustainable Technology Leadership Index (WSTLI) is used to compare countries, identify capability gaps, cluster transformation profiles, and simulate the effect of combined upskilling, leadership governance, and green-technology interventions. The analysis shows that digital readiness alone is insufficient; several economies with high connectivity still show weak sustainability operating capacity, while others with stronger renewable-energy profiles lack the digital-HR capability needed to convert sustainability into scalable business practice. The paper provides a practical measurement architecture for HR leaders, executives, and policy-oriented business analysts who need to align workforce strategy with technology-enabled sustainability.

Keywords: Human resources ▪ Digital leadership ▪ Sustainable business ▪ Workforce transformation ▪ Technology strategy

1. INTRODUCTION

Technology-led sustainability programmes often fail for a simple reason: the organization upgrades systems faster than it upgrades the people, leadership routines, and operating discipline required to use those systems responsibly. Human-resource departments are no longer only administrative support units; they now shape workforce skills, digital work design, leadership accountability, employee participation, inclusion, and organisational resilience. Sustainable business transformation therefore depends on a triad: people who can work with technology, leaders who can govern technology responsibly, and operating systems that convert digital capability into lower environmental and social risk.

The current literature has developed strong arguments around digital HRM, sustainable HRM, digital leadership, and green business transformation. However, these streams are often measured separately. Digital transformation research may focus on technology adoption and business agility, while sus-

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tainable HRM research may focus on employee well-being, green practices, and long-term capability. Leadership research adds a further layer by emphasizing vision, culture, and accountability. The practical question facing organizations is not whether these ideas are important, but how to measure their alignment.

This paper proposes a measurement-oriented answer. It builds a Workforce Sustainable Technology Leadership Index (WSTLI) from three component scores: Human-Resource Technology Readiness (HRTR), Responsible Digital Leadership (RDL), and Sustainable Operating Capacity (SOC). The index is not intended to rank countries as a final judgment. It is intended as a diagnostic model that helps identify whether the binding constraint is workforce capability, leadership governance, or sustainability operating capacity.

The empirical design uses a cross-country public-indicator extract. The indicators are drawn from public international statistics that capture digital access, skills, R&D intensity, women in management, governance effectiveness, renewable-energy reliance, and carbon pressure. This type of dataset is not a firm survey, but it is useful for understanding the macro-environment in which human-resource leaders and businesses operate. It provides a structured view of how people, leadership, technology, and sustainability readiness co-exist across economies.

The paper differs from the previous style of purely technical modelling papers by presenting the analysis as a management measurement architecture. The results are organized around gaps, clusters, scenarios, and decision implications rather than only around prediction accuracy. The purpose is to support HR leaders, executives, and sustainability teams who must translate digital transformation into measurable workforce and business outcomes.

2. RELATED WORK

Recent research increasingly treats digital transformation as a human and leadership challenge rather than a purely technological project. Hamdani and Chihi [1] frame adaptive human–computer interaction for Industry 5.0 around human-centred technological adaptation. Hariyani et al. [2] emphasize that leadership is central to sustainable digital transformation because leaders translate sustainability goals into organizational practices. Eger and Zizka [3] map the links between Industry 4.0, digital transformation, and HRM, showing that workforce capability is a major theme in current research.

Sustainable HRM research has also become more digital. Nastase et al. [4] argue that strategic HRM must evolve with technology-driven organizational models. Hornungova [5] reviews how digital transformation shapes sustainable HRM and identifies future research directions in this area. At the level of HR technology, recent studies examine how digital HRM systems influence HR efficiency, organizational agility, and workforce competitiveness [6]. These studies converge on a practical conclusion: sustainable business capability depends on the joint design of technology and people systems.

Public international data sources provide a complementary view. The World Bank's 2025 World Development Indicators update documents refreshed comparable indicators across people, prosperity, infrastructure, digital access, and environmental conditions [7]. The World Bank's *Digital Progress and Trends Report 2025* provides a data-driven account of connectivity, digital skills, and technology readiness [8]. The ITU's *Facts and Figures 2025* supplies internationally comparable internet-use and connectivity estimates [9], while the ILO's *World Employment and Social Outlook: Trends 2025* frames labour-market and workforce conditions [10]. These sources do not measure leadership inside a firm directly, but they offer a transparent basis for constructing a macro-level readiness model.

Table 1 shows that the present study is positioned between three streams: digital HRM, leadership for sustainability, and public-indicator measurement. The distinction is important. The paper does not claim that a country-level indicator replaces firm-level HR analytics. It uses country-level indicators to create a transparent external readiness environment that firms and HR leaders can use for benchmarking.

3. CONCEPTUAL MEASUREMENT ARCHITECTURE

The proposed model is designed around three questions. First, does the workforce have enough digital and advanced-skill capacity to support technology-enabled transformation? Second, does the leadership and governance context provide enough responsible direction to make that transformation credible? Third, is the operating environment moving toward sustainable business capacity rather than only digital expansion?

Figure 1 represents the paper's logic. The top of the triangle reflects workforce technology readiness. The left base reflects responsible leadership, and the right base reflects sustainability operating capacity. The central index is meaningful only when the three dimensions are interpreted together. A country with excellent connectivity but weak renewable-energy capacity may still face sustainability risk. A country with strong renewable-energy reliance but low advanced workforce capacity may struggle to scale sustainable business technology.

4. DATASET AND INDICATOR CONSTRUCTION

The empirical dataset is a country-level public-indicator extract covering 41 economies. The variables were selected because they align with the paper's three constructs. Internet use and digital skills represent broad digital workforce access. Advanced labour capacity and women in senior management represent human-resource depth and inclusion in leadership. R&D intensity and governance effectiveness represent responsible digital leadership capacity. Renewable-energy reliance and carbon pressure represent sustainability operating conditions. The underlying indicator definitions were drawn from the World Bank, ITU, and ILO data environments [7, 8, 9, 10, 11, 12].

Figure 2 summarizes the analytical workflow. Public indicators are first harmonized into a country-year extract. The variables are then normalized, grouped into component scores, and used to produce diagnostic outputs. The lower part of the figure highlights that the purpose is not only to calculate an index, but also to convert the index into human-resource and leadership recommendations.

Table 2 clarifies how each indicator is interpreted. The variables are not interchangeable. For example, R&D intensity

Table 1. Recent studies and public sources informing the measurement model.

Source	Focus	Main contribution	Use in this paper
Hamdani and Chihi [1]	Human-centred adaptation	Links adaptive interaction and digital environments to user-centred performance.	Supports the human-centred interpretation of technology transformation.
Hariyani et al. [2]	Sustainable digital leadership	Positions leadership as a mechanism for translating digital transformation into sustainability.	Motivates the responsible digital leadership component.
Eger and Zizka [3]	Industry 4.0 and HRM	Maps emerging HRM themes in digital transformation and Industry 4.0.	Supports the workforce-technology readiness perspective.
Nastase et al. [4]	Strategic HRM	Shows how SHRM evolves with digital-era competitiveness and sustainability.	Justifies treating HRM as strategic infrastructure.
Hornungova [5]	Sustainable HRM	Reviews digital transformation as an instrument for sustainable HRM.	Provides conceptual support for linking HR and sustainability.
Mahmoud et al. [6]	Digital HRM systems	Examines digital HRM, HR efficiency, and agility.	Supports the operational interpretation of digital HRM capability.
World Bank WDI update [7]	Public indicators	Documents refreshed international development indicators across major themes.	Supplies the public indicator base.
World Bank DPTR [8]	Digital readiness	Analyses connectivity, skills, data, and technology-readiness conditions.	Supports the digital capability layer.
ITU Facts and Figures [9]	Internet indicators	Provides comparable internet-use and connectivity estimates.	Used as the digital access component.
ILO WESO Trends [10]	Labour indicators	Frames global employment and workforce conditions.	Supports the human-resource indicator layer.

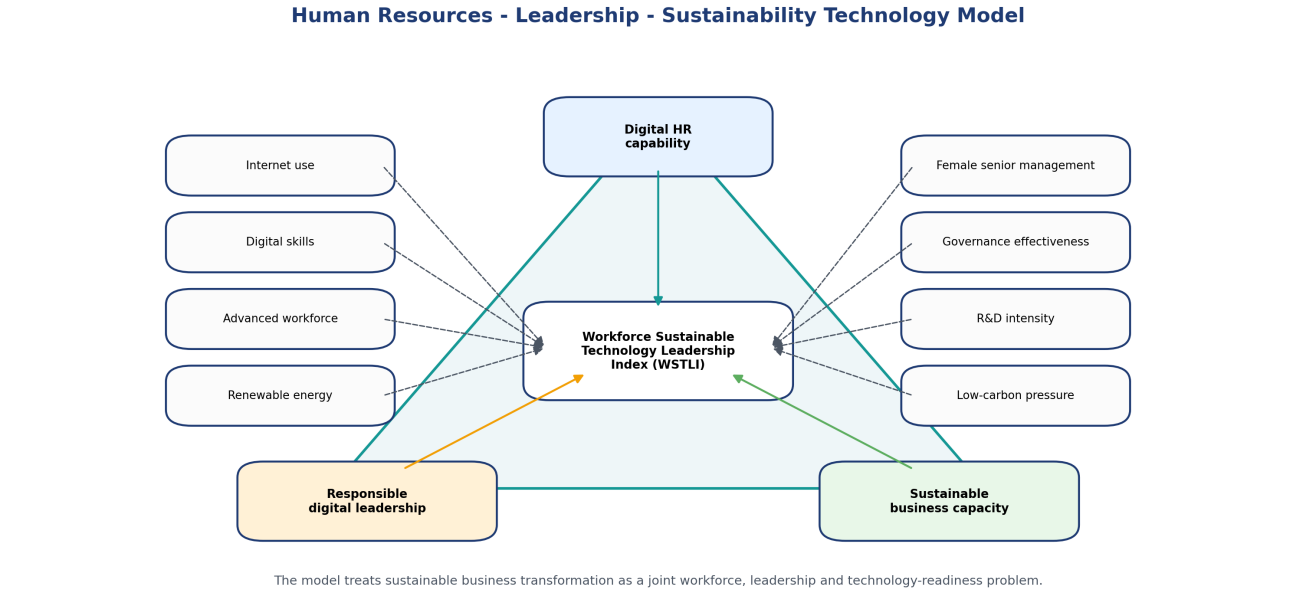


Figure 1. Conceptual canvas linking digital HR capability, responsible digital leadership, and sustainable business capacity.

Table 2. Dataset variables and interpretation.

Variable	Role in model	Expected contribution	Management interpretation
Internet users (%)	Digital access	Higher values increase HRTR.	Indicates whether digital work practices can reach most of the workforce.
Digital skills score	Workforce technology capability	Higher values increase HRTR and RDL.	Represents readiness for digital HR platforms and analytics-enabled work.
Advanced labour (%)	Human capital depth	Higher values increase HRTR.	Indicates availability of advanced skills for technology-intensive work.
Female senior management (%)	Inclusive leadership capacity	Higher values increase HRTR and RDL.	Captures whether leadership pipelines are inclusive and diverse.
R&D expenditure (% GDP)	Innovation intensity	Higher values increase RDL and SOC.	Indicates commitment to knowledge creation and technology renewal.
Governance effectiveness	Responsible leadership context	Higher values increase RDL and SOC.	Approximates public governance quality supporting responsible business practice.
Renewable energy (%)	Sustainable operating capacity	Higher values increase SOC.	Indicates compatibility between business expansion and cleaner energy systems.
CO_2 per capita	Carbon pressure	Lower values increase SOC.	Captures environmental pressure associated with economic activity.

contributes to innovation and leadership capacity but does not guarantee a sustainable business environment. Renewable energy improves sustainability capacity but does not guarantee that HR systems can implement technology-enabled change. The model therefore keeps the components separate before combining them.

5. PROPOSED WORKFORCE SUSTAINABLE TECHNOLOGY LEADERSHIP INDEX

Let $x_{j,c}$ denote normalized indicator j for country c. Human-Resource Technology Readiness is defined as

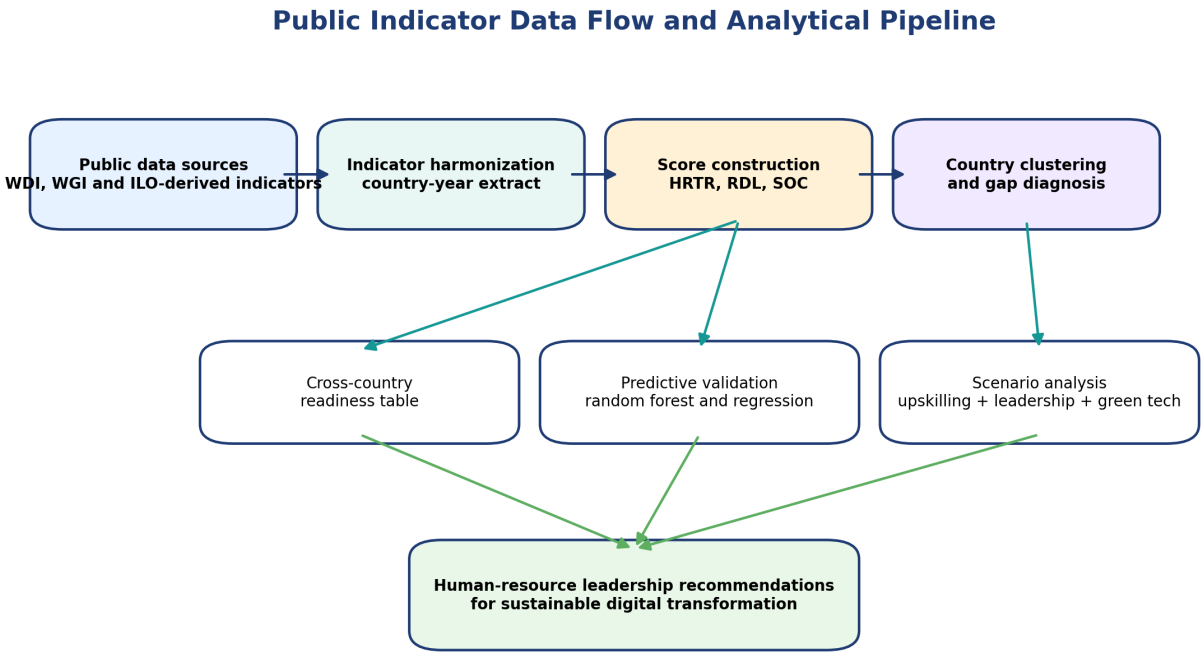


Figure 2. Public-indicator data flow used to construct the workforce sustainable technology leadership dataset.

$$\mathrm{HRTR}_c = 100\,(0.35A_c + 0.25D_c + 0.20I_c + 0.20F_c)\,, \quad (1)$$

where A_c is advanced labour capacity, D_c is digital skills, I_c is internet use, and F_c is female senior management participation.

Responsible Digital Leadership is defined as

$$\mathrm{RDL}_c = 100\,(0.40G_c + 0.25F_c + 0.20R_c + 0.15D_c)\,, \quad (2)$$

where G_c is governance effectiveness and R_c is R&D intensity. Sustainable Operating Capacity is defined as

$$\mathrm{SOC}_c = 100\,(0.40E_c + 0.30C_c + 0.15R_c + 0.15G_c)\,, \quad (3)$$

where E_c is renewable-energy reliance and C_c is inverse carbon pressure. The final index is

$$\mathrm{WSTLI}_c = 0.35\mathrm{HRTR}_c + 0.30\mathrm{RDL}_c + 0.35\mathrm{SOC}_c. \quad (4)$$

The weights deliberately give human-resource capacity and sustainability capacity equal importance. This avoids a common weakness in digital transformation measurement: countries or organizations with strong technology adoption receive high readiness scores even when environmental operating conditions are weak. Leadership receives a slightly smaller but still substantial weight because it acts as an integrating mechanism rather than a separate end state.

6. DESCRIPTIVE RESULTS

Table 3 reports the highest-ranked country-level observations by WSTLI. The table should be read as a diagnostic ranking rather than a final competitiveness index. The most balanced

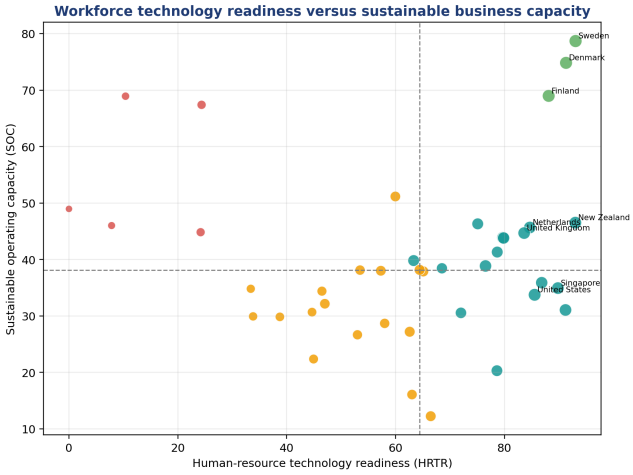


Figure 3. Relationship between human-resource technology readiness and sustainable operating capacity.

cases combine high workforce technology readiness with responsible leadership and sustainability operating capacity.

The leading cases in Table 3 are generally economies with strong digital access, advanced workforce capacity, and credible governance. However, the table also shows that leadership and sustainability do not move perfectly together. Some high-income economies have strong HRTR and RDL values but lower SOC because of carbon pressure or weak renewable-energy reliance. This finding is relevant for HR strategy: digital skills programmes should be paired with sustainability literacy and green-operating routines.

Figure 3 visually separates economies into four zones. The most desirable zone is the upper-right area, where HRTR and SOC are both strong. The lower-right zone indicates sustainability capacity without equivalent workforce technol-

Table 3. Top country observations by Workforce Sustainable Technology Leadership Index.

Country	Region	Income	HRTR	RDL	SOC	WSTLI	Gap	Cluster
Sweden	Europe	High income	93.1	88.6	78.7	86.7	14.4	Integrated leaders
Denmark	Europe	High income	91.3	86.3	74.8	84.0	16.5	Integrated leaders
Finland	Europe	High income	88.1	85.3	69.0	80.6	19.2	Integrated leaders
New Zealand	Oceania	High income	93.0	81.2	46.5	73.2	46.5	Sustainability-balanced
Netherlands	Europe	High income	84.7	78.0	45.7	69.0	39.0	Sustainability-balanced
United Kingdom	Europe	High income	83.6	78.8	44.7	68.5	38.9	Sustainability-balanced
Singapore	East Asia	High income	89.8	79.6	34.9	67.6	54.9	Sustainability-balanced
United States	North America	High income	85.5	83.3	33.7	66.7	51.8	Sustainability-balanced
Australia	Oceania	High income	91.2	78.3	31.0	66.3	60.2	Sustainability-balanced
Germany	Europe	High income	79.7	76.3	43.9	66.1	35.9	Sustainability-balanced
Canada	North America	High income	86.8	74.5	35.9	65.3	51.0	Sustainability-balanced
France	Europe	High income	79.8	73.3	43.8	65.3	36.1	Sustainability-balanced
Korea, Rep.	East Asia	High income	76.5	76.2	38.8	63.2	37.7	Sustainability-balanced
Portugal	Europe	High income	75.1	65.3	46.3	62.1	28.8	Sustainability-balanced

Table 4. Regional averages for people, leadership, and sustainability readiness.

Region	Countries	Internet	Adv. labour	Female lead.	Renew.	HRTR	RDL	SOC	WSTLI
Oceania	2	95.5	51.5	39.5	21.5	92.1	79.8	38.8	69.7
Europe	12	92.8	44.7	35.2	29.0	79.6	71.2	49.6	66.6
North America	2	93.0	48.5	39.0	16.0	86.2	78.9	34.8	66.0
East Asia	4	87.8	44.0	21.0	7.5	69.2	66.2	36.4	56.8
Latin America	5	82.0	33.4	37.6	23.2	58.6	43.0	36.6	46.2
Middle East	4	93.0	38.2	19.5	2.0	60.5	44.0	19.6	41.2
Southeast Asia	4	82.5	30.0	29.2	16.2	51.3	38.9	32.3	40.9
Europe/Central Asia	1	84.0	32.0	17.0	13.0	44.7	28.7	30.7	35.0
Africa	4	58.8	24.2	24.0	45.0	28.3	22.3	48.4	33.5
South Asia	3	39.0	21.3	12.0	39.0	10.7	9.8	46.6	23.0

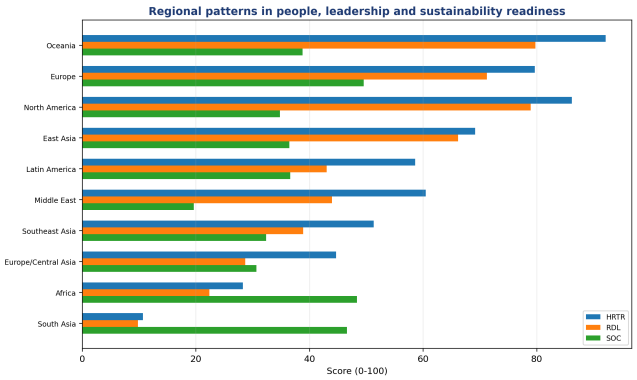


Figure 4. Regional component profiles for HRTR, RDL, and SOC.

ogy depth. The upper-left zone indicates digital workforce capacity without equivalent sustainability operating capacity. These mixed zones are especially important because they reveal where leadership action should be targeted.

7. REGIONAL AND CLUSTER FINDINGS

Table 4 summarizes the component scores by region. Regional averages are not used to stereotype economies; they are used to identify structural patterns that affect HR and sustainability strategy.

Table 4 shows that high digital access does not guarantee high sustainability capacity. North America and parts of the Middle East have strong digital and income conditions but face carbon-pressure limitations. Several European economies show more balanced profiles because their governance and renewable-energy conditions improve SOC. For business leaders, this suggests that global HR policies should not simply copy the same digital transformation template across regions.

Figure 4 provides a clearer comparison of the three components. Regions with similar WSTLI values can have different

Table 5. Cluster profiles derived from HRTR, RDL, and SOC scores.

Cluster	N	HRTR	RDL	SOC	WSTLI
Integrated leaders	3	90.8	86.7	74.2	83.8
Sustainability-balanced	16	80.4	72.0	38.5	63.2
Digital catching-up	17	52.5	38.5	31.1	40.8
Capacity builders	5	13.4	12.9	55.2	27.9

internal structures. A region may be strong in HRTR but weaker in SOC, or it may have reasonable SOC but weaker digital workforce capacity. This supports the paper's argument that HR leaders need a component-level diagnostic, not only a single readiness score.

Table 5 condenses the country results into four managerial profiles. Integrated leaders combine strong people capability, responsible digital leadership, and sustainability operating capacity. Sustainability-balanced economies show stronger environmental capacity relative to digital-HR depth. Digital catching-up economies require broad capability investment. Capacity builders face the deepest alignment problem and need foundational workforce and governance interventions before advanced sustainability analytics can deliver value.

Figure 5 shows the shape of each cluster. The figure is useful because it reveals whether a cluster's weakness is broad or specific. A broad weakness implies capacity building across HR, governance, and sustainability systems. A specific weakness implies targeted intervention. For example, a cluster with high HRTR but lower SOC should prioritize green operating data, climate-related skills, and sustainability-linked process redesign.

8. PREDICTIVE VALIDATION AND FEATURE IMPORTANCE

The index is transparent by design, but it is still useful to test whether the selected indicators predict the constructed

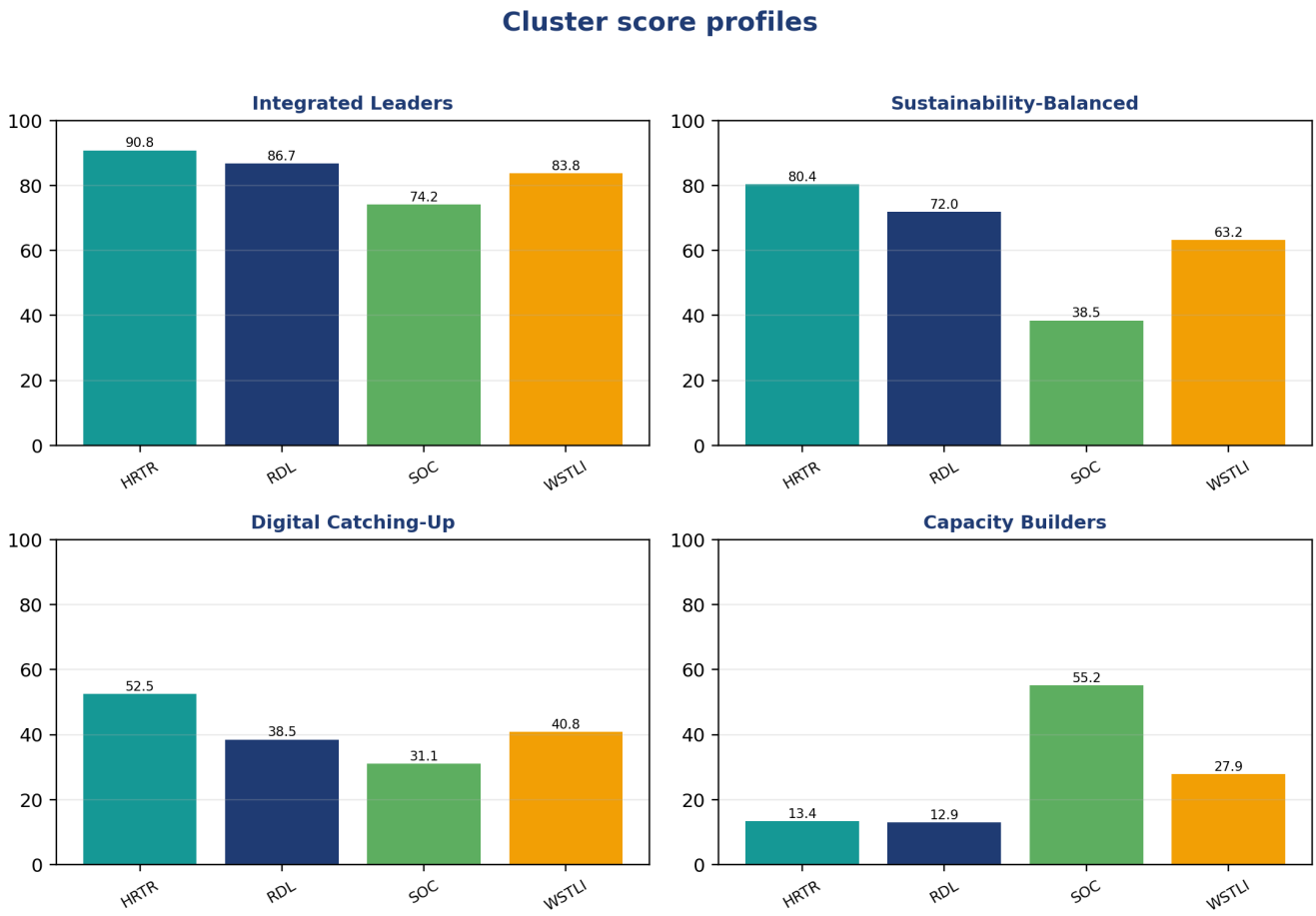


Figure 5. Cluster score profiles across HRTR, RDL, SOC, and WSTLI.

Table 6. Grouped validation summary for predicting WSTLI from original indicators.

Metric	Value
MAE	7.08
R^2	0.739
Countries	41
Features	8

WSTLI in a stable way. A random-forest model was trained using the original indicators and evaluated with grouped cross-validation by region. This test is not used to replace the index formula; it checks whether the underlying indicators contain a coherent signal.

Table 6 shows that the selected variables provide a consistent approximation of WSTLI. The goal is not to maximize predictive accuracy; the goal is to confirm that the variables form a coherent measurement structure. The moderate error level is acceptable for a cross-country diagnostic model because the index combines social, technological, and sustainability variables that naturally differ across institutional contexts.

Figure 6 indicates which public indicators carry the strongest signal in the validation model. Governance effectiveness, digital skills, advanced workforce capacity, renewable energy, and carbon pressure tend to be influential. The finding is substantively important: leadership and governance variables are not secondary controls; they shape whether digital and sustainability capabilities become operationally meaningful.

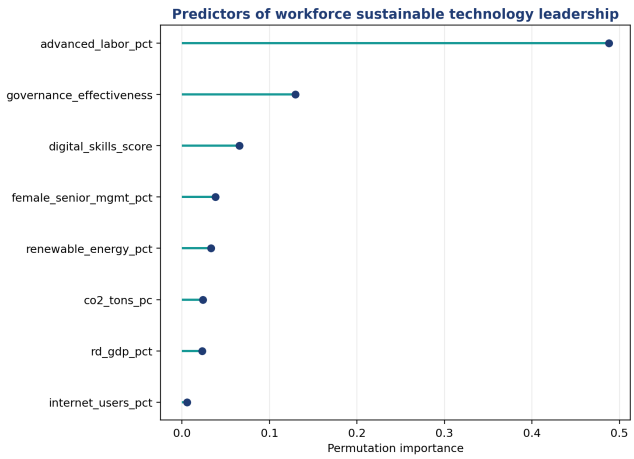


Figure 6. Permutation importance of public indicators in predicting WSTLI.

9. SCENARIO ANALYSIS

The scenario analysis estimates the effect of a balanced transformation package: workforce upskilling, leadership governance strengthening, and green-technology operating improvement. The scenario is intentionally conservative and does not assume that all countries can jump to frontier performance. Instead, it raises each component partially toward the frontier while preserving current structural differences.

Table 7 highlights the countries with the largest simulated gain. These are generally cases where at least one component

Table 7. Largest WSTLI gains under a balanced workforce–leadership–sustainability scenario.

Country	Baseline WSTLI	Scenario WSTLI	Gain
Pakistan	17.1	26.3	9.2
Bangladesh	21.0	29.9	8.9
Egypt, Arab Rep.	29.5	37.8	8.3
India	30.8	39.0	8.2
Nigeria	31.2	39.4	8.2
Morocco	30.5	38.7	8.2
Indonesia	32.2	40.3	8.1
South Africa	33.1	41.1	8.0
Turkey	35.0	42.8	7.9
Kenya	39.2	46.9	7.6
Vietnam	38.6	46.3	7.6
Mexico	39.1	46.7	7.6
China	40.6	48.1	7.5
Saudi Arabia	40.2	47.7	7.5
Qatar	41.8	49.2	7.4

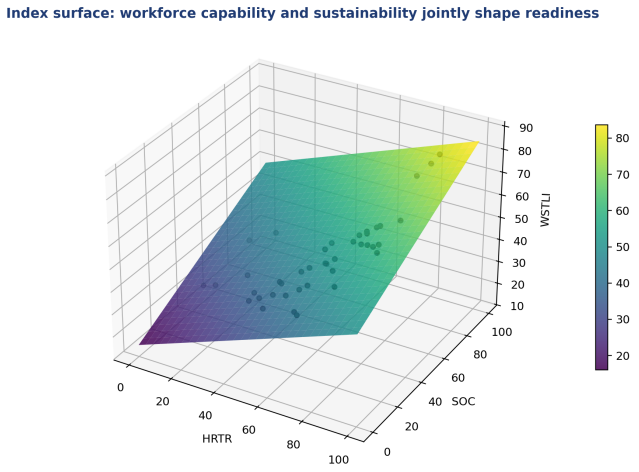


Figure 7. WSTLI response surface under varying HRTR and SOC levels, holding RDL at the sample median.

is substantially below the others. The implication for management is direct: the highest return may come not from investing in the already-strong component, but from strengthening the weakest link. If workforce capacity is weak, HR development is the priority. If SOC is weak, sustainability technology and energy transition capability must be integrated into business planning.

Figure 7 illustrates the interaction between workforce technology readiness and sustainability capacity. The surface rises fastest when both dimensions improve together. This is the central managerial message of the paper: HR digital transformation and sustainable business strategy should not be treated as separate programmes. Their combined movement produces the strongest readiness improvement.

10. LEADERSHIP ACTION FRAMEWORK

The results can be translated into a practical action framework for HR and executive teams. The framework begins with gap diagnosis and then routes the organization toward one of three intervention families: workforce upskilling, digital leadership governance, or sustainability-technology integration.

Figure 8 is designed as a managerial decision flow rather than a technical algorithm. If HRTR is below a regional peer benchmark, the response should focus on workforce upskilling, digital learning pathways, and technology adoption support. If RDL is weak, the response should focus on leadership accountability, governance routines, and measurement transparency. If SOC is weak, the response should connect green operating systems to business data, HR incentives, and performance management.

Table 8 is the practical bridge between analysis and implementation. It shows that the same WSTLI value can imply different actions depending on the internal pattern. This is why the paper avoids treating the index as a simple scoreboard. A useful HR leadership model must identify the kind of work needed, not merely whether a country or organization appears strong or weak.

11. DISCUSSION

The analysis supports three arguments. First, human-resource capability is now part of sustainable business infrastructure. Digital skills, advanced workforce depth, and inclusive leadership pipelines are not soft variables; they influence whether technology can be used responsibly and whether sustainability practices can scale. Second, responsible leadership has an integrative function. Governance effectiveness, R&D intensity, and inclusive senior management help connect workforce capability with sustainable business outcomes. Third, sustainability capacity must be measured alongside digital capacity. High digital readiness can coexist with high carbon pressure, and that mismatch creates strategic vulnerability.

The study also suggests that HR leaders need a broader analytics agenda. Traditional HR dashboards often track headcount, turnover, engagement, and training completion. These measures remain useful, but they do not reveal whether the workforce is prepared for technology-enabled sustainability. A sustainable HR analytics architecture should link skills, leadership, inclusion, digital adoption, energy and carbon signals, and business transformation outcomes. WSTLI provides one way to structure that conversation.

For executive teams, the main lesson is that sustainability cannot be delegated only to environmental specialists, and digital transformation cannot be delegated only to IT. Sustainable business capability emerges when HR, technology, leadership, and operating strategy are managed together. This is particularly important as organizations face mandatory sustainability reporting, AI-enabled work redesign, and rising expectations for responsible leadership.

12. LIMITATIONS AND FUTURE RESEARCH

This paper has limitations. The dataset is a country-level public-indicator extract rather than a firm-level panel. Country indicators provide useful external context but cannot capture internal HR policies, leadership behaviours, or employee perceptions. Future research should connect WSTLI-style external indicators with firm-level HR analytics, employee survey data, sustainability reporting data, and technology adoption records.

A second limitation is that some constructs are represented by proxies. For example, governance effectiveness is used as a responsible-leadership environment indicator, and women in senior management is used as an inclusive leadership proxy. These variables are meaningful but not exhaustive. Future studies should add direct indicators of digital leadership capability, HR technology maturity, green skills, and

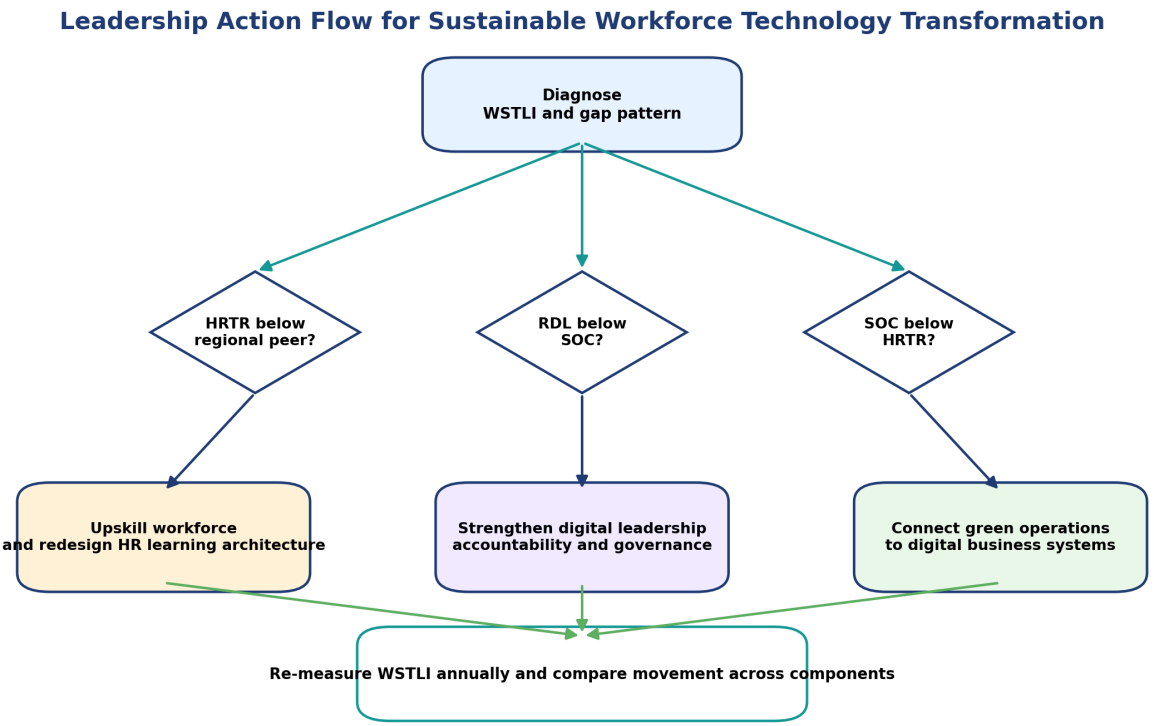


Figure 8. Leadership action flow for converting WSTLI gaps into HR and sustainability interventions.

Table 8. Actionable interpretation of component-score patterns.

Pattern	Likely diagnosis	HR and leadership action	Sustainable business implication
High HRTR, low SOC	Digital workforce capability is not yet connected to sustainability outcomes.	Embed green skills into digital learning and link HR analytics to sustainability metrics.	Digital tools may improve efficiency but not environmental resilience.
Low HRTR, high SOC	Sustainability context exists but workforce technology capacity is insufficient.	Prioritize digital upskilling, change enablement, and inclusive capability building.	Sustainability advantage may remain underused by firms.
Low RDL, high HRTR	Technology adoption may lack responsible governance.	Build leadership accountability, data governance, and transparent decision routines.	Transformation may become fragmented or compliance-driven.
High RDL, low HRTR	Leadership vision is ahead of workforce readiness.	Translate leadership goals into learning paths, job redesign, and employee participation.	Strategy may remain aspirational without operational adoption.
Balanced high scores	People, leadership, and sustainability systems reinforce each other.	Maintain measurement discipline and refresh skills as technology changes.	Higher likelihood of sustained business transformation.
Balanced low scores	Multiple constraints prevent technology-enabled sustainability.	Start with foundational workforce investment and governance capacity.	Advanced sustainability analytics may be premature.

sustainability-linked incentives.

Finally, the weighting scheme is transparent but not universal. Different industries may require different weights. Heavy manufacturing may place more emphasis on carbon pressure and energy transition, while knowledge-intensive services may place more emphasis on digital skills and leadership governance. Future work can estimate sector-specific weights using firm performance, sustainability outcomes, and workforce data.

13. CONCLUSION

This paper developed a Workforce Sustainable Technology Leadership Index for analysing how human resources, leadership, sustainable business capacity, and technology readiness align. Using a cross-country public-indicator extract, the study showed that digital readiness, leadership capacity, and sustainability operating conditions do not automatically move together. The most valuable diagnosis therefore comes from the pattern of component scores, not only from the final index.

The results have direct implications for HR and business leaders. Where workforce technology readiness is weak, upskilling and job redesign should be prioritized. Where responsible digital leadership is weak, governance and accountability routines are needed. Where sustainability operating capacity is weak, digital business systems must be connected to carbon, energy, and environmental performance. The broader message is that sustainable business transformation is not a single technology project; it is a coordinated people–leadership–technology capability.

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