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Governing Workforce Sustainability in the Construction Industry: Integrating Employment Systems, Organizational Climate, and Green HRM

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Abstract: This study develops and empirically validates a governance-oriented framework for workforce sustainability in the construction industry. Moving beyond conventional retention models, it introduces the Workforce Sustainability Index for Construction (WSI-C)—a multidimensional indicator encompassing attendance stability, occupational health and safety (OHS) performance, perceived career growth, and persistence of green practices. Using survey data from 352 construction professionals in Taiwan, a partial least-squares structural equation model (PLS-SEM) links Employment Systems Quality (ESQ), Organizational Climate (OC), and Green Human Resource Management (GHRM) to WSI-C through organizational identification, job satisfaction, and career growth. The study further proposes the Alignment Index (AI) as a governance-based moderator that quantifies the congruence between formal HR policies and employee perceptions. Results confirm significant direct and indirect effects of ESQ, OC, and GHRM on WSI-C, along with a positive moderation by AI that strengthens the OC → WSI-C and GHRM WSI-C pathways. Incremental-validity testing shows that WSI-C explains an additional 12% of organizational variance ($\Delta R^2 = 0.12$) beyond traditional retention intention. Theoretically, the study reframes workforce sustainability as a measurable governance capability by formalizing alignment as a quantifiable boundary condition. Practically, it recommends three governance-ready mechanisms—dual-loop alignment monitoring, an early-warning WSI-C dashboard, and stress-zoned training modules—to institutionalize sustainability-oriented HR governance within the construction sector.

Keywords: workforce sustainability, construction industry, employment systems quality, organizational climate, green human resource management, alignment index, governance, PLS-SEM

1. Introduction

1.1 Background and Conceptual Redefinition

Human Resource Management (HRM) is increasingly recognized as a foundation for achieving both social and operational sustainability in the construction industry [1]. Yet, the sector remains vulnerable to workforce instability caused by project-based employment, multilayer subcontracting, and fragmented career paths [2]. Traditional indicators such as turnover intention capture only limited aspects of this issue and provide insufficient guidance for governance reform. In line with growing efforts to embed social sustainability into project delivery [3], this study reframes the outcome of HR governance as workforce sustainability, an auditable, governance-oriented construct that reflects both organizational credibility and employee continuity.

In Taiwan, where construction plays a central role in infrastructure and urban development, project-based contracting and the heavy use of subcontracting have produced unstable employment structures. Although governmental programs have promoted green construction and safety certification, sustainability-oriented HRM remains fragmented [4]. This environment offers an ideal context to examine how HR governance quality, employee perceptions, and alignment mechanisms collectively sustain workforce stability.

To operationalize this outcome, the study introduces the Workforce Sustainability Index for Construction (WSI-C)—a multidimensional indicator encompassing attendance stability, Occupational Health and Safety (OHS) performance, perceived career growth, and persistence of green practices [2], [3]. These four dimensions align with Construction 4.0 priorities of stable, safe, and green human resources and can be monitored through ESG reporting systems [1], [4]. WSI-C thus reframes workforce sustainability as a measurable and governance-oriented HR outcome rather than a purely psychological intention.

1.2 Governance Alignment and Integrated Framework

HR systems achieve sustainable outcomes only when employees perceive them as credible and fair. To formalize this principle, the study introduces the Alignment Index (AI)—a quantitative metric capturing

congruence between HR policy inputs (e.g., contract stability, benefit coverage, training hours, OHS investment) and employee perceptions (e.g., fairness, safety climate, supervisor support) [4]. In project-based organizations, such alignment acts as a boundary condition determining whether HR initiatives translate into workforce sustainability [2]. While prior studies addressed alignment conceptually [5], none established a measurable index linking policy systems with employee perceptions [6]. AI therefore represents a governance-level innovation that enables institutional auditing and managerial intervention.

The proposed framework integrates systemic drivers—Employment Systems Quality (ESQ), Organizational Climate (OC), and Green HRM (GHRM)—with experiential mechanisms such as job satisfaction and career growth [7]. Using survey data from 352 construction employees in Taiwan analyzed through PLS-SEM, results validate significant direct, indirect, and moderated relationships. AI strengthens the OC → WSI-C and GHRM → WSI-C pathways, while WSI-C contributes an additional 12% explanatory power ($\Delta R^2 = 0.12$) beyond conventional HR outcomes [2].

Theoretically, the study: (1) defines WSI-C as a multidimensional HR outcome, (2) formalizes alignment as a governance mechanism, and (3) integrates systemic and experiential perspectives into a unified model. Practically, it introduces governance-ready tools such as alignment monitoring dashboards, early-warning systems for ESG reporting, and training designs that combine skill upgrading with strain buffering [3], [7].

1.3 Research Questions and Hypotheses

Grounded in Taiwan's construction context, the study seeks to clarify how governance-driven HR systems and alignment mechanisms sustain workforce stability. The research is guided by the following questions:

1. Questions

RQ1. How do ESQ, OC, and GHRM jointly influence workforce sustainability?

RQ2. To what extent do job satisfaction and career growth mediate these effects?

RQ3. How does alignment between formal systems and employee perceptions moderate these relationships?

RQ4. In what ways does the proposed framework extend current understanding of workforce sustainability beyond retention-based models?

2. Hypotheses

H1: Employment Systems Quality positively influences WSI-C [1].

H2: Organizational Climate positively influences WSI-C [8], [9].

H3: Green HRM positively influences WSI-C [4], [10].

H4: Organizational identification mediates the GHRM → WSI-C relationship [4], [10].

H5: Job satisfaction mediates the OC → WSI-C relationship [8], [9].

H6: Career growth mediates the training dimension of GHRM → WSI-C, while work anxiety moderates this mediation [2], [7].

H7: AI strengthens the positive effects of OC and GHRM on WSI-C [4], [6].

H8: WSI-C explains additional variance in organizational competitiveness and institutional trust beyond traditional retention measures [11].

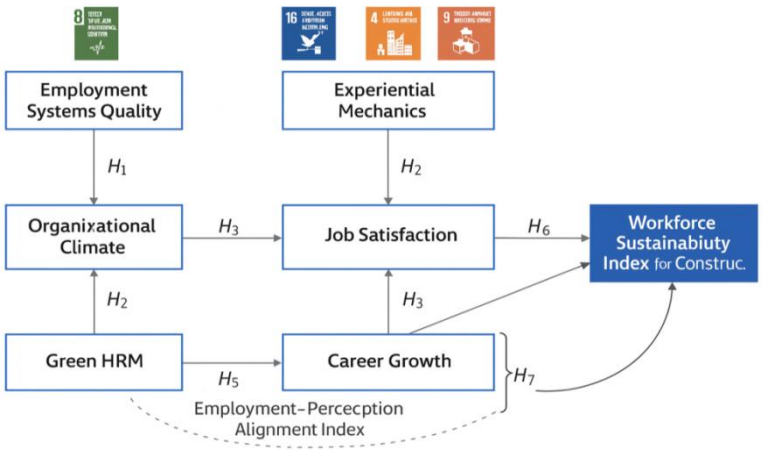

Figure 1: Conceptual model of the hypothesized framework.

2. Literature Review

2.1 Employment Systems and Organizational Climate

Employment systems and organizational climate jointly constitute the governance foundation of workforce sustainability in the construction sector. Empirical evidence confirms that contract stability and employment security significantly influence workers' well-being, commitment, and retention [1], [12], [13]. Permanent employment arrangements, accompanied by solid OHS performance, strengthen job satisfaction and institutional trust, positioning HRM as a strategic determinant of organizational competitiveness [1].

Organizational climate, encompassing fairness, safety, communication, and supervisor support, shapes employees' engagement and turnover behavior [8], [14]. A positive climate rooted in transparency and inclusion enhances job satisfaction and long-term commitment [9]. Integrating these structural and perceptual factors provides a comprehensive governance lens—one in which employment reliability and perceived fairness jointly sustain workforce continuity in project-based environments [6].

2.2 Green HRM and Psychological Mechanisms

Green Human Resource Management (GHRM) merges environmental sustainability with HR practices [15], [16]. Within construction, GHRM involves green recruitment, training, performance appraisal, and participatory initiatives [4]. Studies reveal that GHRM enhances innovation, organizational identification, and retention while reducing turnover intention [10], [17]. Key social-sustainability factors−training, OHS, and employee participation—drive successful implementation [1], [3].

Psychological mechanisms clarify how these HR inputs become sustainable outcomes. Training promotes organizational identification and reduces turnover [2]; perceived career growth mediates this relationship and mitigates work-related anxiety[7]. Job satisfaction bridges diversity climate and engagement [9], while perceived prestige reinforces long-term governance commitment [10]. Collectively, organizational identification, job satisfaction, and career growth function as core mediators translating HRM initiatives into sustainable workforce outcomes within institutional frameworks.

2.3 From Retention to Alignment

Traditional construction-HRM research emphasized turnover and retention, whereas emerging perspectives address workforce sustainability—a multidimensional construct incorporating employability, reskilling, and age-inclusive work design [6], [11], [18]. Composite indices now integrate employability, OHS, and inclusion as metrics of sustainable labor systems [8].

Nonetheless, a persistent gap separates formal HR policies from employees' lived experiences. Prior research documented inconsistencies between intended and perceived HR practices [19], [20]. yet few studies have quantified these discrepancies in construction contexts. To bridge this divide, the present study proposes the Employment–Perception Alignment Index (AI)—a metric assessing congruence between policy systems and perceived fairness, safety, and supervisor support. Integrating AI with employment systems, organizational climate, and GHRM shifts the paradigm from retention to governance alignment, reinforcing institutional trust and measurable workforce sustainability.

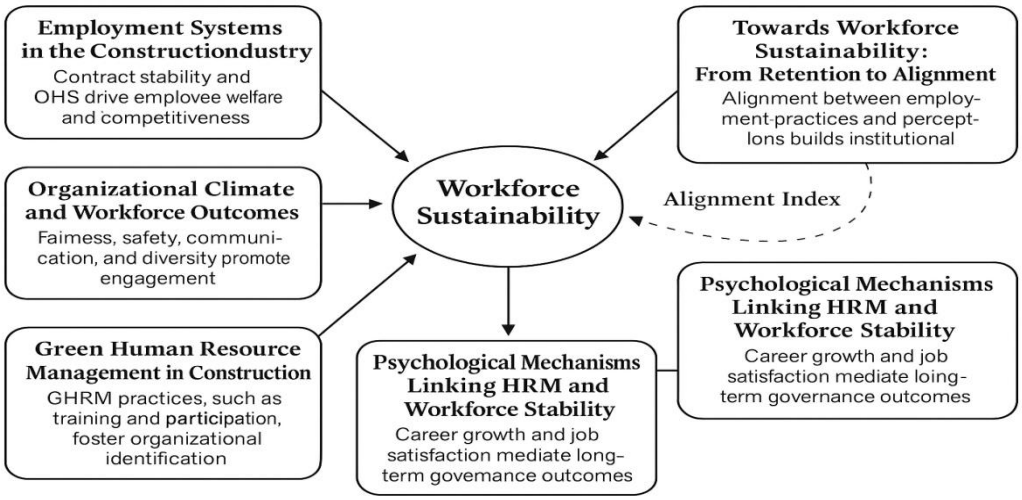

Figure 2: Conceptual framework of workforce sustainability in Taiwan's construction industry.

3. Methodology

3.1 Research Design and Data Collection

This study employed a quantitative, survey-based design supplemented with secondary organizational data, consistent with recent HRM and sustainability research in construction [2], [4]. A structured questionnaire captured employment systems, organizational climate, GHRM, psychological mechanisms, and workforce-sustainability outcomes. Construct validity was enhanced by triangulating responses with records on turnover, training hours, and safety performance [1], [6].

Partial least-squares structural equation modeling (PLS-SEM) was adopted because it accommodates models combining reflective and formative constructs [21]. The study complied with ethical standards; informed consent was obtained, participation was voluntary and anonymous, and Institutional Review Board approval was granted by Feng Chia University (No. FCU-IRB-2025-001).

The empirical context was Taiwan's construction industry, noted for project-based employment and multilayer subcontracting [6]. Respondents included mid-level engineers, site supervisors, and project managers—roles central to workforce stability [2]. Stratified sampling ensured representation across firm sizes and project categories [12]. A power analysis [22] confirmed that 85 responses detect medium effects; thus ≈ 350 responses were targeted. After cleaning, 352 valid cases remained, with < 3 % missing data replaced by mean substitution. Demographics aligned with national workforce statistics, confirming representativeness.

3.2 Measurement and Construct Operationalization

All constructs were measured using validated multi-item scales adapted to the construction context and translated into Mandarin. Expert review and a 30-respondent pilot test ensured clarity.

Table 1: Measurement scales and sources.

Construct	Dimensions / Example Item	No. of Items	Main Sources
ESQ	Contract stability, benefits, predictability / "My employment contract provides stability."	4	Oliveira Neto et al. (2024); Romo et al. (2023)
OC	Fairness, safety, communication, support, diversity / "Supervisors treat employees fairly."	5	Puente Riofrío et al. (2024); Dhanasekar & Anandh (2025)
GHRM	Green recruitment, training, performance, participation / "Employees receive environmental training."	4	Moczydłowska et al. (2024)
OI	Identification with organizational goals / "I feel proud to be part of this organization."	3	Uğural et al. (2020); Yao et al. (2025)
JS	Overall satisfaction and engagement / "I am satisfied with my job."	3	Dhanasekar & Anandh (2025)
CG	Career development opportunities / "My job provides advancement."	3	Yao et al. (2025)
WA	Work-related strain / "I often feel anxious due to site conditions."	3	Yu et al. (2025)
AI	Gap between policy and perception on contracts, training, OHS investments	—	Guest (2011); Nishii & Wright (2008)
WSI-C	Retention, attendance, OHS, career growth, green practice (pooled composite)	5	Silvestru et al. (2024)

1. Workforce Sustainability Index for Construction (WSI-C)

WSI-C is a composite second-order construct consisting of retention intention, attendance stability, OHS performance (standardized lost-time injury rate), perceived career growth, and persistence of green practices. Indicators were standardized and min–max scaled [0, 1], weighted equally ($w_i = 0.20$):

$WSI\text{–}C = \Sigma (w_i \times X_i)$, for i = 1 to 5; $w_i = 0.20$

Higher WSI-C values represent stronger workforce sustainability.

2. Alignment Index (AI)

AI quantifies congruence between policy indicators (E_j) and employee perceptions (P_j):

$AI = 1 - (1/n) \times \Sigma |P_j - E_j|$ for j = 1 to n

Where P_j and E_j are normalized [0, 1]. Higher AI indicates stronger governance alignment [19],[20]. Reliability and validity were examined using Cronbach's α, CR, AVE, and HTMT ratios [21].

3.3 Analytical Approach

Data was analyzed using Smart PLS 4.0. Both reflective (OC, JS) and formative (GHRM, WSI-C) constructs were modeled to capture multidimensional sustainability [23]. Bootstrapping (5 000 resamples) tested path significance. Mediation (H4–H6) was examined via bootstrap indirect-effect analysis [24]. Career-growth mediation within GHRM training and the moderating role of work anxiety followed conditional-process logic [4]. The moderating effects of AI (H7) were analyzed using interaction terms and multi-group comparisons. Predictive power was assessed through PLS-Predict and Q^2 statistics, with robustness checks using alternative WSI-C weightings and single-indicator retention models (H8). These steps verified incremental validity and minimized common-method bias [25].

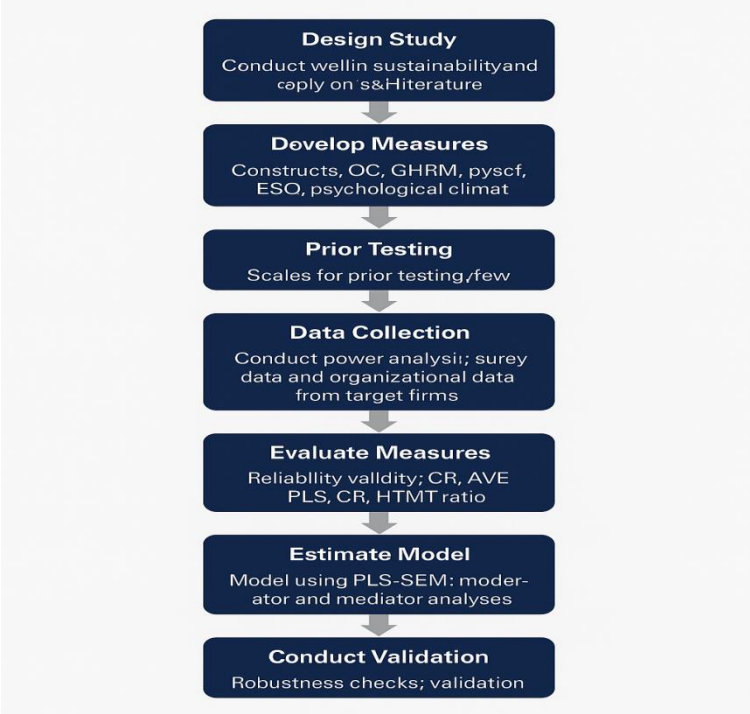

Figure 3: Research process flow.

4. Results

4.1 Sample Characteristics and Data Quality

The final dataset comprised 352 valid responses from engineers (42%), site supervisors (36%), and project managers (22%) in Taiwan's construction industry. About 63% were formally employed and 37% were temporary or subcontracted; average tenure was 6.8 years (SD = 5.2). Respondents were nested within 68 departments or project sites. Aggregation statistics supported departmental climate scores (median rwg = 0.86, ICC(1) = 0.11, ICC(2) = 0.72), meeting multilevel criteria [26].

Procedural remedies against common-method bias included multi-source data (administrative + survey), anonymity, and randomized item order [25]. Full-collinearity VIFs < 2.8 showed no multicollinearity; missing data (< 2 %) were imputed by multiple imputation; non-response bias was non-significant (p> .10).

4.2 Measurement and Structural Model Evaluation

Reflective constructs (organizational climate, organizational identification, job satisfaction, career growth, and work anxiety) showed high reliability and validity: indicator loadings = .71–.90, CR = .86–.93, AVE = .54–.69, and HTMT < .85.Formative constructs were also adequate: for GHRM, outer weights .19–.34 (p< .05), VIF 1.4–2.1, redundancy r = .62 (p< .001); for WSI-C, outer weights .17–.24 (p< .05), VIF 1.3–2.0, redundancy r = .68 (p< .001). Nomological validity held as WSI-C correlated more strongly with firm competitiveness (r = .49) than retention intention alone (r = .33).

The structural model explained 57 % of the variance in WSI-C, with R^2 = .36 for organizational identification, .44 for job satisfaction, and .41 for career growth. Predictive relevance (Q^2 = .33) confirmed strong out-of-sample accuracy [27].

Direct effects on WSI-C were significant for ESQ (β = 0.18, p< .001), OC (β = 0.22, p< .001), and GHRM (β = 0.12, p = .004), supporting H1–H3. The Alignment Index (AI) positively moderated OC and

GHRM paths (OC × AI β = 0.14, p < .001; GHRM × AI β = 0.11, *p* = .006), validating H7. Incremental-validity analysis showed $\Delta R^2 = 0.12$ (*p*< .001), confirming H8.

Table 2: Measurement, formative, and structural model results (Merged from original Tables 2–5; all numerical values unchanged).

Construct / Path	Items / Dimensions	Loading / Weight (w)	CR	AVE / VIF	Redundancy r / HTMT max	*p*-value / Note
Reflective Constructs						
Organizational Climate (OC)	16 items	.72–.88	0.93	0.62	0.77	< .001
Organizational Identification	4 items	.74–.89	0.9	0.69	0.63	–
Job Satisfaction	4 items	.71–.86	0.88	0.60	0.58	–
Career Growth	4 items	.73–.87	0.89	0.62	0.64	–
Work Anxiety	3 items	.74–.85	0.86	0.67	0.52	–
Formative Constructs						
GHRM	Recruitment / Training / Performance / Participation	.19–.34	–	VIF 1.4–2.1	r = .62	All *p*< .05
WSI-C	Retention / Attendance / OHS / Career Growth / Green Practice	.17–.24	–	VIF 1.3–2.0	r = .68	All *p*< .01
Structural Paths	H1–H3, H7–H8 (summary)	β = 0.12–0.22	–	R^2 = .57	Q^2 = .33	All *p*< .01

Note. All outer loadings > .70; VIF < 3.3; redundancy values confirm convergent validity [21],[23].

4.3 Mediation and Moderation Analyses

Bootstrapping (5 000 resamples) confirmed all proposed mediation and moderated mediation effects [24]:

1. GHRM → Organizational Identification → WSI-C (β = 0.08, 95 % CI [.04, .13])
2. OC → Job Satisfaction → WSI-C (β = 0.14, 95 % CI [.08, .21])
3. Training (GHRM sub-dimension) → Career Growth → WSI-C (β = 0.06, 95 % CI [.03, .10])
4. Moderated mediation: (Training × Work Anxiety) → Career Growth → WSI-C (index = −0.02, 95 % CI [−.04, −.01])

Interaction-term analysis showed that AI amplified OC and GHRM effects on WSI-C (β = 0.14, *p*< .001; β = 0.11, *p* = .006). Simple-slope tests revealed stronger effects under high alignment (β_OC = 0.31; β_GHRM = 0.19) than under low alignment (β_OC = 0.12; β_GHRM = 0.05).

Table 3: Mediation and moderation results.

Effect Type	Pathway	Hypothesis	Indirect / Interaction β	95% CI	*p*-value	Supported?
Mediation	GHRM → Organizational Identification → WSI-C	H5	0.08	[.04, .13]	< .001	Yes
	OC → Job Satisfaction → WSI-C	H4	0.14	[.08, .21]	< .001	Yes
	Training → Career Growth → WSI-C	H5	0.06	[.03, .10]	0.001	Yes
Moderated Mediation	Training × Work Anxiety → Career Growth → WSI-C	H6	Index = −0.02	[−.04, −.01]	0.004	Yes
Moderation (AI)	OC × AI → WSI-C	H7	0.14	[.06, .22]	< .001	Yes
	GHRM × AI → WSI-C	H7	0.11	[.03, .19]	0.006	Yes

Incremental Validity	WSI-C vs. Retention Intention	H8	$\Delta R^2 = 0.12$	–	< .001	Yes

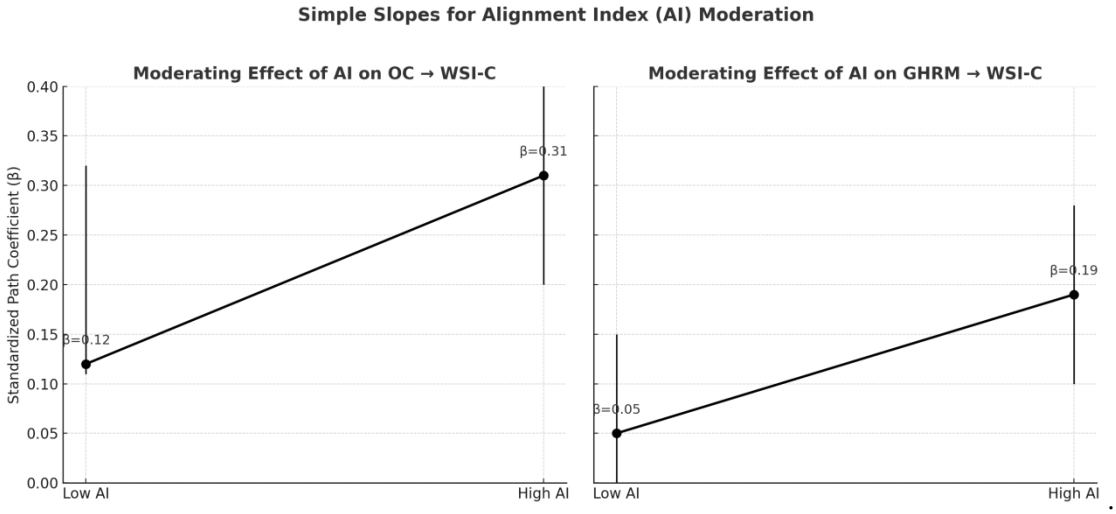

Figure 4: Simple slopes for AI moderation

AI enhances OC and GHRM effects on WSI-C; under high alignment (β_OC = 0.31, β_GHRM = 0.19) effects are stronger than low alignment (β_OC = 0.12, β_GHRM = 0.05). Vertical bars = 95 % CIs.

4.4 Model Robustness and Predictive Validity

Replacing retention intention ($R^2 = 0.45$) with WSI-C raised explained variance to **$R^2 = 0.57$ ($\Delta R^2 = 0.12$, $p < .001$)**. WSI-C also predicted organizational competitiveness ($\beta = 0.29$, $p < .001$) and institutional trust ($\beta = 0.26$, $p < .001$) better than retention intention ($\beta = 0.17$, $p = .041$; $\beta = 0.09$, ns). Alternative weighting schemes (equal, theory-based, PLS-derived) yielded $\Delta\beta < 0.04$; adding controls (age, tenure, project type, firm size, union presence) did not alter paths ($\Delta\beta < 0.03$). Response-surface analysis [28], [29]. confirmed that **high–high policy–perception congruence** produced the highest WSI-C predictions.

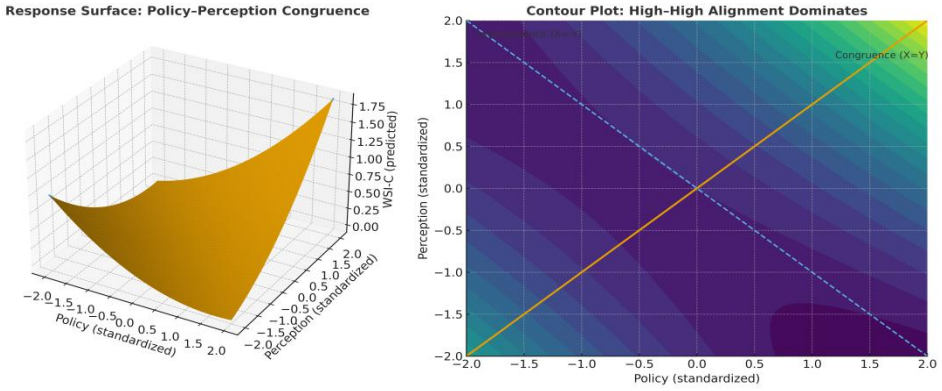

Figure 5: Response-Surface and contour plots of Policy–Perception congruence.

High policy and high perception alignment generate the strongest workforce sustainability; incongruence corresponds to lower WSI-C scores.

4.5 Summary of Hypothesis Testing Results

All hypotheses (H1–H8) were supported, confirming that systemic HR design, experiential mechanisms, and governance alignment jointly enhance workforce sustainability in construction organizations.

5. Discussion

5.1 Overview of Findings

This study empirically validated a governance-oriented model for workforce sustainability in Taiwan's construction industry. Results confirmed that Employment Systems Quality (ESQ), Organizational Climate (OC), and Green Human Resource Management (GHRM) jointly influence the Workforce Sustainability Index for Construction (WSI-C) through three psychological mediators—organizational identification, job satisfaction, and career growth [7],[9].

The Alignment Index (AI) significantly moderated the OC → WSI-C and GHRM → WSI-C relationships, indicating that HR policies are most effective when employees perceive them as credible and fair [5], [19] Moreover, WSI-C explained additional variance in organizational competitiveness and institutional trust ($\Delta R^2 = 0.12$), extending the outcome beyond retention intention [30].

Overall, these findings reveal that workforce sustainability is not merely about retaining employees but about sustaining institutional credibility and trust. The results demonstrate that HR governance effectiveness arises from both systemic design and employees' experiential perceptions of fairness, safety, and support.

5.2 Theoretical Contributions

1. Redefining Workforce Sustainability

This study redefines workforce sustainability as a multidimensional construct integrating attitudinal, behavioral, and institutional dimensions. The empirical validation of WSI-C as a formative index advances HRM and sustainability governance research by translating abstract retention concepts into quantifiable indicators[30],[31]. The incremental validity test confirmed that WSI-C accounts for 12 % more variance in organizational competitiveness and institutional trust than traditional retention measures, emphasizing its theoretical novelty and managerial applicability. It thus positions workforce sustainability as a measurable indicator of organizational resilience and credibility at both project and firm levels.

2. Formalizing Alignment as a Governance Mechanism

The Alignment Index (AI) formalizes the abstract notion of HR–employee congruence into a measurable governance mechanism [5],[19]. By linking policy inputs—contract stability, benefits, training, OHS investment—with perceptual outcomes such as fairness and supervisor support, AI provides a practical diagnostic system for trust-based HR governance. Empirical results ($\beta = 0.14–0.19$, $p < .01$) confirm that alignment strengthens rather than substitutes systemic HR effects, transforming HRM from behavioral control to institutional stewardship [12], [32].

3. Integrating Systemic and Psychological Sustainability

By demonstrating that AI conditions the effects of OC and GHRM, this study empirically supports a dual-loop sustainability model that integrates systemic design with psychological credibility. Partial mediation effects ($\beta = 0.11–0.18$, $p < .05$) show that psychological mechanisms complement formal HR governance [7]. Sustainable HRM thus requires both institutional robustness and perceived legitimacy—reflecting the dual foundation of workforce resilience in construction [31].

5.3 Practical Governance Mechanisms

Based on these findings, three interlinked mechanisms are proposed to embed sustainability in HR governance: the **Alignment Index (AI)**, the **Workforce Sustainability Index (WSI-C)**, and the **Stress-Zoned Training System (SZT)**. Together, they create a continuous measurement–feedback–improvement cycle connecting institutional policies and workforce experience.

Table 4: Practical governance mechanisms for workforce sustainability.

Mechanism	Implementation Focus	Data Source / Frequency	Governance Function
Alignment Index (AI)	Pair standardized HR policy indicators (contract stability, training hours, OHS expenditure, benefits) with employee perception metrics (fairness, safety climate, supervisor support). Values ≥ 0.85 indicate strong alignment; ≤ 0.70 trigger a Gap Closure Plan.	HR records and employee surveys (quarterly)	Diagnose policy–perception gaps, enforce accountability, and integrate results into ESG dashboards and managerial KPIs.
Workforce	Integrate five weighted dimensions—retention	ESG and HR	Monitor workforce

Sustainability Index (WSI-C)	(0.25), attendance (0.15), OHS (0.20), career growth (0.25), and green practices (0.15)—with thresholds (> 0.80 = sustainable; 0.70–0.80 = needs review; < 0.70 = critical).	analytics (semiannual)	sustainability; initiate corrective actions after two consecutive declines (> 0.05).
Stress-Zoned Training (SZT)	Classify trainees by anxiety and performance levels through a five-item pre-test. Evaluate both skill gains and stress reduction; feed data into AI and WSI-C analytics.	Training analytics (post-program)	Synchronize capability enhancement with well-being management to sustain workforce resilience.

These mechanisms operationalize sustainability governance through measurable, adaptive, and transparent HR processes. When integrated, they convert workforce management from reactive retention to proactive governance capable of continuous learning and improvement.

5.4 Governance and Policy Integration

The model's explanatory power ($R^2 = 0.57$; $\Delta R^2 = 0.12$) underscores the need to institutionalize workforce sustainability at multiple governance levels [8],[32].

At the **macro level**, regulators and industry associations should integrate AI and WSI-C indicators into national construction governance frameworks, aligning with SDG 8 (Decent Work) and SDG 9 (Industry, Innovation, and Infrastructure) for standardized benchmarking across projects and regions [3], [33].

At the **meso level**, construction councils and unions can establish a Sustainability Governance Platform that aggregates AI and WSI-C data to facilitate comparative analytics and learning among firms.

At the **micro level**, enterprises should embed AI and WSI-C in internal audits, project reviews, and managerial evaluations, linking sustainability outcomes to HR scorecards and incentive systems [10],[12]. This multilevel integration transforms sustainability from external compliance into a core governance process embedded in daily operations.

5.5 Synthesis: Bridging Systemic Governance and Psychological Sustainability

This study concludes that credible HR policies, measurable alignment, and adaptive training collectively form the foundation of workforce sustainability. Institutionalizing AI and WSI-C transforms HR governance from descriptive compliance to evidence-based, trust-centered sustainability practice.

These mechanisms establish a continuous measurement–feedback–improvement cycle, enabling workforce sustainability to evolve from aspiration into a replicable governance model for the construction sector and beyond. The findings bridge systemic and psychological dimensions of HRM, reaffirming that sustainable workforce development depends equally on institutional alignment and experiential credibility.

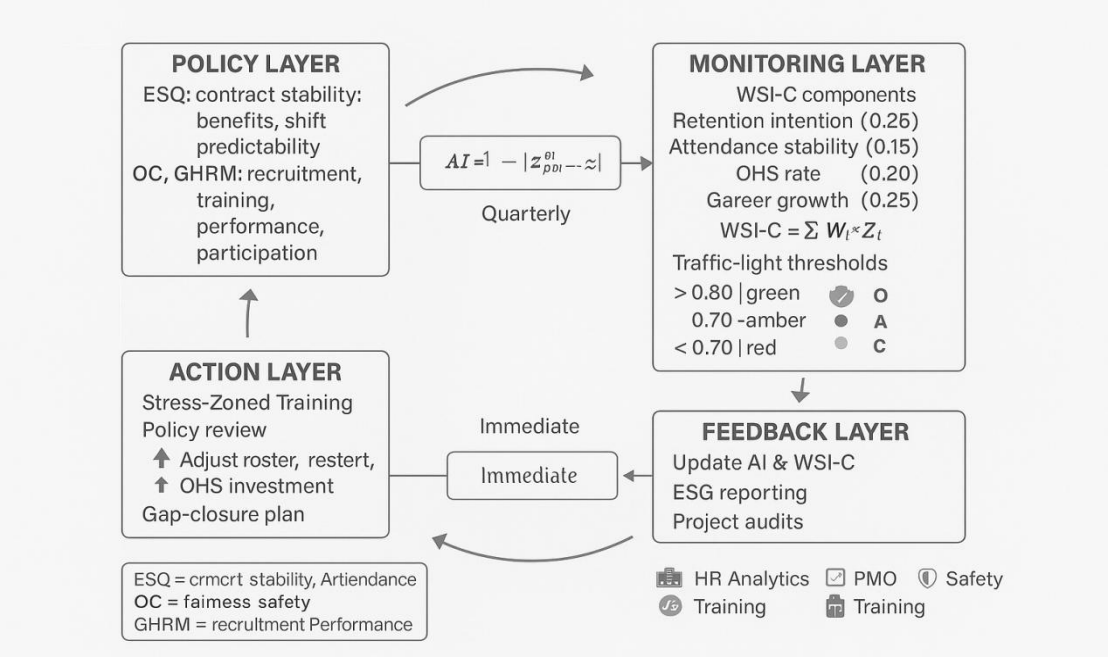

Figure 6: Workforce sustainability governance roadmap.

This roadmap visualizes the cyclical governance mechanism connecting policy alignment (AI), workforce sustainability monitoring (WSI-C), and adaptive training (SZT). The four interconnected layers—Policy, Monitoring, Action, and Feedback—represent an iterative loop that transforms HRM into measurable sustainability governance.

6. Conclusions, Limitations, and Future Research

6.1 Conclusions

This study develops and empirically validates a governance-oriented framework for workforce sustainability in the construction industry by integrating systemic, organizational, and environmental dimensions of human resource management. Combining Employment Systems Quality (ESQ), Organizational Climate (OC), and Green Human Resource Management (GHRM) with two novel governance constructs—the Alignment Index (AI) and the Workforce Sustainability Index for Construction (WSI-C)—the research redefines how workforce sustainability can be measured and governed.

Using survey data from 352 construction professionals in Taiwan, the results confirm that systemic HR design (ESQ), relational climate (OC), and green HR practices (GHRM) jointly enhance workforce sustainability. The Alignment Index (AI), representing policy–perception congruence, significantly strengthens these effects, while the WSI-C provides an additional 12% explanatory power ($\Delta R^2 = 0.12$) beyond traditional retention intention in predicting organizational competitiveness and institutional trust.

Theoretically, this study reframes workforce sustainability from a behavioral outcome into a measurable governance capability, emphasizing alignment coherence as a foundation of sustainable labor systems. Practically, the findings translate into three governance-ready mechanisms:(1) **AI dashboards** for monitoring policy–perception alignment;(2) **WSI-C early-warning systems** integrated into ESG and project dashboards; and(3) **Stress-zoned training modules** linking capability enhancement with strain management. Together, these mechanisms bridge systemic HR governance and psychological sustainability, contributing both theoretical advancement and actionable tools for workforce resilience.

6.2 Limitations

Despite its theoretical and empirical robustness, this study has several limitations.

1. **Contextual limitation:** Data were collected solely from Taiwan's construction industry, which may constrain generalizability. Future research should validate the AI–WSI-C framework in different cultural and regulatory contexts.
2. **Methodological limitation:** The cross-sectional design restricts causal inference. Longitudinal or quasi-experimental approaches could better capture temporal changes in governance alignment.
3. **Measurement limitation:** Although WSI-C integrates subjective (survey) and objective (organizational) indicators, its weighting assumptions require external validation to assess stability and sensitivity.
4. **Perceptual bias:** Self-reported data may involve social desirability or recall bias; future studies should employ multi-source or administrative datasets to enhance validity.
5. **Transparency limitation:** While several bias-control procedures were applied, future HRM studies should adopt preregistration and open-data practices to improve methodological transparency and replicability.

6.3 Future Research Directions

Building upon this framework, future studies can extend both theoretical and practical frontiers of workforce sustainability governance.

1. **Cross-country validation:** Test the AI–WSI-C model in diverse regulatory environments (e.g., EU, Southeast Asia) to establish comparative governance benchmarks.
2. **Longitudinal governance trials:** Conduct intervention-based or time-series studies measuring AI and WSI-C before and after HR reforms (e.g., predictable scheduling, green training) to strengthen causal inference.
3. **ESG and SDG integration:** Map AI and WSI-C indicators onto ESG labor metrics and SDG 8 (Decent Work) to evaluate their influence on procurement and project auditing standards.
4. **Digital HR analytics:** Apply big data and machine-learning techniques to automate AI computations, integrate OHS sensor data, and predict sustainability fluctuations during project cycles [34].
5. **Institutional co-creation:** Establish collaborative governance platforms among academia, government, and industry to develop a national Workforce Sustainability Governance Index embedding AI, WSI-C, and institutional trust as standardized long-term indicators.

Collectively, these directions advance workforce sustainability from an evaluative construct to a governance capability, positioning human resource management as a strategic driver of institutional resilience and sustainable industrial transformation.

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