Green Finance

Green Finance, 8(3): 649–674.
DOI: 10.3934/GF.2026023
Received: 17 June 2026
Revised: 10 August 2026
Accepted: 25 August 2026
Published: 03 September 2026

https://www.aimspress.com/journal/GF

Research article

AI-enabled CRM capability, service innovation, and sustainable banking outcomes: A digital green-finance perspective from Taiwan

Kuo Ming Chu[1,*] and Hui Chun Chan[2]

[1] Department of Business Administration, Cheng Shiu University, Kaohsiung City, 833301, Taiwan
[2] Department of Gerontological Health Care, CTBC University of Technology, Tainan City, 744004, Taiwan

* **Correspondence:** Email: k0574@gcloud.csu.edu.tw.

Supplementary material:

This Supplementary Material accompanies the revised manuscript and reports the complete measurement instrument together with the measurement-and structural-model diagnostics used in the main analysis. The reported coefficients, reliability and validity statistics, explanatory-power indices, and model-fit indices are aligned with Tables 1–3 of the main text. Confidence intervals in Table S4 are reconstructed from the reported standardized coefficients and test statistics using a two-tailed 95% normal approximation; they should therefore be interpreted as internally consistent inferential intervals rather than as a substitute for archived percentile-bootstrap output.

Table S1. Complete measurement instrument.

Response scale for all items: five-point Likert (1 = strongly disagree; 5 = strongly agree). Instrument prepared in English and translated to Mandarin using Brislin's (1986) back-translation.

Construct	Item	Wording	Source / adaptation
AI-enabled CRM capability (AICRM) — analytical intelligence	AICRM1	"Our CRM system uses AI algorithms to predict customer preferences."	Adapted from Königstorfer & Thalmann (2020); Kumar et al. (2023)
AICRM — automation	AICRM2	"AI tools help automate customer service decisions."	Adapted from Mainardes et al. (2023)
AICRM — personalization	AICRM3	"The AI-CRM interface clearly explains the basis for its recommendations (AI transparency)."	New item; informed by Manser Payne et al. (2021); Roy et al. (2025)
AICRM — interaction quality	AICRM4	"I can understand and correct AI-CRM outputs when they are inaccurate (AI controllability)."	New item; informed by Sekhon et al. (2014); van Esterik-Plasmeijer & van Raaij (2017)
Service innovation (SI)	SI1	"Our organization regularly introduces innovative service processes enabled by AI-CRM tools."	Adapted from Wu & Nguyen (2019)
SI	SI2	"We utilize AI-mediated digital platforms to co-create value with customers."	Adapted from Blommerde (2023)
SI	SI3	"We continuously redesign customer-facing services by applying insights generated through AI-CRM."	Adapted from Wu & Nguyen (2019); Blommerde (2023)
Organizational resilience (OR)	OR1	"Our organization quickly adjusts to sudden market changes using AI-generated insights."	Adapted from Garrido-Moreno et al. (2024)
OR	OR2	"AI-CRM-driven intelligence enhances our capacity to recover from service failures."	Adapted from Feliciano-Cestero et al. (2023)
OR	OR3	"Our organization maintains service continuity when unexpected disruptions occur."	Adapted from Garrido-Moreno et al. (2024)
Organizational sustainability (OS)	OS1	"Our company integrates social and environmental considerations into AI-driven innovation decisions."	Adapted from Prieto-Sandoval et al. (2019)
OS	OS2	"AI-CRM solutions contribute to sustainable and ethically governed financial performance."	Adapted from Li & Jin (2024)
OS	OS3	"Our AI-enabled service practices support a long-term balance among economic, social, and environmental objectives."	Adapted from Prieto-Sandoval et al. (2019); Li & Jin (2024)

Note: OS items capture respondents' perceptions of organizational sustainability, not audited environmental performance, emissions, energy use, or ESG-disclosure quality.

Table S2. Full measurement-model diagnostics.

Construct	Item	Loading	Cronbach's α	rho_A	CR	AVE	Item VIF range
AICRM	AICRM1	0.88	0.91	0.918	0.94	0.79	1.28–2.01
	AICRM2	0.90					
	AICRM3	0.89					
	AICRM4	0.88					
SI	SI1	0.84	0.88	0.885	0.90	0.75	1.32–2.06
	SI2	0.88					
	SI3	0.87					
OR	OR1	0.87	0.90	0.904	0.91	0.78	1.24–1.96
	OR2	0.89					
	OR3	0.89					
OS	OS1	0.89	0.92	0.923	0.93	0.81	1.19–1.84
	OS2	0.91					
	OS3	0.90					

All indicator loadings exceed 0.708. Cronbach's α, rho_A, and CR exceed 0.70, all CR values remain below 0.95, and all AVE values exceed 0.50, supporting internal consistency and convergent validity.

Table S3a. Discriminant validity — Fornell-Larcker criterion.

Construct	AICRM	SI	OR	OS
AICRM	0.888			
SI	0.68	0.863		
OR	0.47	0.64	0.883	
OS	0.45	0.67	0.61	0.900

Diagonal (bold) = square root of AVE; off-diagonal = inter-construct correlations.

Table S3b. Discriminant validity — HTMT ratios.

Construct	AICRM	SI	OR	OS
AICRM	—			
SI	0.74	—		
OR	0.52	0.69	—	
OS	0.49	0.71	0.66	—

All HTMT values are below the conservative 0.85 threshold, supporting discriminant validity.

Full-collinearity common-method-bias check. Following Kock (2015), all reported VIF values remained below the conservative 3.3 threshold (Table S2). This result does not eliminate common-method bias, but it indicates that severe full-collinearity is not evident. The main text (§3.4) therefore interprets this diagnostic jointly with the procedural remedies and Harman's single-factor result (first unrotated factor = 31.4% of variance).

Table S4. Structural-model results: direct, indirect, and total effects with 95% confidence intervals.

The structural model was estimated in SmartPLS 4.0 with 5,000 bootstrap subsamples. Reported confidence intervals are two-tailed 95% normal-approximation intervals reconstructed from the coefficients and t statistics available in the retained manuscript files.

Effect	Path	β	t	p	95% CI (normal approximation)	f^2
Direct	AICRM → SI	0.68	14.72	< 0.001	[.589, .771]	0.14
Direct	SI → OR	0.62	11.45	< 0.001	[.514, .726]	0.36
Direct	SI → OS	0.65	12.18	< 0.001	[.545, .755]	0.38
Direct (with mediator)	AICRM → OR	0.04	0.82	0.412	[-.056, .136]	—
Direct (with mediator)	AICRM → OS	0.03	0.61	0.542	[-.066, .126]	—
Indirect	AICRM → SI → OR	0.42	8.37	< 0.001	[.322, .518]	—
Indirect	AICRM → SI → OS	0.44	8.81	< 0.001	[.342, .538]	—
Total	AICRM → OR (direct + indirect)	0.46	9.20	< 0.001	[.362, .558]	—
Total	AICRM → OS (direct + indirect)	0.47	9.59	< 0.001	[.374, .566]	—

Mediation classification (Zhao et al., 2010): the pattern is indirect-only for both outcomes because each indirect effect is statistically significant, whereas the corresponding direct effect is not statistically significant. Given the cross-sectional design, this is a statistical decomposition and not evidence of temporal or causal mediation.

Table S5. Predictive relevance and model fit.

Endogenous construct	R^2	Q^2 (blindfolding)
Service innovation (SI)	0.47	0.31
Organizational resilience (OR)	0.56	0.42
Organizational sustainability (OS)	0.59	0.44

Model fit was acceptable (SRMR = 0.046; NFI = 0.93). All blindfolding Q^2 values were positive, indicating in-sample predictive relevance for the endogenous constructs. Because indicator-level PLSpredict benchmarking against a linear-model reference was not conducted in this analysis, no claim of out-of-sample predictive superiority is made.

Common method bias and procedural remedies. The design incorporated anonymity assurance, separation of predictor and criterion sections, and counterbalancing of selected item blocks. Harman's single-factor result (31.4%) and the full-collinearity VIF assessment provide no indication of a dominant single method factor or severe full collinearity; however, neither test rules out residual same-source bias. This limitation is retained explicitly, and future replication should use a marker variable, a measured latent method factor, temporal separation, or multi-source data.

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