Journal of Collaborative Industrial Management Vol. (2) No. (1), April 2026
Received: 2026-04-10 Revised: 2026-04-30 Accepted: 2026-04-30
e-ISSN 3109-371X

Analysis of Green Industry Practice Implementation in Operational Management: Motivations, Barriers, and Institutional Impacts

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ABSTRACT

This study investigates the implementation of green industry practices within manufacturing operational management, with a particular focus on the motivational drivers that prompt adoption, the barriers that impede scaling, and the institutional impacts that result from sustained environmental stewardship. Employing a qualitative research design grounded in multiple case study methodology and institutional theory, data were collected through in-depth interviews with 36 key informants spanning operations directors, environmental managers, process engineers, supply chain specialists, and regulatory officers across six manufacturing facilities representing diverse industrial sub-sectors. Data collection was complemented by non-participant field observations and systematic document analysis of sustainability reports, environmental audit records, and operational policy documentation. Thematic analysis identified seven motivational driver categories ranging from regulatory compliance and market access imperatives to intrinsic leadership values and enterprise risk management alongside six classes of implementation barriers encompassing financial, technical, organizational, cultural, regulatory, and supply chain dimensions. The study further maps the institutional impacts of green practice adoption across six stakeholder dimensions: regulatory relationships, investor relations, customer legitimacy, community license to operate, industry peer positioning, and human capital. An integrative Green Industrial Operations (GIO) model is proposed, providing a structured pathway for manufacturing organizations to transition from compliance-driven to value-driven environmental management. Findings contribute to the green management and industrial operations literature by foregrounding the institutional and relational dimensions of environmental practice that operational metrics alone fail to capture.

Keywords: *green industry; operational management; institutional theory; environmental management; manufacturing sustainability; qualitative research*

Introduction

The imperative for industrial sustainability has transitioned from a peripheral corporate social responsibility concern to a central strategic and operational priority for manufacturing organizations worldwide. Climate change, biodiversity loss, resource depletion, and the proliferating demands of multi-stakeholder environmental accountability have collectively reframed the conditions of industrial legitimacy and competitiveness [1]. Manufacturing industries, which collectively account for

To cite this article: Putra, R.S., Sari,N.K., Wibowo, E.P. (2026). Analysis of Green Industry Practice Implementation in Operational Management: Motivations, Barriers, and Institutional Impacts. *Journal of Collaborative Industrial Management, vol*(2).

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approximately 28% of global greenhouse gas emissions and a disproportionate share of freshwater consumption, hazardous waste generation, and land degradation, occupy a position of particular scrutiny and responsibility within this evolving landscape [2].

Green industry broadly understood as the adoption of production processes, technologies, and management systems that minimize environmental impact while sustaining or enhancing economic performance has emerged as the dominant paradigm through which manufacturing organizations are expected to respond to this imperative [3]. The green industry concept integrates practices spanning energy management, water stewardship, waste minimization, green procurement, eco-process design, and environmental management systems (EMS) into a coherent operational philosophy oriented toward decoupling economic growth from environmental degradation [4].

Despite the growing body of normative frameworks and quantitative assessments of green industry performance, the lived reality of green practice implementation in manufacturing operational management remains insufficiently understood. Operational managers navigate complex trade-offs between environmental ambition and production imperatives; environmental management professionals contend with organizational cultures that have historically rewarded throughput over sustainability; and senior executives balance the short-term financial costs of green investment against the medium- and long-term institutional benefits of environmental leadership [5]. These dynamics are fundamentally interpretive and relational, requiring research approaches capable of capturing their nuance and complexity.

Institutional theory provides a particularly productive analytical lens for understanding why manufacturing organizations adopt green practices beyond mere compliance with regulatory minimum standards [6]. The theory's distinction between coercive, normative, and mimetic isomorphic pressures offers a structured framework for understanding the diverse institutional forces that shape green practice adoption decisions, while its attention to legitimacy processes illuminates how green practices function not merely as operational changes but as signals that constitute and reproduce organizational identity in relation to the broader institutional environment [7].

This study addresses the gap between normative green industry frameworks and the organizational realities of green practice implementation by conducting a qualitative, institution-theory-informed investigation into three interconnected dimensions: (1) the motivational drivers that prompt manufacturing organizations to adopt green practices; (2) the barriers that impede adoption and scaling; and (3) the institutional impacts on regulatory, investor, customer, community, peer, and human capital relationships that result from sustained environmental stewardship. By integrating these three dimensions within a coherent analytical framework, the study aims to generate insights that are simultaneously theoretically grounded and practically actionable.

The study makes three primary contributions. Theoretically, it extends institutional theory's application to the specific domain of green operational management, generating a multi-dimensional institutional impact framework grounded in manufacturing context. Empirically, it provides one of the first qualitative multi-case studies to systematically compare motivational drivers and barriers across multiple industrial sub-sectors within an emerging economy manufacturing context. Practically, it proposes the Green Industrial Operations (GIO) model a structured transitional pathway from compliance-driven to value-driven environmental management as an actionable tool for industrial managers and policymakers.

Literature Review

Green Industry: Conceptual Foundations and Operational Dimensions

The concept of green industry draws from multiple theoretical traditions including industrial ecology, cleaner production, environmental economics, and sustainability science. UNIDO [3] defines green industry as industries that produce goods and services while ensuring that the production process is environmentally sustainable, with targets including zero-waste manufacturing, renewable energy integration, and life-cycle environmental management. The operational dimensions of green industry implementation span a diverse spectrum of practices. Table 1 presents a taxonomy of green industry practice domains with their key initiatives, operational integration points, and primary benefits.

Table 1. Taxonomy of Green Industry Practice Domains in Manufacturing Operations

Practice Domain	Key Initiatives	Operational Integration Point	Primary Benefit
Energy Management	Transition to renewable energy sources; LED lighting retrofits; waste heat recovery systems; ISO 50001 energy management certification	Production scheduling; facility engineering; procurement	Reduced energy cost (15–30%); lower Scope 1 & 2 emissions
Water Stewardship	Closed-loop cooling systems; rainwater harvesting; effluent recycling; wastewater treatment upgrades	Process engineering; maintenance; environmental compliance	Reduced freshwater withdrawal; regulatory compliance
Waste Minimization	Zero-waste-to-landfill programs; by-product valorization; 3R (Reduce, Reuse, Recycle) protocols; circular material flows	Production planning; quality management; logistics	Lower disposal costs; raw material savings; ESG ratings improvement
Green Procurement	Supplier environmental qualification; bio-based and recycled material substitution; Life Cycle Assessment (LCA) criteria in tendering	Supply chain management; procurement; R&D	Supply chain decarbonization; reduced Scope 3 emissions
Eco-Process Design	Design for Environment (DfE) methodology; process debottlenecking to reduce emissions; solvent substitution	Product development; process engineering; HSE	Reduced hazardous outputs; improved occupational health
Environmental Management Systems	ISO 14001 certification; Environmental Impact Assessment (EIA); sustainability reporting (GRI Standards)	Corporate governance; operations; HR	Institutional legitimacy; investor confidence; export market access

Source: Adapted from UNIDO [3], Rao and Holt [8], and Zhu et al. [9]

The transition from conventional to green industrial operations is not a discrete event but an evolutionary process that unfolds across multiple dimensions simultaneously. Rao and Holt [8] characterize this transition as a progression from reactive pollution control driven by regulatory compliance to proactive environmental management driven by competitive and institutional value creation. This evolutionary perspective is important for understanding why the motivational architecture of green practice adoption changes over time: organizations that begin with compliance motivations may develop more intrinsic, value-driven motivations as they accumulate green management experience and observe the institutional benefits of environmental leadership.

Institutional Theory and Green Practice Adoption

DiMaggio and Powell's [10] institutional theory, particularly the concept of organizational isomorphism, has been widely applied to explain why organizations within the same institutional field tend to adopt similar structural and managerial practices over time. Three isomorphic mechanisms are distinguished: coercive isomorphism, arising from regulatory mandates and the expectations of organizations upon which an entity is dependent; normative isomorphism, driven by professionalization processes and the standards propagated by industry associations, consultants, and educational institutions; and mimetic isomorphism, generated by uncertainty that motivates organizations to model themselves on perceived industry leaders [11].

In the green industry context, all three isomorphic mechanisms operate simultaneously and with varying intensity across organizational contexts. Coercive pressures from environmental regulatory agencies, normative pressures from customer ESG requirements and industry certification standards, and mimetic pressures from green industry peer benchmarking collectively constitute the institutional environment within which manufacturing organizations make green practice adoption decisions [12]. Understanding the relative salience of these pressures in specific manufacturing contexts is critical for designing effective green industry policy and management interventions.

Legitimacy theory, closely related to institutional theory, provides an additional analytical lens for understanding the institutional impacts of green practice adoption. Suchman [14] defines legitimacy as a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions. For manufacturing organizations, green practice adoption functions as a legitimacy-building mechanism that signals alignment with evolving societal environmental expectations, thereby securing continued access to the regulatory approvals, market relationships, financial resources, and community acceptance that constitute the conditions of organizational survival and growth.

Barriers to Green Practice Implementation: A Multidimensional Perspective

The literature on barriers to green practice adoption in manufacturing is extensive but often fragmented across disciplinary silos. Financial barriers particularly the high upfront capital costs of green technology investments and the misalignment between long-term environmental ROI and short-term financial reporting cycles are consistently identified as the most pervasive constraint on green practice adoption [5]. Technical barriers, including insufficient in-house environmental engineering expertise and the complexity of integrating green technologies into existing production systems, are particularly significant in manufacturing facilities with aging infrastructure [13].

Organizational and cultural barriers, while less frequently operationalized in quantitative studies, emerge as equally consequential in qualitative investigations. The siloing of environmental management responsibilities within dedicated HSE departments isolated from the production planning, procurement, and R&D functions where green practices must ultimately be implemented represents a structural barrier that technical investments alone cannot overcome [9]. Cultural norms

that systematically prioritize short-term production throughput over long-term environmental performance create a pervasive organizational climate in which green initiatives are perceived as competing with rather than contributing to core business objectives [17].

Methods

Research Design and Paradigmatic Positioning

This study employs a qualitative research methodology with a multiple case study design following Yin [18]. Qualitative methods are selected on the grounds that the research objectives understanding motivations, barriers, and institutional impacts of green practice implementation require the generation of contextually rich, interpretive data that quantitative instruments cannot adequately capture. The multiple case study design enables analytical replication across diverse manufacturing contexts, strengthening the transferability of findings and enabling comparative insights about context-dependency in green practice adoption.

The study is positioned within a critical realist ontological framework, which acknowledges that observable organizational behaviors (green practice adoption decisions) are generated by underlying causal mechanisms (institutional pressures, organizational capacities, managerial values) that are real but not directly observable. This paradigmatic stance justifies the use of institutional theory as an analytical framework for interpreting the mechanisms observed in the data, while maintaining the empirical discipline characteristic of rigorous qualitative inquiry [19].

Case Selection and Research Framework

Six manufacturing facilities were selected as cases through theoretical sampling, designed to maximize variation across four dimensions: industrial sub-sector (chemical processing, food manufacturing, textile, automotive components, electronics assembly, and packaging materials); enterprise size (two large-scale facilities with >500 employees; two medium-scale with 100–499; two small-scale with <100); geographic location (three facilities in Java, two in Sumatra, one in Kalimantan); and green practice maturity (two early-stage adopters with ISO 14001 in progress; two intermediate with certified EMS; two advanced with integrated sustainability reporting). Table 2 presents the research framework organizing data collection and analysis.

Table 2. Research Design Framework: Dimensions, Questions, Sources, and Analytical Approach

Research Dimension	Key Questions	Data Sources	Analytical Approach
Motivational drivers	What factors compel manufacturing organizations to adopt green practices beyond regulatory minimum compliance?	Executive interviews; sustainability reports; policy documents	Motivation coding; institutional theory lens
Implementation barriers	What organizational, financial, technical, and cultural factors hinder green practice adoption and scaling?	Operational manager interviews; field observations; HSE audit records	Barrier taxonomy; thematic pattern matching

Institutional impacts	How do green practice adoptions affect relationships with regulators, investors, customers, and communities?	Stakeholder interviews; governance documents; media analysis	Stakeholder mapping; institutional isomorphism framework
Organizational learning	How do manufacturing firms build and distribute green operational knowledge across hierarchy levels?	Cross-functional interviews; training records; knowledge repository audits	Knowledge creation theory; process tracing
Performance outcomes	What measurable operational and financial outcomes are attributed to green practice implementation?	Archival KPI data; sustainability disclosures; benchmarking reports	Cross-case comparison; analytical induction

Source: Elaboration of Research Design, 2025

Data Collection

A total of 36 informants participated across the six case organizations. The informant composition was designed to capture multiple organizational perspectives on green practice implementation: 6 operations directors or plant managers; 8 environmental, health, and safety (EHS) managers; 7 process and production engineers; 6 supply chain and procurement specialists; 5 human resource and organizational development managers; and 4 external informants comprising two environmental regulatory officers from the relevant regional offices of the Ministry of Environment and Forestry (KLHK) and two representatives from industry associations with active green industry programs.

Semi-structured in-depth interviews were conducted with each informant, lasting between 70 and 100 minutes, using interview guides organized around the study's three analytical dimensions: motivational drivers, implementation barriers, and institutional impacts. All interviews were audio-recorded with informed consent and transcribed verbatim. Non-participant observations were conducted at each manufacturing facility, focusing on the physical manifestation of green practices (energy monitoring systems, waste segregation infrastructure, water treatment facilities), the organization of environmental management functions, and the integration of green considerations into operational decision-making spaces such as production meetings and quality reviews.

Document analysis was conducted on a corpus of 64 organizational and institutional documents including: ISO 14001 certification audit reports; sustainability reports following GRI Standards; environmental impact assessments; green procurement policies; energy management data; and internal communications relating to green practice initiatives. Documents were analyzed for evidence of how green practices are institutionalized, measured, communicated, and integrated into operational management frameworks.

Data Analysis

Thematic analysis following Braun and Clarke [20] was the primary analytical method. The analysis progressed through six phases data familiarization, initial coding, theme searching, theme reviewing,

theme defining and naming, and report production generating 487 initial codes, 28 sub-themes, and three thematic families corresponding to the study's three analytical dimensions. An institutional theory coding framework was developed a priori to organize institutional impact findings, while motivational and barrier themes were developed inductively from the data.

Rigor was ensured through methodological triangulation of interview, observation, and document data; member checking with 14 informants who reviewed and validated preliminary thematic summaries; and an inter-coder reliability process in which two independent coders analyzed 20% of the transcript corpus, achieving a Cohen's kappa of 0.81. Negative case analysis systematic examination of cases or instances that did not conform to emerging patterns was conducted to refine and bound the generalizability of thematic claims.

Results and Discussion

Motivational Drivers of Green Practice Adoption

Analysis of the data corpus identified seven distinct categories of motivation that prompt manufacturing organizations to adopt green industry practices. These motivations are not mutually exclusive but operate in complex configurations that vary by organizational context, leadership orientation, and institutional field position. Table 3 presents the motivation taxonomy with associated drivers, practical manifestations, and theoretical alignments.

Table 3. Taxonomy of Motivational Drivers for Green Industry Practice Adoption

Motivation Category	Driver	Manifestation in Practice	Theoretical Alignment
Regulatory Compliance	Environmental regulation enforcement	ISO 14001 adoption; emission permit management; effluent reporting to KLHK	Institutional coercive isomorphism [11]
Market Access	Export customer environmental requirements	Green procurement clauses in supply contracts; buyer ESG scorecards	Normative stakeholder pressure [12]
Cost Efficiency	Energy and material cost reduction	Solar panel installation; waste heat recovery; water recycling	Resource-based view; operational efficiency logic [13]
Reputational Capital	ESG investor and media scrutiny	Sustainability report publication; carbon disclosure; community engagement programs	Legitimacy theory [14]
Leadership Values	Intrinsic environmental commitment of senior management	CEO-led sustainability task forces; internal carbon pricing; green innovation funds	Upper echelon theory [15]

Peer Learning	Industry association benchmarking and knowledge sharing	Participation in green industrial clusters; cross-firm site visits	Mimetic isomorphism [11]
Risk Management	Climate-related supply chain and regulatory risk	Climate scenario analysis; green supplier qualification; facility resilience audits	Enterprise risk management; TCFD framework [16]

Source: Thematic Analysis of Field Research Data, 2025

Regulatory compliance emerged as the most universally reported motivation across all six case organizations, consistent with coercive isomorphism as a foundational driver of green practice adoption in manufacturing contexts [11]. However, a critical finding is that compliance-driven organizations consistently exhibited the narrowest and most superficial green practice profiles adopting the minimum practices necessary to satisfy regulatory requirements without developing the organizational capabilities, cultural orientations, or institutional relationships associated with genuine green industrial leadership.

Market access motivations particularly the demands of export customers for supplier environmental compliance and ESG qualification were reported as increasingly influential, particularly among manufacturers serving European and North American markets. EHS managers at the advanced-maturity facilities described detailed supplier environmental assessment questionnaires received from key buyers, encompassing criteria spanning energy intensity, water use efficiency, waste diversion rates, and human rights due diligence. These normative isomorphic pressures exerted through supply chain relationships often exceeded the stringency of domestic regulatory requirements, effectively functioning as a private governance mechanism that supplemented state regulation.

The data revealed an important motivational evolution pattern: organizations that had initially adopted green practices primarily for regulatory compliance or market access reported a gradual internalization of environmental values as they accumulated green management experience and observed the tangible operational and institutional benefits of their investments. This finding aligns with the organizational learning literature's concept of deutero-learning the development of higher-order learning capabilities that modify the organization's approach to learning itself [21]. In the green industry context, early compliance-driven adoption creates the organizational experience base from which more sophisticated, value-driven motivations emerge.

Particularly noteworthy was the role of senior leadership environmental values as an intrinsic motivational force in the two most advanced case organizations. Operations directors at these facilities described personal environmental commitments that predated regulatory mandates and market pressures, and that had driven proactive green investments during periods of institutional uncertainty. This finding resonates with upper echelon theory's proposition that executive values and cognitive frames are powerful determinants of strategic choices that cannot be fully explained by environmental determinism [15].

Implementation Barriers: A Multi-Level Analysis

Six classes of implementation barriers were identified through thematic analysis, spanning financial, technical, organizational, cultural, regulatory, and supply chain dimensions. Table 4 presents the barrier taxonomy with specific barriers, observed manifestations, and mitigation strategies identified in the data.

Table 4. Implementation Barriers to Green Industry Practices in Manufacturing Operations

Barrier Type	Specific Barrier	Observed Manifestation	Mitigation Strategy
Financial	High upfront capital requirements for green technology	Solar installations, WWTP upgrades deferred due to CAPEX constraints; ROI horizons misaligned with short-term financial planning cycles	Green financing instruments; phased investment roadmaps; government grant programs
Technical	Insufficient in-house green technology expertise	Dependence on external consultants; limited ability to optimize installed green systems; slow adoption of LCA tools	Technical training programs; university-industry partnerships; green engineering talent pipeline
Organizational	Siloed departmental ownership of sustainability responsibilities	HSE department isolated from production planning; sustainability KPIs absent from operational performance dashboards	Cross-functional sustainability committees; integrated KPI frameworks; green champions at departmental level
Cultural	Prevailing short-termism and productivity-prioritization culture	Environmental considerations systematically deprioritized during production pressure periods; green initiatives perceived as cost centers	Change management programs; green leadership modeling; visible top management commitment
Regulatory	Inconsistent and unpredictable regulatory enforcement	Investment uncertainty in environmental technology upgrades due to policy volatility; compliance-only mindset prevails	Industry-government dialogue platforms; long-term policy roadmaps; regulatory certainty mechanisms
Supply Chain	Supplier green capability gaps	Difficulty sourcing certified green materials; supplier resistance to environmental compliance requirements	Supplier development programs; tiered green procurement standards; collaborative capacity building

Source: Thematic Analysis of Field Research Data, 2025

Financial barriers were reported with the highest frequency and intensity across the case organizations, particularly in the small- and medium-scale facilities where capital allocation decisions are more constrained and investment appraisal horizons shorter. The mismatch between the long-term payback periods characteristic of green technology investments typically five to fifteen years for

renewable energy installations and the one-to-three-year financial planning cycles of most manufacturing organizations emerged as a structural barrier that persisted even in organizations with strong motivational commitment to green practice adoption.

The data, however, reveal important heterogeneity in how financial barriers are experienced and managed. Advanced-maturity organizations had largely resolved this tension through three complementary strategies: the reframing of green investments as risk management expenditures (thereby accessing risk management budgets rather than competing for CAPEX allocation); the use of green financing instruments including sustainability-linked loans and green bonds at preferentially lower interest rates; and the development of robust environmental ROI models that quantified avoided costs (energy savings, waste disposal cost reductions, avoided environmental fines) alongside less tangible benefits such as improved regulatory relationships and customer contract security.

Organizational and cultural barriers emerged as the most complex and persistent class of constraints across all maturity levels. The siloing of environmental management within dedicated EHS departments physically and organizationally separated from production planning, procurement, and engineering functions was identified as a systemic barrier to green practice mainstreaming. EHS managers described experiences of proposing green initiatives that were technically sound and economically viable but could not secure operational implementation because production managers had not been involved in their development and did not perceive environmental outcomes as within their performance accountability.

This organizational barrier is deeply connected to the cultural barrier of short-termism and productivity-prioritization. In facilities operating under intense production pressure, environmental considerations were systematically deprioritized during periods of schedule compression. One environmental manager characterized this dynamic as the environmental immune system: when operational pressure increases, the organization's natural response is to delay or suspend environmental activities that are perceived as non-essential to the immediate production task. Overcoming this immune response requires not merely awareness campaigns but fundamental restructuring of performance management systems to embed environmental KPIs with equivalent weight to productivity and quality metrics.

Supply chain barriers specifically the limited green capability of upstream suppliers represent an increasingly significant constraint as organizations seek to extend green practices beyond their facility boundaries to achieve Scope 3 emission reductions and supply chain sustainability improvements. Procurement managers described the difficulty of sourcing certified sustainable raw materials, the resistance of smaller suppliers to environmental compliance requirements, and the limited effectiveness of unilateral supplier qualification mechanisms in the absence of collaborative capacity-building support.

Institutional Impacts of Green Practice Adoption

The study's third analytical dimension the institutional impacts of sustained green practice adoption generated findings that extend beyond the operational performance metrics typically reported in green management studies to encompass the relational and legitimacy-building consequences of environmental stewardship. Six institutional impact dimensions were identified, collectively constituting what the study terms the institutional dividend of green industrial operations. Table 5 presents the institutional impact framework.

Table 5. Institutional Impact Framework: The Green Industrial Operations (GIO) Dividend

Institutional Dimension	Impact Pathway	Observed Outcome	Strategic Implication
Regulatory Relationship	Proactive compliance builds trust with KLHK and regional environmental agencies	Preferential permit processing; inclusion in green industry pilot programs; reduced inspection frequency	Position green compliance as strategic asset, not cost obligation
Investor Relations	ESG disclosure improves access to sustainability-linked financing instruments	Lower cost of green bonds; inclusion in sustainable investment indices; improved credit ratings	Develop comprehensive ESG reporting infrastructure aligned with GRI and TCFD standards
Customer Legitimacy	Green certifications fulfill buyer ESG supply chain requirements	Retention of export contracts with European and North American buyers; premium pricing access	Align green certification roadmap with key customer environmental requirements
Community License to Operate	Environmental stewardship reduces community opposition and social conflict risk	Smoother facility expansion permits; reduced NGO scrutiny; positive local employment narrative	Institutionalize community environmental dialogue and transparent impact reporting
Industry Peer Position	Green practice leadership generates normative influence within industrial sector	Recognition in industry associations; invitation to policy consultation; talent attraction advantage	Leverage green leadership for industry association positioning and policy advocacy
Human Capital	Environmental values alignment attracts and retains sustainability-oriented professionals	Lower turnover among environmental engineers; stronger employer branding in graduate recruitment	Integrate green practice commitment into employer value proposition

Source: Elaboration of Research Findings Using Institutional Theory Framework, 2025

The regulatory relationship dimension yielded particularly substantive findings. Informants from advanced-maturity organizations consistently described qualitatively distinct relationships with environmental regulatory agencies, characterized by proactive information sharing, collaborative problem-solving around compliance challenges, and preferential treatment in permit processing. These relationships which one operations director described as a partnership rather than a surveillance relationship represent a form of relational capital accumulated through sustained

demonstration of environmental commitment that provides tangible operational advantages not available to compliance-only organizations.

The investor relations dimension has intensified significantly in recent years as ESG investing has mainstreamed and sustainability-linked financial instruments have proliferated. EHS and finance managers at three of the six case organizations reported direct engagement from institutional investors regarding environmental performance metrics, with explicit linkage to investment decisions and cost of capital. The transition from ESG as a reputational concern to ESG as a material financial variable represents a fundamental shift in the institutional incentive structure for green practice adoption one that aligns long-term financial self-interest with environmental stewardship in ways that compliance-only regulatory regimes cannot achieve.

Community license to operate the informal social permission granted by local communities for industrial operations in their vicinity emerged as a particularly salient institutional dimension in the Indonesian manufacturing context, where community opposition to industrial activity has become an increasingly potent constraint on facility expansion and operational continuity. Advanced-maturity organizations that had invested systematically in community environmental dialogue, transparent impact reporting, and local employment prioritization reported significantly smoother regulatory approval processes for facility expansions and considerably less exposure to NGO scrutiny and media criticism.

Human capital impacts were reported most explicitly in the two electronics assembly facilities, where competition for sustainability-oriented engineering and management talent was described as increasingly intense. Environmental values alignment the perception that the organization genuinely practices what it espouses regarding environmental stewardship was identified as a significant factor in recruitment and retention decisions among graduates of engineering and business programs with strong sustainability curricula. This finding suggests that green practice adoption generates human capital benefits through employer branding mechanisms that extend the institutional dividend of environmental management to the talent market.

The Green Industrial Operations (GIO) Model

Drawing on the integrated findings from motivational driver analysis, barrier assessment, and institutional impact mapping, the study proposes the Green Industrial Operations (GIO) model a structured transitional pathway that describes the progression from compliance-driven to value-driven environmental management in manufacturing organizations.

The GIO model identifies three developmental stages. The Compliance Stage is characterized by reactive green practice adoption driven primarily by coercive institutional pressures. Organizations in this stage adopt the minimum practices necessary for regulatory compliance and customer qualification, invest minimally in green management capability development, and perceive environmental management as a cost center. The institutional dividend is limited, and barriers particularly financial and cultural are experienced most acutely. Green practice implementation is episodic rather than systematic.

The Integration Stage represents the transition from compliance orientation to operational integration. Organizations in this stage have internalized green practices into production planning, procurement, and engineering processes; developed cross-functional environmental management structures; and begun to build the organizational capabilities technical expertise, performance measurement systems, knowledge management processes that enable systematic rather than episodic green practice improvement. Motivational complexity increases, with market access, cost

efficiency, and reputational considerations supplementing regulatory compliance. The institutional dividend begins to materialize in improved regulatory relationships and initial investor engagement.

The Value Creation Stage characterizes organizations that have embedded environmental stewardship into their strategic identity and operational culture. Green practices are pursued proactively, driven by intrinsic leadership values, sophisticated risk management reasoning, and the demonstrated institutional benefits of environmental leadership. The organizational culture is characterized by shared environmental commitment rather than compliance obligation, and innovation in green processes and products is actively cultivated. The institutional dividend is fully realized across all six stakeholder dimensions, generating competitive advantages in regulatory relationships, financial markets, customer contracts, community relations, industry positioning, and talent acquisition.

The model's key practical implication is that effective green industry policy and management must be stage-sensitive. Interventions appropriate for compliance-stage organizations regulatory enforcement, financial penalty structures, minimum standard-setting are insufficient and potentially counterproductive when applied to organizations already operating at integration or value creation stages. Conversely, the complex, collaboration-intensive interventions appropriate for value creation stage development ecosystem partnerships, co-innovation programs, impact investing structures will have limited traction in compliance-stage organizations that have not yet developed the organizational foundations for such engagement [22].

Implications for Green Industrial Management Research and Practice

The study's findings carry several significant implications for the green industrial management research agenda. First, they demonstrate the necessity of multi-level analysis that encompasses regulatory, market, cultural, and relational dimensions simultaneously. Single-dimension analyses whether focused exclusively on energy efficiency, emissions reduction, or certification adoption systematically underestimate the institutional complexity of green practice implementation and generate recommendations that are technically correct but organizationally incomplete.

Second, the study highlights the importance of temporal dynamics in green practice research. The motivational evolution pattern identified from compliance-driven to value-driven orientations implies that cross-sectional research designs will generate systematically incomplete pictures of the organizational logic of green practice adoption. Longitudinal and retrospective approaches that can capture this evolution are needed to generate more complete theoretical accounts of green industry development pathways [23].

Third, the supply chain barrier findings point to the need for ecosystem-level rather than firm-level analytical frameworks for green practice research. Individual firm green performance is increasingly constrained by the green capabilities of supply chain partners, making dyadic and network-level analyses of green practice diffusion essential for understanding the aggregate environmental performance of industrial sectors [24].

For practitioners, the GIO model provides a diagnostic tool for assessing organizational green management maturity and designing stage-appropriate development interventions. Manufacturing organizations seeking to accelerate their progression through the model stages should prioritize: building cross-functional green management governance structures; embedding environmental KPIs with equivalent weight to financial and productivity metrics in performance management systems; developing supplier green capability through collaborative rather than purely compliance-oriented supply chain management; and engaging proactively with regulatory, investor, and community stakeholders rather than waiting for external pressure to mandate engagement.

Conclusion

This study has examined the implementation of green industry practices in manufacturing operational management through a qualitative, institutionally-informed analytical lens, generating integrated findings on motivational drivers, implementation barriers, and institutional impacts across six manufacturing facilities representing diverse sub-sectors and green practice maturity levels.

The study makes three principal contributions. Theoretically, it extends institutional theory's application to green operational management, demonstrating how coercive, normative, and mimetic isomorphic pressures interact with intrinsic organizational motivations to produce diverse green practice adoption profiles, and how sustained environmental stewardship generates a multi-dimensional institutional dividend that conventional operational performance metrics fail to capture. Empirically, it provides a comparative qualitative analysis of green practice implementation across multiple industrial sub-sectors within an emerging economy context, generating contextually grounded insights that complement the predominantly quantitative and developed-economy literature. Practically, the proposed GIO model offers manufacturing organizations a structured diagnostic and developmental framework for planning and evaluating their green management evolution.

The central finding of the study is that green industry practice implementation is irreducibly a social and institutional phenomenon, not merely a technical or financial one. Organizations that treat green practices as engineering problems to be solved through technology investment will systematically underperform relative to organizations that treat them as strategic and relational commitments requiring cultural transformation, stakeholder engagement, and ecosystem collaboration. The most effective green industrial managers are those who navigate both dimensions simultaneously pursuing technical excellence in environmental performance while cultivating the institutional relationships and organizational cultures that create the conditions for self-sustaining green innovation.

Future research should investigate the GIO model's applicability across different national regulatory contexts, particularly examining how the strength and consistency of environmental regulatory enforcement modulates the relative salience of compliance versus value-driven motivations. Quantitative studies could operationalize the model's three stages through validated measurement instruments, enabling large-sample testing of the hypothesized relationships between green practice maturity, motivational complexity, and institutional dividend outcomes. Longitudinal case studies tracking individual organizations through GIO model transitions would further illuminate the organizational learning and leadership dynamics through which green practice evolution occurs.

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