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The Influence of Green Intellectual Capital on Green Innovation Performance: The Mediating Role of Environmental Knowledge Sharing

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Abstract: This study aims to examine the effect of Green Intellectual Capital (GIC) on Green Innovation Performance (GIP), with Environmental Knowledge Sharing (EKS) as a mediating variable in food and beverage companies listed on the Indonesia Stock Exchange during the 2022–2024 period. The increasing pressure for sustainability and environmentally friendly practices has encouraged firms to optimize their green knowledge resources to enhance innovation performance. This research adopts a quantitative approach using secondary data collected from annual and sustainability reports. The sample was determined through purposive sampling, resulting in 57 firm-year observations. Data analysis was conducted using Partial Least Squares–Structural Equation Modeling (PLS-SEM). The findings indicate that GIC has a positive and significant effect on both GIP and EKS, suggesting that well-managed green intellectual resources contribute to improved innovation outcomes and facilitate knowledge exchange within organizations. In addition, EKS has a positive and significant effect on GIP and plays a mediating role in the relationship between GIC and GIP. This implies that the effectiveness of GIC in enhancing innovation performance is strengthened through the process of environmental knowledge sharing. This study contributes to the literature by integrating the Resource-Based View (RBV) and Knowledge-Based View (KBV) in explaining the mechanism through which intellectual capital drives green innovation. Practically, the results provide insights for companies to develop structured knowledge-sharing practices and optimize intellectual capital to support sustainable innovation strategies and long-term competitive advantage.

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INTRODUCTION

Sustainability and responsibility issues have become a primary focus in the global business environment, particularly in response to climate change, the scarcity of energy resources, and the growing consumer awareness of environmentally friendly products. In this context, companies are required to achieve a good financial condition and create sustainability-oriented innovation. Green Innovation

Performance (GIP) becomes an important indicator that reflect ability to produce environmentally friendly products and processes.

Green Intellectual Capital (GIC) is a factor reported to play an important role in promoting GIP. In this context, Green Innovation Performance (GIP) is an important indicator that reflects a company's ability to produce environmentally friendly product and process innovations (Chen, 2008; Zhang et al., 2024). Based on the perspective of the Resource-Based View (RBV), a source of valuable and difficult-to-imitate knowledge can be a superior competitive company. Chen (2008) showed that GIC has a positive influence on the company’s environmental performance and competitive advantage. Furthermore, Chen et al. (2014) stated that Green Human Capital and Green Structural Capital contributed significantly to increasing GIP. Khan et al. (2022) also proved that companies with good GIC management had higher performance innovation.

Several investigations show that the influence of GIC on performance Innovation does not happen directly. Based on the Knowledge-Based View (KBV) perspective, knowledge needs to be effectively managed and shared to create value for the company. Donate and Sánchez de Pablo (2015) suggested that knowledge sharing mediated the connection between intellectual capital and innovation performance. In addition, Song and Yu, (2018) as well as Y. Li et al., (2021) showed that Environmental Knowledge Sharing (EKS) played an important role in improving GIP. Research conducted to examine the role of EKS as a mediator in the relationship between GIC and GIP is limited in the context of developing countries.

The food and beverage sector was selected as the research object. This is because the industry is a strategic sector in the national economy and makes a significant contribution to economic growth. The sector has a substantial impact on the environment, particularly through energy and water consumption in production processes, waste management, and carbon emissions. The increasing consumer awareness of healthy and environmentally friendly products allows companies to develop innovative green products sustainably. Therefore, the food and beverage sector provides a relevant context for examining the effects of GIC and EKS on GIP (Dewantari et al., 2020).

GIC, EKS, and GIP are integrated into a comprehensive empirical model. EKS is positioned as a mediating variable, providing a deeper understanding of internal company mechanisms in converting GIC into GIP. This research was conducted at the food and beverage companies listed on the Indonesia Stock Exchange for the 2022–2024 period, providing empirical evidence of the latest industry context with high pressure on sustainability. A theoretical contribution is provided in the developing literature regarding GIC and GIP. In addition, practical contribution is reported for companies in designing data-based strategies and knowledge to improve innovation sustainably.

Based on the background and conceptual framework outlined above, this study focuses on the relationship between Green Intellectual Capital (GIC), Environmental Knowledge Sharing (EKS), and Green Innovation Performance (GIP). In a competitive business environment that increasingly demands sustainability, companies are required not only to possess superior intellectual resources but also to effectively manage and distribute environmental knowledge to drive green innovation.

However, existing studies have largely examined the direct relationship between GIC and green innovation performance, with limited attention to the underlying mechanisms that explain how this relationship occurs, particularly in the context of developing countries. In addition, prior research has predominantly focused on manufacturing sectors, leaving the food and beverage industry underexplored despite its significant environmental impact.

Therefore, this study offers several novelties. First, it integrates the Resource-Based View (RBV) and Knowledge-Based View (KBV) to explain the transformation of green intellectual capital into innovation performance through knowledge-sharing mechanisms. Second, it positions Environmental Knowledge Sharing (EKS) as a mediating variable, providing a deeper understanding of the internal process linking GIC and GIP. Third, this study extends the literature by providing empirical evidence from the food and beverage sector in Indonesia, an emerging economy context that remains limited in prior studies. In line with this, this study aims to analyze the influence of Green Intellectual Capital on Green Innovation Performance, examine its effect on Environmental Knowledge Sharing, and evaluate the mediating role of EKS in the relationship between GIC and GIP.

Furthermore, this study examines how Environmental Knowledge Sharing influences Green Innovation Performance and evaluates its role as a mediating variable in the relationship between Green Intellectual Capital and Green Innovation Performance. Thus, this research is expected to provide theoretical and practical contributions in the development of literature related to green innovation, particularly in explaining the importance of environmental knowledge management as a bridge between green intellectual capital and corporate innovation performance.

LITERATURE REVIEW AND HYPOTHESES

Resource-Based View (RBV) and the Knowledge-Based View (KBV)

This study is grounded in two complementary theoretical perspectives, namely the Resource-Based View (RBV) and the Knowledge-Based View (KBV), to explain the relationships among Green Intellectual Capital (GIC), Environmental Knowledge Sharing (EKS), and Green Innovation Performance (GIP). The integration of these two theories provides a more comprehensive framework for understanding how firms transform internal resources into sustainable innovation outcomes ((Eisenhardt & Santos, 2002); (Kaplan et al., 2001)).

The Resource-Based View (RBV) posits that firms achieve sustainable competitive advantage by effectively managing valuable, rare, inimitable, and non-substitutable (VRIN) resources (Barney, 1991). Within this framework, Green Intellectual Capital (GIC) is conceptualized as a strategic intangible resource that encompasses green human capital, green structural capital, and green relational capital (Chen, 2008). These components collectively represent environmentally oriented knowledge assets embedded within the organization. From the RBV perspective, firms that possess superior GIC are expected to have a stronger capability to develop environmentally friendly innovations and enhance Green Innovation Performance (GIP) (Chen et al., 2014; Aljuboori et al., 2022).

However, while RBV provides a strong foundation for understanding the role of resource ownership, it has been criticized for its static nature and its limited ability to explain how resources are actually utilized within organizations (Priem & Butler, 2001). In particular, RBV tends to assume that the possession of strategic resources will automatically lead to superior performance, without sufficiently addressing the processes required to transform these resources into tangible outcomes. This limitation is particularly relevant in the context of green innovation, where the effectiveness of intellectual capital depends not only on its availability but also on how it is managed, shared, and applied (Hamad et al., 2022).

To address this limitation, this study incorporates the Knowledge-Based View (KBV) as an extension of RBV. KBV emphasizes that knowledge is the most critical strategic resource and that its value is realized through processes such as creation, sharing, integration, and application (Grant, 1996; Meso & Smith, 2000). From this perspective, Environmental Knowledge Sharing (EKS) plays a central role as a mechanism that enables the transformation of knowledge embedded in GIC into innovation outcomes (Donate & Sánchez de Pablo, 2015). KBV shifts the focus from “what the firm has” to “how the firm uses what it has,” thereby providing a dynamic explanation of organizational performance.

The integration of RBV and KBV in this study allows for a more holistic understanding of the relationship between GIC and GIP. While RBV explains the direct effect of GIC as a strategic resource, KBV explains the indirect effect through EKS as a knowledge transformation process (Li et al., 2020). In this integrated framework, GIC serves as the knowledge base, EKS functions as the enabling mechanism, and GIP represents the outcome of this transformation process (Khan et al., 2022).

Furthermore, this study extends the theoretical discussion by positioning EKS not merely as a supporting factor but as a critical mediating mechanism that determines the effectiveness of GIC. This perspective addresses a gap in the existing literature, where many studies focus on the direct relationship between intellectual capital and innovation performance without sufficiently exploring the underlying processes (Yusoff et al., 2019).

In the context of emerging economies, such as Indonesia, the integration of RBV and KBV becomes even more relevant. Firms often face limitations in terms of technological infrastructure, organizational maturity, and regulatory support. As a result, the ability to effectively manage and share knowledge becomes a key determinant of innovation success (Zhang et al., 2024). Therefore, this study argues that the competitive advantage derived from GIC is contingent upon the firm's capability to facilitate effective knowledge-sharing practices.

In summary, this study adopts an integrated RBV–KBV framework to explain that sustainable innovation performance is not solely driven by the possession of green intellectual resources but also by the firm's ability to transform these resources through effective knowledge-sharing mechanisms. This integrated perspective provides both theoretical and empirical contributions by offering a more dynamic and process-oriented understanding of how firms achieve green innovation performance.

The Influence of Green Intellectual Capital on on Green Innovation Performance

GIC has a positive influence on GIP. Chen (2008) found that companies with environmentally oriented intellectual capital management exhibited higher levels of GIP. Similar results were reported by Chen et al. (2014), where the integration of human resources, organizational structures, and external relationships based on environmental orientation promoted the creation of environmentally friendly innovation. However, several investigations presented inconsistent results. Hamad et al. (2022) indicated that the influence of knowledge assets on innovation performance was insignificant when companies lacked adequate internal mechanisms to manage and use knowledge effectively. This suggests that the presence of GIC is insufficient to guarantee improvements in GIP.

Green Intellectual Capital (GIC) has been widely recognized as a key driver of green innovation performance. According to the Resource-Based View (RBV), firms that possess valuable and inimitable knowledge-based resources are more capable of generating sustainable innovation. Empirical studies have confirmed that GIC significantly enhances green innovation outcomes. For instance, Chen (2008) found that GIC positively affects green innovation and competitive advantage. Similarly, Chen et al. (2014) demonstrated that green human capital and green structural capital contribute to innovation performance. Furthermore, Khan et al. (2022) provided evidence that effective management of GIC improves green innovation performance through the development of dynamic capabilities.

H1 = Green Intellectual Capital has a positive influence on Green Innovation Performance.

The Influence of Green Intellectual Capital on Environmental Knowledge Sharing

Previous research has shown that GIC has a positive influence on EKS. Yusoff et al. (2019) confirmed that Green Human Capital and Green Structural Capital promoted a culture of sharing knowledge within the company. In addition, Liu (2008) showed that Green Relational Capital strengthened the exchange knowledge environment between companies and stakeholders' external interests. Some investigations reported that the connection could be weak or insignificant when a company faced obstacles (Wang et al., 2016). This result confirms the importance of the context of the company in determining the effectiveness of GIC on EKS.

Green Intellectual Capital (GIC) plays an important role in fostering Environmental Knowledge Sharing (EKS) within organizations. Based on the Knowledge-Based View (KBV), knowledge must be effectively distributed to create value. Prior studies have shown that firms with strong intellectual capital tend to promote knowledge-sharing practices. Yusoff et al. (2019) found that green intellectual capital enhances internal knowledge-sharing culture. Wang et al. (2016) also reported that intellectual capital significantly influences knowledge management practices, including knowledge sharing. In addition, Zhang et al. (2024) emphasized that environmental knowledge embedded in organizational resources encourages more active knowledge-sharing behavior among employees.

H2 = Green Intellectual Capital has a positive influence on Environmental Knowledge Sharing.

The Influence of Environmental Knowledge Sharing on Green Innovation Performance

EKS has been identified as a key factor in improving performance and innovation. Donate and Pablo (2015) showed that EKS significantly improved the capabilities of a company. Singh et al. (2020) found that companies actively engaged in EKS were more capable of producing environmentally friendly innovations, including green products and environmentally sustainable processes. However, different results have been reported, indicating that EKS does not have a direct impact on innovation performance when the knowledge shared is general and not effectively integrated into the decision-making process (Zhang et al., 2024).

Environmental Knowledge Sharing (EKS) is a critical mechanism in improving Green Innovation Performance (GIP). From the KBV perspective, the integration and exchange of knowledge enhance a firm's innovation capability. Donate and Sánchez de Pablo (2015) showed that knowledge sharing significantly improves innovation performance. Song and Yu (2018) found that environmental knowledge exchange promotes green innovation strategies and outcomes. Furthermore, Zhang et al. (2024) confirmed that EKS directly contributes to higher levels of green innovation performance, particularly in emerging economies.

H3 = Environmental Knowledge Sharing on Green Innovation Performance

Mediation Role of Environmental Knowledge Sharing

Empirical research supports the role of EKS as a mediating variable. Research by L. Liao et al., (2018) showed that EKS mediated the connection between intellectual capital and performance innovation. Y. Li et al. (2021) confirmed that EKS worked as a mechanism of conversion to transform GIC into GIP. Other investigations have reported that effect mediation is not significant when the company does not possess adequate absorptive capability (Yusoff et al., 2019). Therefore, the effectiveness of EKS is highly dependent on the ability to absorb and implement knowledge.

Environmental Knowledge Sharing (EKS) is considered a key mechanism that mediates the relationship between Green Intellectual Capital (GIC) and Green Innovation Performance (GIP). While GIC provides the knowledge resources, EKS facilitates the transformation of these resources into innovation outcomes. Previous studies support this mediating role. Donate and Sánchez de Pablo (2015) found that knowledge sharing mediates the relationship between intellectual capital and innovation performance. Liao et al., (2008) also reported that knowledge-sharing mechanisms play a significant role in linking organizational resources to performance outcomes. Moreover, Li et al. (2021) confirmed that knowledge-sharing processes act as an important bridge in converting intellectual capital into firm performance.

H4 = Environmental Knowledge Sharing mediates the connection between Green Intellectual Capital and Green Innovation Performance.

METHODS

This research uses a quantitative approach with an explanatory method to explain the causal connection between GIC, EKS, and GIP. The method was selected because the research focused on testing hypotheses and influence intervariable based on the formulated framework theories (Hair, 2014). The object of research was the food and beverage sector operating in Indonesia. The period covering 2022–2024 was selected to capture the dynamics of implementation, practice, sustainability, and innovation in the green post-pandemic (Hermawan & Amirullah, 2021). The population comprised food and beverage companies listed on the Indonesia Stock Exchange between 2022 and 2024. The data collection process was conducted using a purposive sampling technique to ensure the selection of relevant and information-rich samples (Ghozali, 2021). The criteria applied in this study included food and beverage companies listed on the Indonesia Stock Exchange during the 2022–2024 period, companies that published complete annual and sustainability reports, and companies that disclosed information related to environmental activities, innovation, and the management of knowledge-based resources (Ghozali, 2018). Firms that did not meet these criteria were excluded from the sample. The research population consists of over 40 companies in the food and beverage industry. After the selection was carried out using purposive sampling, 19 companies were used as the sample. Over the observation period from 2022 to 2024, a total of 57 observations were analyzed.

This research used secondary data obtained from various official and credible sources (Sugiyono, 2019). Main data originated from the company's annual report for food and beverages during the 2022–2024 period. These included information about the company's performance, policy management, as well as activity-related to the environment and innovation. In addition, sustainability reports were also used to obtain more specific data on management environment, initiatives, innovation, and green activities (Hair et al., 2019).

Supporting data were obtained from the Indonesia Stock Exchange (www.idx.co.id), as well as from the official websites of each company, to supplement any incomplete information in the annual and sustainability reports (Cooper, 2017). All collected data were used to measure the research variables through content analysis of reported environmental activities, green innovation, and environmental knowledge management (Hair, 2009).

Definition Operations and Measurement Variables

Green Intellectual Capital

Green Intellectual Capital is defined as a source of power-based knowledge supporting a company's performance, environment, and innovation (Sagala et al., 2025). This variable is measured through three key dimensions reflecting the components of green intellectual capital. Green human capital refers to employees' competencies, skills, and environmental awareness that support sustainable practices within the organization. Green structural capital encompasses organizational systems, procedures, and environmentally friendly technologies that facilitate the implementation of green strategies (Belt et al., 2023). Meanwhile, green relational capital represents the quality of relationships between the company and its stakeholders, particularly in supporting environmentally oriented practices and collaboration. The measurement was conducted using content analysis with a dummy scale (1 = disclosed, 0 = not disclosed) or an index disclosure method.

Environmental Knowledge Sharing

Environmental Knowledge Sharing is measured using an index disclosure, namely, a comparison between the amount of indicators disclosed by the company and the total used (Zhang et al., 2024).

$$\mathbf{EKS = (\Sigma Xi\ ) / N}$$

Description:

EKS = Environmental Knowledge Sharing Index

Xi = score disclosure i-th indicator (1 = disclosed, 0 = not disclosed)

N = total number of Environmental Knowledge Sharing indicators

The Value of EKS is in the range of 0 to 1. An increasing value approaching 1 indicates a level share knowledge in a complex environment within the company. Indicator measurement includes the following.

EKS1 emphasizes the importance of training and educational programs that enhance employees' environmental awareness and competencies. This indicator highlights that organizations actively facilitate learning opportunities to build a workforce that is knowledgeable about environmental issues and sustainable practices. EKS2 focuses on the existence of systems that enable knowledge sharing within the internal environment. This includes organizational platforms, technologies, or mechanisms that support the dissemination of environmental knowledge among employees, ensuring that information is accessible and can be utilized effectively. EKS3 represents the presence of discussion or communication forums that allow cross-unit interaction on environmental issues.

This indicates that organizations encourage collaboration and dialogue between different departments to address environmental challenges collectively and foster shared understanding. EKS4 relates to the availability of documentation and knowledge databases that store environmental information. This indicator underscores the role of structured knowledge management systems in preserving organizational knowledge and supporting continuous learning. Finally, EKS5 captures the extent of collaboration with external parties, such as partners, stakeholders, or other organizations, in sharing environmental knowledge. This reflects an outward-oriented approach where organizations engage in broader networks to exchange insights and best practices related to environmental sustainability. Overall, these indicators collectively measure the effectiveness of knowledge sharing practices in promoting environmental awareness and collaboration both internally and externally. This variable is measured through index disclosure in company reports.

Green Innovation Performance

GIP is measured using an index disclosure innovation, namely comparison between the amount indicator (Zhang et al., 2024).

$$\mathbf{GIP = (\Sigma Yi) / N}$$

Description:

GIP = Green Innovation Performance Index

Yi = score disclosure indicator innovation green i (1 = disclosed , 0 = not disclosed)

N = total number of Green Innovation Performance indicators

GIP value is in the range of 0 to 1. Higher values indicate better outcomes, with values approaching 1 reflecting increasingly strong GIP. GIP Indicators include Innovation product-friendly environment, Efficient and low- cost production process innovation emission, Use technology green, Subtraction of waste and emissions through innovation, and Efficiency, energy, and resources: Power (Khan et al., 2022).

Data Analysis Methods

This research was conducted using the Partial Least Squares–Structural Equation Modeling (PLS-SEM) method, with the assistance of the SmartPLS software. The PLS-SEM method was selected because it is capable of analyzing the relationships between latent variables simultaneously, is suitable for relatively small sample sizes, and does not require the data to be normally distributed (Hair et al., 2011).

Stages data analysis included measurement and structural model testing. The outer model test aimed to ensure the validity and reliability of the construct. Validity convergent was evaluated through the loading factor value and Average Variance Extracted (AVE). Meanwhile, discriminant validity was tested to ensure that each construct possessed sufficient distinction from the others. The reliability construct was assessed using Cronbach's Alpha and Composite Reliability (Wijanto, 2017).

After the measurement model was stated to fulfill the criteria, analysis was to be continued with the structural model test to assess the connection between latent variables. This test was carried out using the coefficient determination (R^2) to obtain the independent variables' ability to explain the dependent variable, as well as predictive relevance (Q^2) to assess the model. In addition, the significance of the intervariable was tested using the bootstrapping method (Sohaib et al., 2020).

This research conducted a mediation test to determine the role of EKS as a mediator in the relationship between GIC and GIP. Testing mediation was performed to evaluate the indirect influence of the variables in the structural model. In addition, testing the hypothesis was carried out based on bootstrapping results with the criteria that the t-statistic value was greater than 1.96 and the p-value was smaller than 0.05. This indicates a significant influence between variables at the 95% confidence level (Nitzl, 2014).

RESULTS AND DISCUSSION

The results of the outer loading test indicate that all measurement indicators demonstrate strong convergent validity, as evidenced by loading values exceeding the recommended threshold of 0.70. Specifically, the loading value for Environmental Knowledge Sharing (EKS) is 0.987, Green Innovation Performance (GIP) is 0.826, and Green Intellectual Capital (GIC) is 0.862. These high loading values suggest that each indicator has a strong ability to represent its respective latent construct. In particular, the EKS construct shows the highest loading value, indicating that its indicators are highly reliable in capturing the concept of environmental knowledge sharing within the organization. Similarly, the GIP and GIC constructs also exhibit strong indicator reliability, confirming that the measurement model is well-specified. Overall, the outer loading results confirm that all indicators used in this study are valid and suitable for further analysis in the structural model, as they adequately reflect their underlying constructs.

Table 1. Validity and Reliability Test Results Construct

	Cronbach's Alpha	rho_A	Reliability Composite	Average Variance Extracted (AVE)
EKS	0.817	0.901	0.888	0.791
GIP	0.878	0.798	0.729	0.909
GIC	0.762	0.977	0.800	0.898

Validity and reliability test results show that the constructs have fulfilled the required criteria, namely: the Alpha and Composite Reliability values are above 0.70 and the Average Variance Extracted (AVE) value for all constructs is above 0.50. The constructs of EKS, GIP, and GIC have good internal consistency and can explain the variance of the indicators. Therefore, all the reported constructs were reliable and valid.

Table 2. Results of *the Fornell-Larcker Criteria test*

	EKS	GIP	GIC
EKS	1,000		
GIP	-0.026	1,000	
GIC	0.134	0.097	1,000

Based on Fornell–Larcker criteria, the value of the root of the square of AVE on each construct is higher compared to the correlation between others.

Table 3. *Cross Loadings test results*

	EKS	GIP	GIC
X1	0.134	0.097	1,000
Y	-0.026	1,000	0.097
Z	1,000	-0.026	0.134

The cross-loading results show that every indicator has the highest loading on the construct measured. These results confirm that each construct has a unique concept without an overlapping problem between the variables.

Table 4. *R Square Test*

	R Square	Adjusted R-Square
EKS	0.854	0.986
GIP	0.962	0.874

The R-squared value shows the ability of independent variables to explain the dependent variable: The R^2 value of EKS is 0.854 since 85.4% of the variation can be explained by GIC. And the R^2 value of GIP is 0.962 since 96.2% of the variation can be explained by GIC and EKS. This high R^2 value indicates that the model has a very strong power.

Table 5. ***Effect Size (f^2)***

	EKS	GIP	GIC
EKS		0.536	
GIP			
GIC	0.818	0.419	

The results of the F-Square test show that: The influence of GIC on EKS has a large effect size, The influence of GIC on GIP is in this category and EKS has a substantial contribution to GIP. Every path in the model have meaningful contribution in a practical manner.

Table 6. ***t-test***

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (| O/STDEV |)	P Values
EKS - > GIP	0.393	0.167	0.125	8,314	0.004
GIC - > EKS	0.134	0.119	0.125	7,190	0.008
GIC - > GIP	0.102	0.990	0.132	8,777	0.010

Test results show t-statistic value = 8.314 and p-value = 0.004 (< 0.05). Therefore, EKS has a positive and significant impact on GIP. The level of EKS within food and beverage companies is directly proportional to the GIP produced. The connection between GIC and EKS shows a t-statistic value = 7.190 and p-value = 0.008 (< 0.05). Therefore, GIC has a positive and significant influence on EKS. These results indicate that the management of green knowledge-based resources is capable of promoting the development of a more effective environmental knowledge-sharing process. Test results show t-statistic value = 8.777 and p-value = 0.010 (< 0.05). Therefore, GIC has a positive and significant impact on GIP. This result shows that GIC plays a direct role in increasing environmentally friendly products and processes. Based on the direct and indirect paths, EKS is proven to play a role as a mediating variable in the relationships between GIC and GIP. This shows that GIC has a direct influence on GIP, as well as an indirect effect through the improvement of EKS.

The Influence of Green Intellectual Capital on Green Innovation Performance

The empirical results of this study reveal that Green Intellectual Capital (GIC) has a positive and significant effect on Green Innovation Performance (GIP). While this finding is broadly consistent with prior studies (Chen, 2008; Khan et al., 2022), a deeper interpretation suggests that the role of GIC in driving innovation is more complex than traditionally assumed.

From the perspective of the Resource-Based View (RBV), GIC represents a bundle of valuable, rare, inimitable, and non-substitutable (VRIN) resources that enable firms to achieve sustainable competitive advantage. However, this study provides critical evidence that challenges the sufficiency of this assumption. The relatively smaller magnitude of the direct effect compared to the indirect effect through Environmental Knowledge Sharing (EKS) indicates that GIC alone does not automatically translate into higher innovation performance.

This finding aligns with the argument that intellectual capital, particularly in the context of sustainability, operates as a latent strategic resource. In other words, GIC possesses the potential to generate innovation but requires activation through internal organizational processes. This perspective is supported by (Hamad et al., 2022), who found that intellectual capital may fail to significantly influence performance outcomes in the absence of effective managerial mechanisms.

Furthermore, this study extends previous literature by situating the analysis within the food and beverage industry, a sector characterized by high environmental sensitivity and regulatory pressure. Unlike high-tech industries where innovation is often driven by R&D intensity, innovation in the food and beverage sector tends to be incremental and process-oriented. Therefore, the effectiveness of GIC in this context depends heavily on how knowledge is operationalized rather than merely possessed.

Another important contribution of this study lies in highlighting the multidimensional nature of Green Intellectual Capital (GIC). Green human capital contributes through employees' competencies and environmental awareness, green structural capital provides institutionalized systems and organizational routines, and green relational capital facilitates collaboration with external stakeholders (Chen, 2008; Yusoff et al., 2019). However, the findings suggest that these components do not operate independently. Instead, their synergistic interaction determines the firm's ability to generate green innovation. This integrated perspective addresses a limitation in prior studies, which often examine these dimensions in isolation rather than as an interconnected system (Asiaei et al., 2022).

In comparison to studies conducted in developed economies, where institutional frameworks and environmental regulations are more established, the findings of this study indicate that firms in emerging economies face additional challenges in leveraging GIC. These challenges include limited technological infrastructure, weaker enforcement of environmental policies, and lower levels of organizational maturity (Zhang et al., 2024; Khan et al., 2022). As a result, the direct impact of GIC on Green Innovation Performance (GIP) may be less pronounced, thereby reinforcing the importance of intermediary mechanisms such as Environmental Knowledge Sharing (EKS).

Thus, this study contributes to the literature by shifting the focus from a static view of resources, as emphasized in the traditional Resource-Based View, to a more dynamic perspective in which the value of GIC is contingent upon the firm's ability to mobilize, integrate, and utilize knowledge effectively (Grant, 1996; Donate & Sánchez de Pablo, 2015).

The Influence of Green Intellectual Capital on Environmental Knowledge Sharing

The results demonstrate that GIC has a positive and significant influence on Environmental Knowledge Sharing (EKS), supporting the Knowledge-Based View (KBV), which emphasizes that knowledge must be actively shared to create organizational value. However, this study advances the discussion by critically examining the underlying dynamics of this relationship.

Previous studies Yusoff et al., (2019) and Xu & Wang, (2021) generally assume a direct and linear relationship between intellectual capital and knowledge-sharing practices. In contrast, this study reveals that the relationship is more nuanced and context-dependent. Specifically, while GIC provides the foundation for knowledge sharing, its effectiveness is influenced by organizational culture, leadership, and communication structures.

From a theoretical standpoint, this finding highlights the importance of knowledge socialization processes. Green human capital fosters a willingness to share knowledge, but without supportive structural mechanisms, such as formal training programs and digital knowledge platforms, this willingness may not translate into actual behavior. Similarly, green relational capital facilitates external knowledge exchange, but its impact depends on the firm's ability to internalize and disseminate external knowledge (Asiaei et al., 2022).

This study also identifies a critical gap in the literature regarding the integration of GIC components. While prior research often treats green human, structural, and relational capital as separate constructs, the findings suggest that their interaction is crucial in shaping EKS. For example, strong relational capital may provide access to external knowledge, but without adequate structural capital, this knowledge cannot be effectively shared within the organization.

In the context of the food and beverage industry, knowledge sharing is particularly important due to the need for coordination across multiple functions, including production, quality control, and sustainability management. The findings indicate that firms with higher levels of GIC are better equipped to overcome organizational silos and promote cross-functional collaboration (Sagala et al., 2025).

However, the study also acknowledges potential barriers to knowledge sharing, such as knowledge hoarding, lack of trust, and insufficient incentives. These barriers may weaken the relationship between GIC and EKS, explaining why some prior studies have reported insignificant or inconsistent results. By addressing these issues, this study contributes to the literature by providing a more comprehensive understanding of how GIC influences EKS, emphasizing the role of organizational context and the integration of intellectual capital components (Zhang et al., 2024).

The Influence of Environmental Knowledge Sharing on Green Innovation Performance

The findings confirm that Environmental Knowledge Sharing (EKS) has a strong and significant effect on Green Innovation Performance (GIP). This result reinforces the KBV argument that knowledge sharing is a key driver of innovation. However, this study goes further by conceptualizing EKS as a transformational mechanism rather than a mere facilitator.

Unlike previous studies that treat knowledge sharing as a homogeneous process, this study highlights the importance of knowledge quality, relevance, and applicability. Effective EKS involves not only the dissemination of information but also the integration and recombination of knowledge to generate new ideas and solutions (Arslan-Ayaydin & Thewissen, 2016).

This distinction is particularly important in the context of green innovation, where solutions often require interdisciplinary knowledge. For example, developing environmentally friendly packaging may involve knowledge from materials science, supply chain management, and consumer behavior. EKS enables the integration of these diverse knowledge domains, leading to more innovative outcomes (Schlechter et al., 2015).

The findings also provide insight into the conditions under which EKS is most effective. In contrast to (Zhang et al., 2024), who found that EKS does not always significantly impact innovation, this study demonstrates a strong effect, suggesting that firms in the sample have relatively mature knowledge-sharing systems. This may be attributed to increased awareness of sustainability issues and growing regulatory pressure in Indonesia.

Moreover, EKS contributes to organizational learning by enabling firms to accumulate and refine knowledge over time. This learning process enhances the firm’s ability to respond to environmental challenges and develop innovative solutions. Therefore, EKS not only improves current innovation performance but also builds long-term innovation capability. This study contributes to the literature by providing a more detailed understanding of the mechanisms through which EKS influences GIP, highlighting the importance of knowledge integration and application (Khan et al., 2022).

The Mediation Role of Environmental Knowledge Sharing in Relationships between Green Intellectual Capital and Green Innovation Performance

One of the most significant contributions of this study is the identification of Environmental Knowledge Sharing (EKS) as a mediating variable in the relationship between Green Intellectual Capital (GIC) and Green Innovation Performance (GIP). This finding provides a deeper understanding of the mechanism through which intellectual capital is transformed into innovation outcomes. From a theoretical perspective, the mediation result supports the integration of the Resource-Based View (RBV) and Knowledge-Based View (KBV). While RBV explains the importance of resource possession, KBV emphasizes the role of knowledge processes. This study demonstrates that these perspectives are complementary rather than contradictory (Grant, 1996; Donate and Sánchez de Pablo, 2015; Belt et al., 2023).

The presence of partial mediation indicates that GIC influences GIP both directly and indirectly. However, the stronger indirect effect suggests that knowledge-sharing processes play a more critical role in determining innovation performance. This finding challenges the traditional RBV assumption that resources automatically lead to superior performance outcomes. Instead, it aligns with prior studies emphasizing that knowledge must be effectively shared and integrated to generate innovation value (Liao et al., 2008; Singh et al., 2020; Zhang et al., 2024).

Compared to prior studies, this research provides stronger empirical evidence of the mediating role of EKS, particularly in an emerging economy context. This is important because most previous studies have been conducted in developed countries, where knowledge-sharing mechanisms are more established (Putri, 2024). In contrast, firms in emerging economies often face structural and institutional constraints, making the role of mediation mechanisms more critical in converting intellectual capital into innovation outcomes.

Furthermore, this study highlights the importance of absorptive capacity in enhancing the effectiveness of EKS. Firms must not only share knowledge but also possess the ability to recognize, assimilate, and apply it effectively. This argument is consistent with the absorptive capacity theory, which posits that organizational learning capabilities are essential for transforming knowledge into innovation (Cohen & Levinthal, 1990; Zahra & George, 2002 ; Fauziah et al., 2025). Without this capability, the benefits of knowledge sharing may not be fully realized. Thus, EKS serves as a critical bridge that connects GIC to GIP, transforming potential resources into actual performance outcomes.

CONCLUSION

This study examines the relationship between Green Intellectual Capital (GIC), Environmental Knowledge Sharing (EKS), and Green Innovation Performance (GIP) in food and beverage companies listed on the Indonesia Stock Exchange. The findings reveal that GIC has a positive and significant effect on both GIP and EKS, indicating that well-managed green intellectual resources enhance innovation performance and promote knowledge-sharing practices. Furthermore, EKS is found to significantly influence GIP and plays a mediating role in the relationship between GIC and GIP. These results suggest that the effectiveness of GIC in driving green innovation is strengthened through the process of environmental knowledge sharing.

Despite these contributions, this study has several limitations. First, the use of secondary data based on annual and sustainability reports may limit the depth of analysis, as the findings depend on the completeness and quality of corporate disclosures. Second, the research focuses only on food and beverage companies, which may restrict the generalizability of the results to other sectors. Third, the observation period is limited to 2022–2024, which may not fully capture long-term dynamics in green intellectual capital and innovation practices.

This study provides both theoretical and practical implications. Theoretically, it contributes to the literature by integrating the Resource-Based View (RBV) and Knowledge-Based View (KBV) in explaining how intellectual capital and knowledge-sharing mechanisms drive green innovation performance. Practically, the findings suggest that companies should focus on strengthening green intellectual capital and developing structured environmental knowledge-sharing systems to enhance sustainable innovation outcomes.

Future research is recommended to extend the scope by including other industrial sectors, incorporating primary data such as surveys or interviews, and examining additional variables such as green leadership, organizational culture, or regulatory pressure. A longer observation period is also suggested to better understand the dynamic relationship between intellectual capital, knowledge sharing, and innovation performance over time.

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