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Strategic Sustainability in Developing-Economy Manufacturing: Energy Efficiency, Supplier Collaboration, and Compliance as Performance Levers in Rwanda

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A B S T R A C T

This article develops a focused strategic interpretation of the strongest findings from a dissertation on sustainable supply chain management (SSCM) at CIMERWA Plc in Rwanda. Rather than re-estimating the full model, the paper concentrates on the three practices that emerged as the most powerful performance levers in the case organization: energy efficiency management, supplier environmental collaboration and regulatory compliance. The aim is to explain why these practices matter disproportionately in a resource-intensive developing-economy manufacturing context and what this implies for management and policy. The study draws on a quantitative, explanatory, cross-sectional case design using partial least squares structural equation modelling applied to 182 usable survey responses from 210 distributed questionnaires. The reported direct effects show that energy efficiency management is the strongest predictor of organizational performance (β = 0.27), followed by supplier environmental collaboration (β = 0.24) and regulatory compliance (β = 0.22). The paper interprets these findings through the resource-based view, the relational view and institutional theory, while remaining cautious about the unresolved moderation issue in the wider dissertation: the approved moderator was regulatory enforcement intensity, but the reported interaction used regulatory compliance instead. The article argues that strategic sustainability in developing-economy manufacturing is most effective where internal process capability, inter-organizational coordination and institutional discipline reinforce one another. It contributes a context-sensitive account of which sustainability levers matter most in African manufacturing and why they should be central to industrial strategy, firm-level transformation and future research on sustainability under conditions of constraint.

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Strategic lever	Mean adoption score	Direct effect (β)	Strategic reading
Regulatory compliance	4.12	0.22	Institutional discipline and legitimacy are embedded in operations.
Energy efficiency management	4.01	0.27	Core operational capability affecting cost, process stability and environmental burden.
Supplier environmental collaboration	3.92	0.24	Performance depends partly on upstream coordination and shared

			capability.
Reverse logistics	3.54	0.15	Important but weaker and more infrastructure-dependent in this context.

Introduction

One of the limitations of large multivariate sustainability models is that, once all paths are estimated, the distinct strategic significance of particular practices can become obscured. A model may show that multiple SSCM dimensions matter, but managers and policymakers still need to know which levers deserve priority and why. This question is especially pressing in developing-economy manufacturing, where firms face constraints in capital, technology, infrastructure and supplier depth. Under such conditions, sequencing matters. Firms cannot always do everything at once.

This article therefore narrows the analytical lens. Rather than revisiting the full dissertation as a general performance model, it focuses on the three practices that emerged as the strongest direct predictors of organizational performance at CIMERWA Plc: energy efficiency management, supplier environmental collaboration and regulatory compliance. Together, these results suggest a strategic pattern. The strongest sustainability levers are not peripheral public-relations tools. They are the practices most directly tied to how the firm runs its operations, coordinates its supply relationships and aligns itself with institutional expectations.

The paper argues that these three levers are central because they connect the internal, relational and institutional dimensions of manufacturing performance. Energy efficiency speaks to process capability and cost discipline. Supplier collaboration speaks to interdependence, knowledge exchange and distributed capability. Regulatory compliance speaks to legitimacy, routine discipline and organizational alignment with the external environment. In a resource-intensive industrial setting, these dimensions are not separate; they are mutually reinforcing.

The article uses Rwanda as the contextual frame. The country's policy trajectory increasingly links industrial modernization with environmental responsibility, green growth and institutional accountability. This makes Rwanda a productive setting for understanding how sustainability priorities are translated into manufacturing practice. The argument advanced here is that strategic sustainability in developing-economy manufacturing should be built around the practices that most effectively connect operational performance, supply chain coordination and institutional discipline.

Strategic framing and literature gap

The SSCM literature is rich in typologies of practices but less developed in its treatment of prioritization. Most studies catalogue green procurement, eco-design, reverse logistics, collaboration, compliance and other dimensions under a common sustainability umbrella. That is useful for model completeness, but it does not always help managers decide which practices should anchor a phased transformation strategy. This matters most in industrial settings where adoption costs are real and implementation bandwidth is limited.

The resource-based view suggests that firms should prioritize capabilities that are deeply embedded in routines and difficult to imitate (Barney, 1991; Hart, 1995). In heavy manufacturing, energy efficiency is an obvious candidate because it affects the firm's cost base, process reliability and environmental burden at the same time. It is both operationally central and strategically consequential. A resource-based reading therefore predicts that firms with stronger energy capability will be better positioned to convert sustainability into performance.

The relational view points to a second priority: supplier environmental collaboration. Manufacturing supply chains are distributed systems, and sustainability performance is often shaped by upstream coordination, information sharing and joint capability development rather than by unilateral directives (Dyer and Singh, 1998). In contexts where supplier capability is uneven, collaboration is not merely supportive; it is constitutive of sustainability performance.

Institutional theory highlights a third priority: regulatory compliance. Firms do not pursue sustainability

solely because it is intrinsically efficient. They also respond to coercive rules, normative expectations and legitimacy pressures (DiMaggio and Powell, 1983; Bansal and Roth, 2000). In policy-active environments, compliance can become more than a legal minimum. It can structure routines, improve monitoring and discipline operations in ways that influence performance. Yet the literature often vacillates between treating compliance as a burden and treating it as a strategic asset. The present case offers a more nuanced view.

The gap addressed in this paper is therefore not whether SSCM affects performance in general, but which sustainability levers appear most strategically powerful in a developing-economy manufacturing setting and how those levers should be interpreted. This is a question of prioritization, contextualization and translation from empirical ranking into strategic meaning.

Methodology

The article draws on the same empirical base as the wider dissertation but adopts a different analytical emphasis. The study used a quantitative, explanatory, cross-sectional case design focused on CIMERWA Plc. Data were collected through a structured questionnaire and analysed using PLS-SEM. Of 210 distributed questionnaires, 182 usable responses were returned, yielding an 86.7 per cent response rate. Respondents came from managerial and operational roles across relevant organizational functions, offering a reasonable spread of perspectives on sustainability practices and performance.

This paper does not present the full hypothesis architecture. Instead, it selectively interprets the direct-effect results for the three strongest predictors of organizational performance. The purpose is not to inflate their importance beyond the model, but to understand why they stand out in this context and what implications follow from that ranking. The paper also uses descriptive indicators to support interpretation. Regulatory compliance recorded the highest mean level of adoption (4.12), energy efficiency management followed at 4.01 and supplier environmental collaboration at 3.92, while reverse logistics remained the lowest at 3.54. These descriptive patterns align meaningfully with the structural ranking.

One methodological caution is essential. The wider dissertation specified regulatory enforcement intensity as the approved moderator, but the reported moderation estimate used regulatory compliance instead. The present paper therefore does not treat the moderation issue as resolved evidence. Where institutional contingency is discussed, it is framed interpretively and prospectively rather than as a fully validated interaction claim.

Results and strategic interpretation

The direct-effect model shows that energy efficiency management is the strongest predictor of organizational performance ($\beta = 0.27$, $t = 4.21$, $p < 0.001$). Supplier environmental collaboration follows ($\beta = 0.24$, $t = 3.88$, $p < 0.001$), with regulatory compliance close behind ($\beta = 0.22$, $t = 3.67$, $p < 0.001$). These coefficients sit above those for green procurement ($\beta = 0.21$) and eco-design and product innovation ($\beta = 0.19$), and clearly above reverse logistics ($\beta = 0.15$).

This ranking is strategically coherent. Energy efficiency matters most because it operates at the core of manufacturing transformation. In cement production, energy use is intertwined with cost, throughput, process stability and environmental exposure. It is therefore unsurprising that a firm-level capability in energy management should deliver a comparatively strong performance return. Unlike more symbolic sustainability practices, energy interventions are difficult to decouple from the economics of production.

Supplier collaboration is the second major lever. This suggests that the performance effects of sustainability are not produced solely inside the plant. Upstream coordination remains critical. Sustainability standards, input quality, environmental consistency and process adaptation all depend on some degree of supplier alignment. In contexts where supplier capability cannot be taken for granted, collaboration may be more valuable than stricter but purely transactional control.

Regulatory compliance's strong position also deserves serious interpretation. Compliance often appears in managerial discourse as something firms must absorb rather than strategically use. Yet in this case it is associated with stronger organizational performance. That association may reflect reduced disruption risk, better process monitoring, stronger documentation, more disciplined routines and enhanced legitimacy

with regulators and stakeholders. Compliance, in this reading, is not only a response to external pressure; it is also an organizing mechanism.

The combined message is that the strongest sustainability levers are those that reach deepest into the firm's operating system while also connecting it outward—to suppliers and to institutions. This is why the trio of energy efficiency, collaboration and compliance is more strategically revealing than any single practice in isolation.

Discussion

The results invite a more strategic reading of sustainability in developing-economy manufacturing. First, they indicate that the most powerful sustainability practices are those that deliver operational seriousness. Energy efficiency management is not simply about using fewer resources. It disciplines the production system, reduces waste, affects cost structure and embeds sustainability in day-to-day operating logic. For firms under tight margin and infrastructure pressures, this may make energy capability the most credible entry point for wider sustainability transformation.

Second, the findings suggest that sustainability capability is distributed. The strength of supplier environmental collaboration confirms that firms do not become sustainable by command alone. They do so partly by creating working arrangements through which suppliers can align standards, exchange information and adapt jointly. This insight is especially important for developing economies, where supplier bases may be heterogeneous and where strong focal-firm performance depends on the quality of coordination across uneven organizational boundaries.

Third, compliance appears as a strategic discipline rather than a narrow burden. Institutional theory helps explain this. In contexts where policy ambitions around green growth and industrial accountability are becoming more explicit, firms that internalize compliance effectively may also become better organized, more monitorable and more legitimate. The contribution of compliance to performance therefore need not be understood only in defensive terms. It may also indicate that institutional alignment structures managerial seriousness.

The unresolved moderation issue in the wider dissertation adds a useful caution. Although the reported interaction suggested that SSCM yields greater returns where compliance is stronger, the approved moderator was regulatory enforcement intensity rather than compliance itself. This means the paper cannot claim formal evidence that stronger external enforcement amplifies performance effects. Even so, the discrepancy is analytically productive. It points to an important next question: are these strategic levers most powerful because of internal capability alone, or because internal capability and credible external enforcement reinforce one another? Future research should address that issue directly.

Taken together, the evidence implies that developing-economy manufacturing firms may need a more selective sustainability strategy than the universalistic checklists often found in policy discourse. A credible starting architecture would prioritize energy capability, supplier coordination and compliance discipline because these appear to generate the most immediate and robust links to organizational performance.

Conclusion

This paper has argued that strategic sustainability in developing-economy manufacturing is best understood through the practices that most strongly connect operational capability, relational coordination and institutional discipline. In the CIMERWA case, those practices are energy efficiency management, supplier environmental collaboration and regulatory compliance. Their prominence suggests that sustainability yields the strongest organizational returns when it is embedded in the operating core of the firm and in the interfaces through which the firm relates to suppliers and regulators.

The article therefore contributes a more prioritized reading of SSCM. Rather than treating all sustainability practices as equivalent, it shows that some levers are more strategically consequential in a resource-intensive manufacturing context. For firms and policymakers alike, the message is that sustainability transformation should begin where capability, coordination and discipline are most likely to reinforce one another.

Theoretical contribution

The article contributes theoretically by shifting the conversation from broad inclusion of SSCM dimensions to strategic prioritization among them. It shows how RBV, the relational view and institutional theory can be used together to interpret ranked empirical findings rather than merely to justify variable selection. The result is a more context-sensitive understanding of why specific sustainability practices matter more than others in heavy manufacturing under developing-economy conditions.

Managerial and policy implications

At firm level, managers should prioritize energy intelligence, structured supplier collaboration platforms and compliance systems that are embedded in operations rather than isolated in audit units. Sustainability budgets should favour interventions that reshape core routines before they are allocated to more peripheral initiatives. At policy level, support mechanisms should focus on energy transition, supplier capability development and credible compliance infrastructures. Industrial sustainability programmes are likely to have greater effect when they strengthen the concrete levers that firms can use to improve both competitiveness and environmental discipline.

Limitations and future research

The paper is based on a single-firm case and on cross-sectional survey evidence, so its conclusions should be interpreted as analytically strong but not universally generalizable. It also relies on the ranking of coefficients within one organizational setting, meaning that the strategic priority of these levers may differ in other sectors. The unresolved distinction between regulatory compliance and regulatory enforcement intensity remains especially important. Future research should test comparable models across multiple manufacturing firms, examine sectoral variation in sustainability priorities and build cleaner measures of enforcement intensity so that institutional contingency can be assessed more rigorously.

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