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Green intellectual capital and bank sustainability performance: The mediating roles of employee green behaviours and green banking practices

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Orientation: Sustainability has become a strategic priority in the banking sector, requiring internal resources that support environmental performance. Green intellectual capital (GIC) is increasingly viewed as a critical intangible asset in advancing sustainable banking.

Research purpose: This study examines how green intellectual capital contributes to banks' sustainability performance through the mediating roles of employee green behaviours and green banking practices.

Motivation for the study: Although prior research highlights the importance of GIC, limited empirical evidence explains the mechanisms through which it translates into sustainability outcomes, particularly in emerging economies' banking sectors.

Research design, approach and method: A quantitative research design was employed using survey data from 130 employees of large commercial banks (KBMI 4) in Indonesia. Data were analysed using partial least squares structural equation modelling (PLS-SEM). Green intellectual capital was modelled as a higher-order construct comprising green human, structural and relational capital.

Main findings: The results show that GIC significantly enhances employee green behaviours and green banking practices. Both mediators positively influence sustainability performance. The findings indicate full mediation, meaning GIC improves sustainability performance only when translated into employee actions and institutionalised practices.

Practical/managerial implications: Bank managers should complement investments in green knowledge and capabilities with initiatives that foster pro-environmental employee behaviour and formalise green banking practices.

Contribution/value-add: This study extends the resource-based view by identifying behavioural and operational mechanisms through which GIC generates sustainability performance in the banking sector.

Keywords: green intellectual capital; employee green behaviours; green banking practices; sustainability performance; banking sector; emerging economies.

Introduction

In recent years, sustainability has become a critical concern for the global banking industry because of increasing environmental degradation, climate change risks and growing regulatory and stakeholder pressure. Banks are no longer assessed solely on financial performance but are increasingly evaluated based on their environmental and social responsibilities. Consequently, sustainability performance has emerged as a key indicator of long-term competitiveness and legitimacy in the banking sector (Jain 2023; Yusliza et al. 2020).

Prior research highlights the importance of internal organisational resources in driving sustainability outcomes. In this context, green intellectual capital (GIC) – comprising green human capital, green structural capital and green relational capital – has gained substantial attention as a strategic intangible resource that supports sustainable value creation (Ahmed et al. 2022; Nisar et al. 2021). Studies suggest that organisations with strong GIC are better positioned to develop sustainability-oriented strategies and enhance environmental and organisational performance (Pratiwi et al. 2025; Rehan et al. 2025).

However, recent empirical evidence indicates that GIC does not automatically translate into sustainability performance. Instead, its effectiveness depends on how green

knowledge, capabilities and systems are transformed into concrete behaviours and operational practices (Alrifae 2026). This argument is particularly relevant in the banking sector, where sustainability initiatives rely heavily on human interaction, service delivery and institutionalised processes rather than production technologies.

One critical behavioural mechanism through which green intellectual capital may influence sustainability outcomes is employee green behaviour (EGB). Employee green behaviours refer to voluntary and task-related actions undertaken by employees to minimise environmental impact, such as conserving energy, reducing waste and supporting environmental initiatives. Previous studies demonstrate that green human capital and supportive organisational systems significantly encourage employees to engage in pro-environmental behaviours (Bangwal, Chaudhary & Kumar 2025; Unsworth 2021; Benevene, Buonomo & West 2021). In service-intensive industries, including banking, such behaviours play a pivotal role in translating sustainability strategies into daily operational practices (Liaquat et al. 2024).

In addition to behavioural mechanisms, green banking practices (GBPs) represent an important operational pathway linking GIC to sustainability performance. Green banking practices include environmentally responsible lending, digital banking, green financial products and environmental risk assessment. Empirical studies show that the adoption of GBP enhances environmental performance, operational efficiency and long-term financial stability (Jain 2023; Mir & Bhat 2025). Moreover, recent research highlights that GIC enables banks to institutionalise sustainability through structured green banking initiatives and green financing activities (Gazi et al. 2025; Mulatsih 2025; Abualfaraa et al. 2020).

Despite the growing body of literature on GIC, EGB and GBP, most existing studies examine these constructs in isolation. Limited empirical research has simultaneously integrated GIC, EGBs and GBP within a single framework to explain sustainability performance, particularly in emerging economies. Furthermore, prior findings suggest that the mediating mechanisms through which GIC affects sustainability performance remain insufficiently understood in the banking context (Rehan et al. 2025).

Addressing these gaps, the present study investigates how GIC influences banks' sustainability performance through the mediating roles of EGBs and GBP. Using empirical evidence from large commercial banks in Indonesia, this study aims to provide a more comprehensive understanding of how internal green resources are transformed into behavioural and operational outcomes that drive sustainability performance in the banking sector.

A condensed version of the literature review and hypothesis development

Green intellectual capital and sustainability in banking

Green intellectual capital refers to the stock of environmentally related knowledge, capabilities, organisational systems and stakeholder relationships that enable firms to pursue sustainability-oriented strategies. Drawing on the resource-based view (RBV), GIC is considered a strategic intangible asset that can generate sustainable competitive advantage when effectively leveraged (Yusliza et al. 2020; Xin & Wang 2023). In the banking sector, GIC typically encompasses green human capital, green structural capital and green relational capital, reflecting employees' environmental competencies, institutionalised sustainability systems and environmentally oriented external relationships (Salim et al. 2023; Shahbaz et al. 2024).

Empirical studies provide evidence that GIC contributes to organisational sustainability by enhancing environmental performance, innovation capability and long-term competitiveness (Ahmed et al. 2022; Nisar et al. 2021; Cai & Li 2018). Recent research in emerging economies further confirms that GIC supports sustainable financial and environmental outcomes in banking institutions (Mulatsih 2025; Pratiwi et al. 2025). However, several scholars argue that GIC alone is insufficient to directly improve sustainability performance, as its value depends on effective implementation through behavioural and operational mechanisms (Alrifae 2026; Rehan et al. 2025; Katz et al. 2023).

Green intellectual capital and employee green behaviours

Employee green behaviours refer to voluntary and task-related actions undertaken by employees to minimise environmental impact, such as conserving energy, reducing waste and supporting environmental initiatives (Zhang, Panatik & Zhang 2024). Prior literature highlights that GIC plays a fundamental role in shaping such behaviours by enhancing employees' environmental awareness, skills and motivation (Nisar et al. 2021).

Green human capital equips employees with the knowledge necessary to perform environmentally responsible actions, while green structural capital – such as environmental management systems and green policies—creates an enabling organisational context (Unsworth 2021). Empirical evidence consistently demonstrates that organisations with strong GIC are more likely to foster EGBs, particularly in service-oriented sectors (Bangwal et al. 2025; Pratiwi et al. 2025). In banking, where sustainability initiatives are largely implemented through human interaction and service delivery, EGBs constitute a crucial behavioural pathway. Therefore, the following hypothesis (H) is proposed:

H1: Green intellectual capital positively affects EGBs.

Green intellectual capital and green banking practices

Green banking practices refer to environmentally responsible banking activities, including green lending, digital banking, green financial products and environmental risk assessment (Chen, Lin & Chang et al. 2022; Rao & Shukla 2024).

Previous studies indicate that GIC enables organisations to institutionalise sustainability-oriented practices by embedding environmental considerations into operational routines (Yusliza et al. 2020). In the banking context, empirical research shows that banks with higher levels of GIC are more proactive in implementing green banking initiatives and green financing activities (Jain 2023; Rehan et al. 2025). Furthermore, recent studies highlight that GBPs serve as an operational mechanism through which GIC generates sustainability outcomes (Gazi et al. 2025). Accordingly, this study proposes:

H2: Green intellectual capital positively affects GBP.

Green intellectual capital and sustainability performance

Sustainability performance reflects an organisation's ability to achieve economic, environmental and social objectives simultaneously. Several studies report a positive association between GIC and sustainability performance (Ahmed et al. 2022; Yusliza et al. 2020). However, emerging evidence suggests that this relationship may not be direct.

Recent research argues that GIC represents a latent resource whose impact materialises only when translated into behavioural and operational outcomes (Alrifae 2026). In the banking sector, sustainability performance is largely influenced by employee behaviour and institutionalised practices rather than technological processes. This leads to the following hypothesis:

H3: Green intellectual capital positively affects sustainability performance.

Employee green behaviours and sustainability performance

The collected data were analysed using PLS-SEM, which is suitable for predictive analysis and complex mediation models. Reliability and validity were assessed using composite reliability, Cronbach's alpha, average variance extracted (AVE), and discriminant validity, while direct and indirect effects were tested using bootstrapping procedures. Pro-environmental employee actions contribute to resource efficiency, regulatory compliance and corporate reputation, thereby enhancing sustainability performance (Unsworth 2021).

Empirical studies confirm that EGBs positively influence environmental and organisational performance (Bangwal et al. 2025; Liaquat et al. 2024). In the banking sector, employees' engagement in sustainability initiatives plays a vital role in implementing green strategies and achieving sustainability goals. Accordingly, the following hypothesis is proposed:

H4: Employee green behaviours positively affect sustainability performance.

Green banking practices and sustainability performance

Green banking practices represent the institutionalisation of sustainability within banking operations. Prior studies demonstrate that green banking initiatives enhance environmental performance, reduce operational risk and improve long-term financial stability (Jain 2023; Mir & Bhat 2025).

Moreover, GBPs enable banks to integrate sustainability into core business activities, such as credit evaluation and product development, thereby strengthening overall sustainability performance (Mulatsih 2025; Rehan et al. 2025). Therefore, the following hypothesis is formulated:

H5: Green banking practices positively affect sustainability performance.

Mediating role of employee green behaviours and green banking practices

Recent literature emphasises the importance of mediating mechanisms in explaining how GIC translates into sustainability outcomes. Green intellectual capital provides the foundational resources for sustainability, but its impact is realised only when employees adopt green behaviours and organisations institutionalise sustainability through GBP (Alrifae 2026).

Empirical evidence supports the mediating role of EGBs and green organisational practices in linking GIC to sustainability performance (Gazi et al. 2025; Rehan et al. 2025; Yusliza et al. 2020). This mediating perspective is particularly relevant in the banking sector, where sustainability initiatives depend on both individual behaviour and formalised operational systems. Based on this reasoning, the following hypotheses are proposed:

H6: Employee green behaviours mediate the relationship between GIC and sustainability performance.

H7: Green banking practices mediate the relationship between GIC and sustainability performance.

Research methods and design

This study employs a quantitative research design to examine the relationships between GIC, EGBs, GBP and sustainability performance in the banking sector. Data were collected through a structured questionnaire administered to employees of large commercial banks classified under KBMI 4 in Indonesia. A purposive sampling technique was used, resulting in 130 valid responses. Green intellectual capital was operationalised as a higher-order construct comprising green human capital, green structural capital and green relational capital. The collected data were analysed using PLS-SEM, which is suitable for predictive analysis and complex mediation models. Reliability and validity were assessed through composite reliability, Cronbach's alpha, average variance extracted (AVE) and discriminant validity, while direct and indirect effects were tested using bootstrapping procedures.

Ethical considerations

Ethical clearance to conduct this study was obtained from Universitas Hasanuddin and Institutional Ethics Committee (No. 1544/UN4-22/PT.01.02/2025).

Results

Measurement model assessment

The measurement model was evaluated to assess the reliability and validity of the research instruments. Internal consistency reliability was examined using Cronbach's alpha and composite reliability (CR), while convergent validity was assessed through AVE. As recommended in PLS-SEM literature, Cronbach's alpha and CR values above 0.70 indicate acceptable reliability, and AVE values exceeding 0.50 confirm adequate convergent validity (Fornell & Larcker 1981; Hair et al. 2019, 2021).

As reported in Table 1, all constructs meet the recommended thresholds. Cronbach's alpha values range from 0.85 to 0.91, indicating strong internal consistency. Composite reliability values exceed 0.88, and all AVE values are above 0.60, confirming satisfactory convergent validity.

Indicator reliability was further supported as all outer loading values exceeded the recommended threshold of 0.70, indicating that the indicators reliably represent their respective constructs (Hair et al. 2019).

Structural model and coefficient of determination (R^2)

The explanatory power of the structural model was evaluated using the coefficient of determination (R^2). According to PLS-SEM guidelines, R^2 values of 0.25, 0.50 and 0.75 represent weak, moderate and substantial explanatory power, respectively (Hair et al. 2019).

As shown in Table 2, GIC explains a moderate proportion of variance in EGBs ($R^2 = 0.46$) and GBP ($R^2 = 0.49$). Furthermore, sustainability performance demonstrates substantial explanatory power ($R^2 = 0.63$), indicating that the combined effects of GIC, EGBs and GBP account for a significant portion of variance in banks' sustainability performance.

TABLE 1: Reliability and convergent validity.

Construct	Cronbach's alpha	Composite reliability	AVE
Green intellectual capital	0.91	0.93	0.68
Employee green behaviours	0.87	0.90	0.64
Green banking practices	0.85	0.89	0.62
Sustainability performance	0.88	0.91	0.66

AVE, average variance extracted.

TABLE 2: Coefficient of determination (R^2).

Endogenous construct	R^2	Explanatory power
Employee green behaviours	0.46	Moderate
Green banking practices	0.49	Moderate
Sustainability performance	0.63	Substantial

Structural path results

The structural model results, as illustrated in Figure 1, indicate that GIC has a significant positive effect on EGBs and GBP ($p < 0.001$). However, the direct effect of GIC on sustainability performance is not statistically significant ($p > 0.05$).

In contrast, EGBs and GBP both show significant positive effects on sustainability performance ($p < 0.01$). Bootstrapping analysis confirms that the indirect effects of GIC on sustainability performance through EGBs and GBP are statistically significant, indicating full mediation. When the mediating variables are included in the model, the direct path between GIC and sustainability performance becomes insignificant.

Overall, the structural model demonstrates strong predictive capability and supports the proposed mediation framework, confirming that GIC influences sustainability performance primarily through behavioural and operational mechanisms.

Discussion

The structural model results are presented in Figure 2. This study provides empirical evidence on how GIC contributes to sustainability performance in the banking sector through behavioural and operational mechanisms. The findings confirm that sustainability performance is not driven directly by GIC but rather by how green knowledge and capabilities are translated into employee behaviours and GBP.

Green intellectual capital and employee green behaviours (H1)

The results support H1, indicating that GIC significantly enhances employee green behaviours. This finding suggests that employees are more likely to engage in pro-environmental actions when banks invest in green knowledge, skills and sustainability-oriented organisational systems. This result is consistent with prior studies demonstrating that green human capital and green structural capital positively influence employees' environmental awareness and workplace green behaviours (Bangwal et al. 2025; Nisar et al. 2021; Unsworth 2021).

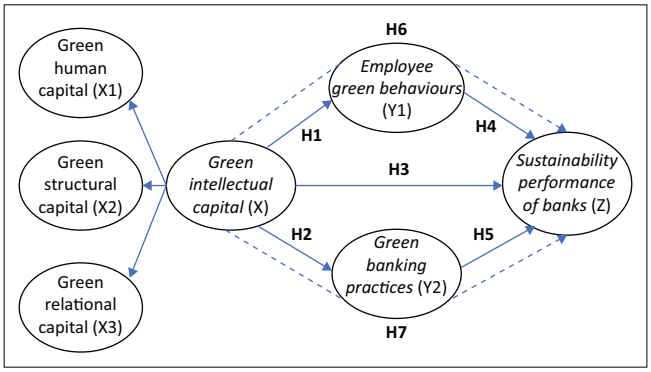
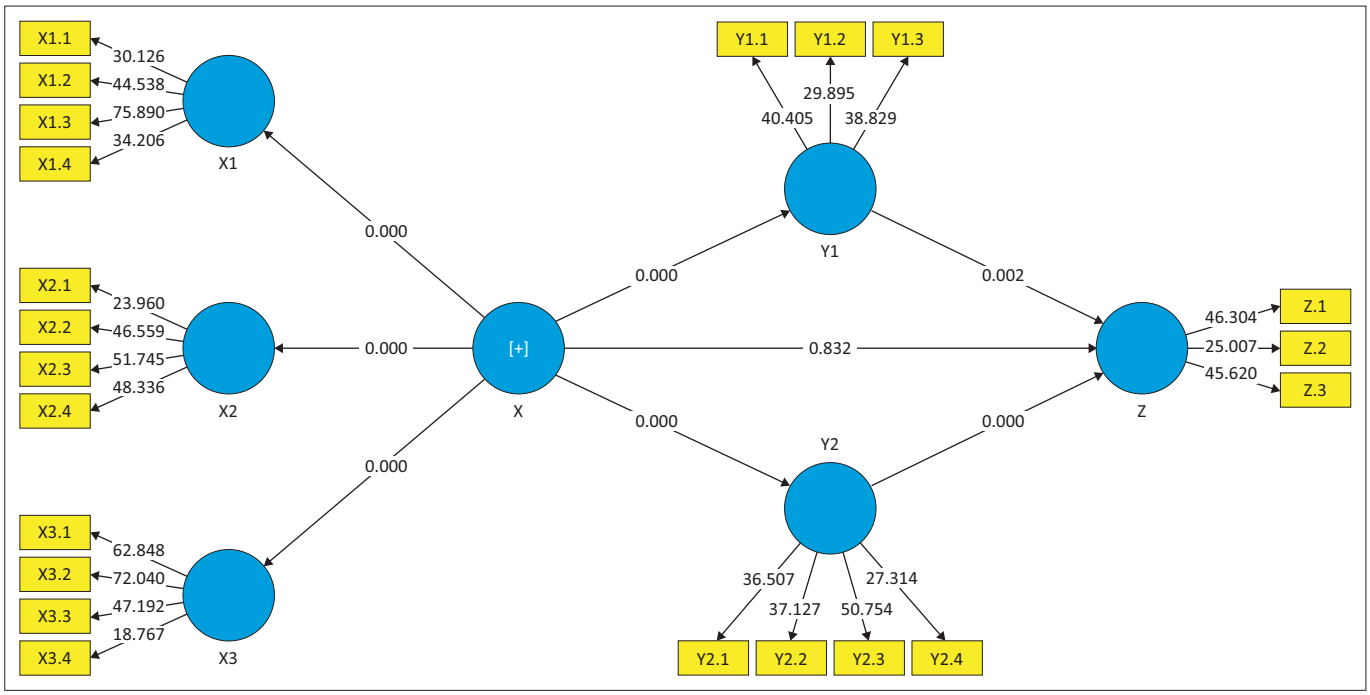


FIGURE 1: Conceptual framework.



Note: The figure illustrates standardised path coefficients and significance levels obtained from SmartPLS bootstrapping analysis.

X, green intellectual capital; X1, green human capital; X2, green structural capital; X3, green relational capital; Y1, employee green behaviours; Y2, green banking practices; Z, sustainability performance of banks.

FIGURE 2: Structural model results (partial least squares structural equation modelling).

Recent evidence from service-oriented industries further supports this relationship, showing that organisational investments in green competencies and supportive infrastructures create an enabling environment for EGBs (Pratiwi et al. 2025). In the banking sector, where sustainability initiatives rely heavily on employee discretion and service delivery, GIC serves as a critical antecedent of behavioural change.

Green intellectual capital and green banking practices (H2)

The findings also support H2, revealing that GIC has a significant positive effect on GBPs. This result confirms that green banking initiatives – such as green lending, digital banking and environmental risk assessment – require a strong foundation of green knowledge, organisational routines and stakeholder engagement.

This finding aligns with prior studies indicating that GIC enables banks to institutionalise sustainability through structured green banking policies and green financing activities (Jain 2023; Yusliza et al. 2020). Moreover, recent research highlights that green relational capital facilitates collaboration with regulators and stakeholders, further strengthening the implementation of GBP (Gazi et al. 2025). These results underscore the role of GIC as an enabling infrastructure for sustainable banking operations.

Green intellectual capital and sustainability performance (H3)

Contrary to theoretical expectations, the direct effect of GIC on sustainability performance is not statistically significant, leading to the rejection of H3. This finding supports emerging arguments in the literature that GIC represents a latent resource whose value does not materialise unless it is effectively operationalised (Alrifae 2026).

Similar findings have been reported in recent studies, suggesting that GIC alone does not guarantee improved sustainability outcomes in financial institutions (Rehan et al. 2025). This result is particularly relevant in the banking sector, where sustainability performance is driven by service processes and human behaviour rather than technological outputs. Thus, the absence of a direct relationship highlights the importance of intermediate mechanisms in translating GIC into performance outcomes.

Employee green behaviours and sustainability performance (H4)

The results confirm H4, demonstrating that EGBs positively influence sustainability performance. This finding indicates that employees' voluntary and task-related pro-environmental actions contribute significantly to environmental efficiency, regulatory compliance and organisational reputation.

Consistent with previous studies (Iqbal, Ahmad & Halim 2018; Bangwal et al. 2025; Unsworth 2021), this result emphasises the critical role of employees in achieving sustainability goals in service-based industries. Furthermore, recent evidence shows that motivational and organisational factors strengthen the relationship between EGBs and environmental performance in banking institutions (Liaquat et al. 2024). These findings reinforce the view that sustainability strategies must actively engage employees to be effective.

Green banking practices and sustainability performance (H5)

The findings also support H5, indicating that GBPs significantly enhance sustainability performance. This result is consistent with prior research demonstrating that environmentally responsible banking activities improve environmental performance while simultaneously strengthening long-term financial stability (Jain 2023; Mir & Bhat 2025).

Recent studies further suggest that GBPs contribute to sustainability by integrating environmental criteria into lending decisions and promoting green financial products (Mulatsih 2025). Moreover, green financing and CSR-oriented banking initiatives have been shown to reduce environmental risk exposure and improve stakeholder trust, reinforcing banks' sustainability performance (Gazi et al. 2025).

Mediating role of employee green behaviours (H6)

The mediation analysis confirms H6, indicating that EGBs fully mediate the relationship between GIC and sustainability performance. This finding suggests that GIC enhances sustainability outcomes primarily by shaping employees' pro-environmental behaviours.

This result extends existing literature by empirically validating EGBs as a key behavioural mechanism through which GIC creates value (Nisar et al. 2021; Pratiwi et al. 2025). It also supports recent arguments that sustainability-oriented knowledge and systems must be internalised by employees to generate tangible performance benefits (Alrifae 2026).

Mediating role of green banking practices (H7)

Finally, the results support H7, demonstrating that GBPs fully mediate the relationship between GIC and sustainability performance. This finding highlights the importance of institutionalising green knowledge into formal banking operations and financial products.

Consistent with recent empirical studies, GBPs serve as an operational mechanism that transforms GIC into sustainability outcomes (Gazi et al. 2025; Rehan et al. 2025). The full mediation effect suggests that sustainability performance in banking is achieved not merely through green knowledge accumulation but through its integration into organisational practices and decision-making processes.

Overall implications of the findings

Collectively, the findings provide strong support for a mediation-based perspective on sustainability performance in the banking sector. By integrating GIC, EGBs and GBP into a single framework, this study advances the sustainable banking literature and offers a more nuanced explanation of how internal green resources generate sustainability outcomes.

Conclusion

This study investigates the role of GIC in enhancing sustainability performance in the banking sector by examining the mediating effects of EGBs and GBP. Using evidence from large commercial banks in Indonesia, the findings demonstrate that GIC significantly influences sustainability performance only through behavioural and operational mechanisms rather than through a direct pathway.

The results reveal that GIC positively affects both EGBs and GBP. In turn, these mediating variables significantly enhance banks' sustainability performance. The absence of a significant direct relationship between GIC and sustainability performance underscores the importance of translating green knowledge, capabilities and systems into concrete employee actions and institutionalised banking practices. These findings confirm that sustainability outcomes in banking are driven by how internal green resources are operationalised rather than by their mere existence.

This study makes several theoretical contributions. Firstly, it extends the resource-based view by clarifying the indirect mechanisms through which GIC generates sustainability performance. Secondly, it integrates GIC, EGBs and GBP into a unified framework, offering a more comprehensive explanation of sustainability performance in the banking sector. Thirdly, the study contributes empirical evidence from an emerging economy, addressing the contextual gap in the sustainable finance literature.

From a practical perspective, the findings suggest that bank managers should prioritise initiatives that foster pro-environmental employee behaviours and institutionalise GBP alongside investments in GIC. Policies related to training, incentive systems, green product development and environmental risk management are essential to ensure that green knowledge is effectively transformed into sustainable performance outcomes.

Despite its contributions, this study has limitations. The cross-sectional design restricts causal inference, and the focus on large commercial banks in a single emerging economy may limit generalisability. Future research could employ longitudinal designs, incorporate additional contextual variables such as regulatory pressure and green leadership and extend the analysis to other financial institutions and countries to further enrich the understanding of sustainable banking performance.

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discussion have been revised, updated, and adapted for publication as a journal article. The original thesis is publicly available at: https://repository.unhas.ac.id/id/eprint/25333/. The author affirms that this article complies with ethical standards for secondary publication, and appropriate acknowledgement has been made of the original work.

Competing interests

The authors, Fakhryadi Amran; Dian S. Parawansa; Sumardi Lasise and Muhammad Asdar, declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

CRediT authorship contribution

Fakhryadi Amran: Conceptualisation, Formal analysis, Funding acquisition, Investigation, Project administration, Visualisation, Writing – original draft. Dian S. Parawansa: Conceptualisation, Data curation, Supervision, Validation, Writing – original draft, Writing – review & editing. Sumardi Lasise: Investigation, Methodology, Project administration, Supervision, Validation, Writing – review & editing. Muhammad Asdar: Conceptualisation, Data curation, Methodology, Writing – review & editing. All authors reviewed the article, contributed to the discussion of results, approved the final version for submission and publication and take responsibility for the integrity of its findings.

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Data availability

The data that support the findings of this study are not publicly available because of confidentiality agreements and ethical restrictions, as the dataset contains sensitive information obtained from employees of large commercial banks (KBMI 4) in Indonesia. Access to anonymised data may be made available by the corresponding author, Fakhryadi Amran, upon reasonable request and subject to approval from the participating institutions. No publicly archived datasets were used in this study. All figures and tables are generated from the primary survey data collected and analysed by the authors.

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