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Integrating Green Intellectual Capital into Sustainable Business Practices for Ecopreneurship at Pertamina Fuel Terminal BBM PROPER Biru

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ABSTRACT

This study examines the roles of Green Organizational Capital (GOC) and Green Relational Capital (GRC) in enhancing Corporate Sustainability Performance (CSP), with Green Innovation (GI) as a mediator and Knowledge Management Systems (KMS) as a moderator within Pertamina's Fuel Terminal operations. **A qualitative approach** was used, employing semi-structured interviews, document analysis, and observations. Data were analyzed thematically to uncover patterns and relationships. GOC and GRC significantly impact CSP, with GI serving as a critical mediator. However, KMS has a limited moderating role, indicating gaps in integrating knowledge systems into sustainability practices. **This study contributes** to the understanding of Green Intellectual Capital (GIC) and identifies areas for improving KMS in sustainability efforts. Organizations should strengthen internal structures, external relationships, and knowledge management to promote green innovation and long-term sustainability. The study offers a novel framework integrating GIC, GI, and KMS in the energy sector, providing actionable insights for emerging economies.

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1. INTRODUCTION

Global warming and climate change have emerged as critical global challenges, significantly affecting ecosystems, economies, and societies [1]. The energy sector, as one of the largest contributors to greenhouse gas emissions, faces increasing pressure to adopt sustainable practices that balance economic growth, environmental preservation, and social equity [2]. This holistic approach is often captured in the Triple Bottom Line (TBL) framework, which emphasizes profit, people, and the planet as interconnected dimensions of corporate success [3].

In Indonesia, Pertamina, a leading state-owned energy company, has demonstrated its commitment to sustainability through programs like PROPER. This program evaluates companies environmental performance, encouraging them to exceed compliance with environmental regulations [4, 5]. However, achieving true Corporate Sustainability Performance (CSP) requires more than compliance it necessitates leveraging organizational resources and innovation to address sustainability challenges effectively [6].

Green Intellectual Capital (GIC) offers a strategic framework for achieving CSP by integrating envi-

ronmental goals into organizational structures and stakeholder relationships. GIC comprises three dimensions: Green Organizational Capital (GOC), focusing on internal systems and structures that promote sustainability; Green Relational Capital (GRC), which leverages external partnerships to enhance environmental initiatives; and Green Human Capital (GHC), which develops employees skills and knowledge for sustainable operations [7, 8]. While GHC has been widely studied, the roles of GOC and GRC in driving sustainability outcomes remain underexplored, particularly in the context of emerging economies [9, 10].

Green Innovation (GI) is critical for translating GIC into actionable sustainability outcomes. GI includes the development of environmentally friendly products, processes, and practices that align with organizational goals and stakeholder expectations [11]. Furthermore, the integration of a Knowledge Management System (KMS) facilitates the structured sharing and application of knowledge, [12], enhancing the effectiveness of green innovation [13, 14]. Despite their importance, the interaction between GI and KMS in driving CSP has not been fully explored [15, 16], leaving a gap in the understanding of their synergistic effects [17–19].

This study aims to fill these gaps by investigating the influence of GOC and GRC on CSP [20], mediated by GI and moderated by KMS, in the context of Pertamina's Fuel Terminal [21, 22]. By integrating these variables, the research provides a comprehensive framework for understanding how intellectual capital and innovation drive sustainability in the energy sector [23].

2. LITERATURE REVIEW

2.1. Green Intellectual Capital (GIC)

GIC refers to intangible assets that enable organizations to achieve sustainability goals [24, 25]. GIC is divided into three components: GOC, GRC, and GHC [26, 27]. GOC includes internal systems, structures, and processes designed to promote environmental responsibility [28]. GRC, on the other hand, focuses on relationships with stakeholders, such as suppliers and customers [29], that enhance the organization's environmental initiatives [30]. Research highlights the importance of GIC in driving corporate sustainability by fostering innovation and improving organizational adaptability [31, 32]. However, while GHC has been widely studied, there is limited exploration of the specific roles of GOC and GRC in influencing CSP [33, 34].

2.2. Green Innovation (GI)

GI involves the development of products, processes, and systems that reduce environmental harm while maintaining economic viability [35–37]. GI is seen as a critical mediator in the relationship between GIC and CSP [38]. Organizations with robust GIC are better positioned to adopt GI practices [39], enabling them to meet sustainability objectives [40]. Furthermore, GI has been shown to directly impact CSP by improving environmental performance and enhancing stakeholder trust [41].

2.3. Knowledge Management System (KMS)

A KMS facilitates the storage [42, 43], sharing, and application of organizational knowledge [44, 45], particularly in sustainability contexts [46]. Effective KMS enhances the impact of green innovation by ensuring that environmental knowledge is accessible and actionable [47]. Studies indicate that KMS can act as a moderator, strengthening the relationship between GI and CSP [48, 49]. However, challenges such as the lack of tacit knowledge transfer remain barriers to maximizing its potential [50, 51].

2.4. Corporate Sustainability Performance (CSP)

CSP encompasses economic, environmental, and social dimensions of organizational performance [52]. CSP has become a critical measure of corporate success [53–55], reflecting an organization ability to balance profitability with environmental stewardship and social responsibility [52]. The integration of GIC and GI has been identified as a key driver of CSP, yet the role of KMS in amplifying these effects remains underexplored [56].

2.5. Integration of GIC, GI, KMS, and CSP

The interplay between GIC, GI, and KMS offers a comprehensive framework for achieving CSP [57–59]. GIC provides the foundational resources for sustainability, while GI transforms these resources into actionable practices [60, 61]. KMS ensures that knowledge related to sustainability is effectively disseminated and applied across the organization [62]. Despite their theoretical significance, empirical evidence on how these variables interact remains limited, particularly in developing economies like Indonesia [63].

3. RESEARCH METHODOLOGY

This study employs a qualitative research design to explore the interplay between GOC, GRC, GI, and CSP, with KMS as a moderating variable [64]. By adopting this approach, the research aims to gain a deep and nuanced understanding of how these green capitals and innovations collectively influence sustainability outcomes within the corporate context [65, 66]. The research was conducted at Pertamina's Fuel Terminal, focusing on its sustainability initiatives under the PROPER framework [67], which provides a structured guideline for environmental performance and regulatory compliance in Indonesia [68]. This setting allows for an in-depth examination of real-world practices, challenges, and the effectiveness of knowledge management systems in enhancing corporate sustainability efforts [69].

Figure 1. Research Design Framework

Figure 1 illustrates the research design framework used to analyze the impact of various variables on corporate sustainability performance. The research design begins with the definition of research variables, including GOC, GRC, GI, and CSP. These variables are analyzed in the research location at Pertamina Fuel Terminal. The study also utilizes the PROPER sustainability framework to assess corporate performance. KMS acts as a moderating variable, influencing the relationships between the primary variables. The sampling method used is Purposive Sampling, with participants consisting of Senior Managers, Operational Staff, and External Stakeholders.

3.1. Data Collection Methods

- **Interviews:** Semi-structured interviews were conducted with key informants, including managers, employees, and external stakeholders involved in sustainability efforts [70, 71]. Questions focused on organizational strategies, stakeholder collaboration, and knowledge-sharing practices.
- **Document Analysis:** Organizational documents such as sustainability reports, PROPER evaluations, and internal policies were reviewed to validate findings [72, 73].
- **Observations:** Non-participant observations were conducted to understand real-time sustainability practices and innovation processes [74, 75].

3.2. Sampling Method

Purposive sampling was used to select participants directly involved in sustainability initiatives, including senior managers, operational staff, and external stakeholders [76]. This approach ensured that the sample comprised individuals with relevant expertise and firsthand experience in implementing and overseeing

sustainable practices within the organization, thereby providing rich, insightful data essential for understanding the effectiveness and challenges of these initiatives [77, 78].

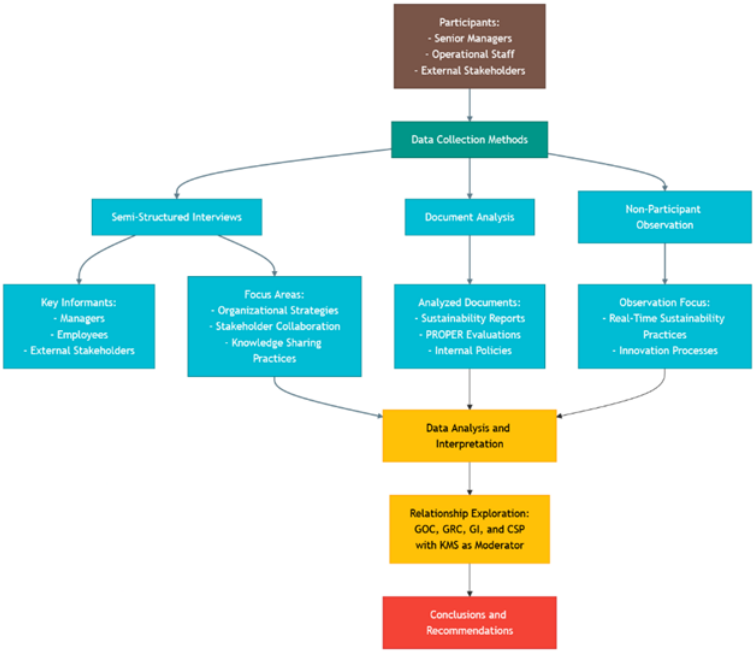

Figure 2. Data Collection and Analysis Framework

The figure 2 presents a structured framework for data collection and analysis, employing three principal qualitative methods: semi-structured interviews, document analysis, and non-participant observation. Data were gathered from a diverse set of participants, including senior management, operational personnel, and external stakeholders. Semi-structured interviews were conducted with key informants to explore critical themes such as organizational strategies, stakeholder collaboration, and knowledge-sharing practices. Document analysis focused on institutional artifacts including sustainability reports, PROPER evaluations, and internal policy documents. Concurrently, non-participant observation was utilized to capture real-time sustainability practices and innovation processes within the organizational setting. The integration of these data sources facilitated a rigorous process of data analysis and interpretation, aimed at examining the interrelationships among GOC, GRC, GI, and CSP, with KMS acting as a moderating construct. The analytical outcomes informed the development of empirically grounded conclusions and strategic recommendations.

4. RESULT AND DISCUSSION

4.1. Results

The study explored the relationship between GOC [79, 80], GRC, GI, and CSP, moderated by KMS [81]. The findings are summarized as follows:

- **Green Organizational Capital (GOC) and CSP:** Participants emphasized that organizational systems, structures, and culture significantly influence CSP [82]. Companies with robust environmental management frameworks and green policies reported better sustainability outcomes [83]. However, some gaps were identified in integrating these systems across all operational levels [84, 85].

- **Green Relational Capital (GRC) and CSP:** Stakeholder relationships, particularly with suppliers, regulators, and communities, played a pivotal role in achieving CSP. Collaborative initiatives, such as joint environmental programs, enhanced both social and environmental dimensions of sustainability [86, 87].

- **Green Innovation (GI) as a Mediator:** GI was found to be a critical mechanism through which GOC and GRC influence CSP [88, 89]. Innovations in energy efficiency and waste management contributed

directly to improved environmental performance. However, participants noted that innovation efforts were often reactive rather than proactive, indicating a need for better strategic alignment.

- **Knowledge Management System (KMS) as a Moderator:** While KMS was expected to strengthen the relationship between GI and CSP, its impact was found to be limited. Many participants reported challenges in knowledge sharing, particularly in transferring tacit knowledge. This gap highlighted the need for structured knowledge management practices.

4.2. Discussion

- **The Role of GOC and GRC in Driving CSP:** The findings are consistent with prior studies indicating that GOC and GRC form the foundation of sustainability. GOC supports internal alignment with sustainability goals, while GRC fosters external collaborations that enhance reputation and stakeholder trust. However, integrating these elements consistently across operations remains a challenge.

- **Green Innovation as a Catalyst for CSP:** GI serves as a transformative tool for translating GIC into tangible sustainability outcomes. This finding supports earlier research by Wang & Juo that highlights the role of innovation in reducing environmental impact. To optimize its potential, companies must adopt proactive innovation strategies that align with long-term sustainability goals.

- **The Limited Role of KMS:** Contrary to expectations, KMS did not significantly moderate the relationship between GI and CSP. This finding aligns with Shahzad, who noted that KMS effectiveness depends on organizational commitment to knowledge sharing. The absence of formal mechanisms for transferring tacit knowledge emerged as a critical barrier, underscoring the need for strategic investments in knowledge infrastructure.

- **Interdependencies Between GIC, GI, and KMS:** The study reveals that while GIC provides the foundation for sustainability, its impact is amplified by GI. However, the full potential of these interactions cannot be realized without effective knowledge management. Organizations must view KMS as an enabler rather than a standalone solution.

5. MANAGERIAL IMPLICATIONS

The managerial implications of this study contribute to the literature by providing empirical evidence of how Green Intellectual Capital (GIC) dimensions influence Corporate Sustainability Performance (CSP) through Green Innovation (GI) and Knowledge Management Systems (KMS). Organizations are advised to integrate Green Organizational Capital (GOC) and Green Relational Capital (GRC) into their strategic frameworks and invest in proactive innovation practices. Strengthening KMS to support tacit knowledge transfer is crucial for achieving sustained CSP. Additionally, enhanced sustainability practices contribute positively to societal well-being by reducing environmental degradation, fostering stakeholder trust, and promoting corporate responsibility.

6. CONCLUSION

This study investigates the roles of GOC and GRC in enhancing CSP at Pertamina, with a focus on the mediating role of GI and the moderating role of KMS. The findings reveal that GOC and GRC significantly impact CSP, with GI serving as a critical mediator. However, the moderating role of KMS is limited, indicating gaps in integrating knowledge systems into sustainability practices.

The study contributes to the understanding of GIC by highlighting the interactions between GOC, GRC, GI, and CSP. It underscores the need to strengthen internal structures, external relationships, and knowledge management systems to promote green innovation and long-term sustainability. Enhanced sustainability practices not only reduce environmental degradation but also foster stakeholder trust and corporate responsibility.

This research offers a novel framework for integrating GIC, GI, and KMS in the energy sector, providing actionable insights for achieving corporate sustainability in emerging economies. Companies are encouraged to adopt proactive innovation strategies and improve knowledge management to enhance sustainability outcomes.

7. DECLARATIONS

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7.2. Author Contributions

Conceptualization:SN.; Methodology: SN.; Software: SN.; Validation: SN., VR., I.S. and LC.; Formal Analysis: H.S.; Investigation: SN., VR., I.S. and LC.; Resources: SN.; Data Curation: SN.; Writing Original Draft Preparation: SN.; Writing Review and Editing: SN., VR., I.S. and LC.; Visualization: SN.; All authors, SN., VR., I.S. and LC., have read and agreed to the published version of the manuscript.

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The data presented in this research are available on request from the corresponding author.

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7.5. Declaration of Conflicting Interest

The authors declare that they have no conflicts of interest, known competing financial interests, or personal relationships that could have influenced the work reported in this paper.

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