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Original Research Article

The Role of 3PL Providers in Sustainable Material Procurement for Saudi Construction and Infrastructure Projects

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Abstract: Saudi construction and infrastructure projects require material flows that are reliable, compliant, cost-effective, and environmentally responsible due to the rapid pace of construction and infrastructure development across the Kingdom. This review examines the role of third-party logistics providers in sustainable material procurement for Saudi projects, with particular attention to public works contracts, local content, digital tendering, warehousing, expediting and supplier performance management. The paper synthesizes studies published between 2020 and 2025 and develops an integrated operating model that positions logistics providers as procurement orchestration partners rather than transport subcontractors. The review shows that sustainable procurement in Saudi construction is not limited to selecting low carbon products. It depends on early logistics involvement, supplier qualification, material traceability, consolidation hubs, packaging reduction, route optimization, reverse logistics, evidence-based supplier scoring and governance aligned with national industrial and logistics priorities. Existing literature highlights advances in electronic tendering, public procurement reform, construction logistics and digital supply chain capabilities, yet it gives limited attention to how 3PL providers connect these domains within large, geographically dispersed projects. The proposed framework addresses that gap by linking procurement planning, warehouse control, expediting, quality verification and sustainability reporting. The study contributes a review-based agenda for clients, contractors, logistics providers and policy makers seeking to reduce delays, improve transparency, support local suppliers and lower material related environmental impacts in Saudi infrastructure delivery.

Keywords: Third party logistics; sustainable procurement; Saudi construction; infrastructure projects; material supply chain; supplier performance; local content.

INTRODUCTION

Saudi Arabia is delivering an exceptional infrastructure and pipeline construction project under Saudi Vision 2030, including major developments such as NEOM, The Line, Red Sea Project, Qiddiya, Jeddah Central and extensive transport, energy, urban and regional infrastructure expansions across the Kingdom. These projects involve transport corridors, urban districts, energy assets, utilities, housing, landmarks and social infrastructure on an unprecedented scale. Consequently, they depend on large volumes of cementitious products, steel, aggregates, façade systems, mechanical equipment, electrical

assemblies, and finishing materials that must move through complex domestic and international supply networks. In such conditions, material procurement is no longer a transactional buying activity; it is a strategic coordination problem that links design certainty, supplier capability, contract governance, logistics capacity, quality assurance, carbon reduction and local economic participation. Recent work on Saudi public works contracts stresses that the transition toward electronic procurement is intended to improve transparency, tender governance and sustainable development outcomes [1, 11, 13]. At the same time, studies of third-party logistics show that logistics providers can influence operational performance, sustainable impact and strategy development when their capabilities are integrated with digital tools and organizational resources [2, 20].

The construction sector differs from manufacturing because demand is project based, sites are temporary, design changes are frequent and material flows are exposed to congestion, weather, customs procedures and interface risks. A procurement decision that appears economical at tender stage may produce waste, rework, late delivery or storage damage later. Third party logistics providers can reduce these hidden costs by coordinating supplier bookings, consolidation centres, route planning, off site kitting, call-off control, site delivery windows, returnable packaging and reverse flows. Evidence from construction logistics research indicates that project specific logistics arrangements can improve coordination and reduce site disruption when the provider is involved early enough to influence planning rather than simply execute deliveries [3,4]. These findings are particularly relevant for Saudi mega and giga projects, where remote locations, simultaneous packages and high material intensity make logistics capability central to sustainable procurement.

Sustainable material procurement also has a national policy dimension. Saudi procurement reform, local content policies and industrial development goals encourage public and semi-public clients to consider economic diversification, domestic supplier development and long-term value rather than relying exclusively on purchase price [1,5,14,18]. Sustainability in this setting includes environmental outcomes such as reduced transport emissions, material circularity and waste minimization; economic outcomes such as cost predictability, supplier resilience and local value creation; and social outcomes such as workforce development, safety and community benefits. However, the literature often examines public procurement reform, construction logistics or sustainable supply chain management separately. What is less developed is a detailed review of how 3PL providers can become the connective mechanism between sustainable material selection and dependable project execution.

This paper addresses that gap by reviewing recent literature and proposing an integrated framework for the role of 3PL providers in sustainable material procurement for Saudi construction and infrastructure projects. The focus is on review-based synthesis, not primary survey evidence. The argument is that 3PL providers can create value in four ways: translating sustainability requirements into practical logistics controls; improving supplier visibility and expediting discipline; reducing material waste through consolidation, storage and handling systems; and producing evidence for supplier performance management. The paper therefore contributes to academic discussion on sustainable construction supply chains and provides managerial guidance for clients, contractors, consultants and logistics firms operating in Saudi Arabia.

Aim and objectives of the study

The aim of the study is to evaluate how 3PL providers support sustainable material procurement in Saudi construction and infrastructure projects and to develop a review-based framework that integrates procurement governance, logistics operations and supplier performance management. The study pursues five objectives. First, it examines how recent Saudi procurement reforms and electronic tendering influence transparency, contract discipline and sustainability expectations. Second, it identifies the logistics capabilities that enable sustainable material procurement, including consolidation, warehousing, expediting, traceability, last mile delivery and reverse logistics. Third, it analyses how digital systems connect 3PL activities with procurement, quality assurance and sustainability reporting. Fourth, it clarifies how 3PL providers can strengthen local content and supplier development without weakening price, quality or schedule control. Fifth, it proposes a performance model that clients and contractors can use to evaluate 3PL contribution across environmental, economic and social dimensions. The review is guided by the following research question: how can 3PL providers become strategic enablers of sustainable material procurement in Saudi construction and infrastructure projects?

METHODOLOGY

This paper adopts a structured integrative review methodology suitable for a topic that crosses construction management, logistics, procurement governance and sustainable supply chain research. The review considered peer reviewed articles, policy-

related studies and high relevance industry sources published between 2020 and 2025. The search logic combined terms related to third party logistics, construction logistics, sustainable procurement, Saudi public works contracts, electronic tendering, local content, supplier performance, circular materials and digital supply chains. Sources were screened for conceptual relevance, recency, methodological clarity and applicability to construction or infrastructure delivery. The attached Saudi procurement study was used as a contextual anchor because it examines the shift toward electronic procurement, public works contract models and sustainable development transition in Saudi Arabia [1]. A recent 3PL sustainability study was also used to connect digital transformation, organizational resources and sustainable strategy outcomes [2].

The analysis followed four stages. First, the literature was classified into five thematic clusters: Saudi procurement and contract governance; construction logistics and 3PL arrangements; sustainable material procurement and circular construction; digital procurement and supply chain visibility; and supplier performance management. Second, each source was coded for the function assigned to logistics providers, the sustainability dimension addressed, and the level of project lifecycle coverage. Third, the review compared the evidence across procurement, warehousing, expediting and supplier evaluation activities. Fourth, the findings were synthesized into an operating framework and a control matrix. Because the purpose is theory development and practical synthesis, the paper does not calculate statistical effect sizes. Instead, it builds an argument from converging findings in recent literature. This approach is appropriate where empirical evidence is fragmented but the managerial problem is immediate. To reduce selection bias, the review emphasizes studies that discuss real project settings, Saudi procurement reforms, construction supply chain risks, digitalization, or sustainable supply chain capabilities. Limitations remain because some Saudi mega project procurement data are not publicly available, and many 3PL arrangements are commercially confidential.

A further methodological consideration is the boundary of the review. The paper focuses on material procurement activities where logistics providers can directly influence sourcing outcomes, including inbound transport, consolidation, storage, documentation, expediting and reverse flows. It does not examine labour procurement, design consultant selection or purely financial procurement instruments except where they shape material decisions. The unit of analysis is therefore the project material supply network, rather than the individual purchase order. This boundary is important because Saudi infrastructure schemes often involve layered clients, programme managers, designers, contractors, suppliers and authorities. A narrow purchasing lens would miss the operational interfaces where sustainability is won or lost. The synthesis therefore evaluates whether each study explains actionable links between procurement criteria and logistics execution. Evidence was interpreted cautiously when studies discussed general supply chains without construction specificity. Priority was given to sources that addressed project delivery, public procurement, digital visibility, supplier evaluation or logistics outsourcing. This logic also supports transferability: although the review is centred on Saudi projects, the framework can be adapted to other markets where large project portfolios, localization targets and sustainability reporting requirements intersect. This boundary keeps the review coherent and prevents the discussion from drifting into unrelated procurement law, while still preserving enough breadth to capture logistics, sustainability and supplier governance interactions within project delivery practice and management decisions.

Table 1: Review themes and implications for 3PL-enabled sustainable material procurement.

Review theme	Main insight	3PL implication	Key sources
Saudi procurement governance	Electronic tendering and revised public works contracts strengthen transparency and process control.	Translate procurement clauses into logistics evidence, delivery rules and supplier documentation gates.	[1,11,13]
Construction logistics	Dedicated project logistics arrangements can reduce site disruption and improve coordination.	Plan consolidation centres, delivery booking, kitting and site call-off discipline.	[3,4]
Saudi construction risks	Delays, cost escalation and fragmented coordination remain persistent project risks.	Use expediting and control tower visibility to identify supplier and package bottlenecks.	[7-10,17]

Review theme	Main insight	3PL implication	Key sources
Sustainable materials	Procurement decisions influence waste, circularity, emissions and lifecycle outcomes.	Capture origin, packaging, recycled content and reverse logistics data from purchase order to installation.	[19,25]
Digital transformation	Digital tools improve performance when combined with capabilities and governance.	Integrate transport, warehouse and procurement systems with shared data standards.	[2,21,22,27]
Local content and resilience	Local sourcing supports industrial development but requires supplier maturity.	Support supplier mapping, shared warehousing, capability building and fair scorecards.	[1,5,14,18]

Saudi procurement and construction supply chain context

Saudi public works procurement is moving from fragmented paper-based routines toward more transparent electronic tendering and governed purchasing processes. Recent research describes electronic procurement as a mechanism for tender disclosure, bid submission, evaluation and award management, while also noting that some large projects may operate through special exemptions or bespoke arrangements [1,12,13]. This matters for 3PL providers because logistics requirements are often hidden inside technical specifications or contractor method statements. When procurement systems make requirements more explicit, 3PL providers can support measurable criteria for delivery reliability, material traceability, packaging standards, storage conditions and supplier compliance. Electronic procurement therefore creates an opportunity to move sustainability from aspiration into contractual evidence.

Within this procurement context, several Vision 2030 giga-projects illustrate why material logistics has become a programme-level concern rather than a routine delivery function. NEOM is an overarching development zone covering approximately 26,500 km^2 of north-western Saudi Arabia in the Tabuk Province, encompassing five distinct sub-projects: The Line, a linear urban development of which 2.4 km of foundation work has been completed before construction was suspended in September 2025 pending strategic review; Oxagon, a coastal industrial and advanced manufacturing complex now pivoting toward AI data centre infrastructure; Trojena, a mountain resort destination in the Hejaz highlands; Sindalah, a luxury island resort in the Gulf of Aqaba; and Magna, a collection of coastal tourism sub-developments along the Red Sea shore. Across these components, NEOM has involved high-volume civil earthworks, specialist systems, utility infrastructure and logistics networks serving both remote highland and coastal locations simultaneously. The Red Sea destination, developed by Red Sea Global (RSG), targets the completion of 50 resorts across 22 islands and six inland sites by 2030, covering approximately 28,000 km^2 of coastline between the cities of Umlaj and Al-Wajh [11,12]. The project's own Red Sea International Airport, which opened in 2023 and began receiving international flights in 2024, serves as a dedicated logistics and passenger gateway for the destination [11]. As of 2026, nine resorts are operational across island and inland sites, including Six Senses Southern Dunes, the St. Regis Red Sea Resort on Ummahat Island, Nujuma (a Ritz-Carlton Reserve), Shebara on Sheybarah Island, and Desert Rock, with construction and fit-out continuing across Shura Island's eleven planned resort properties [10,13,14]. Qiddiya City is a 334 km^2 entertainment, sports and culture destination located approximately 40 km south-west of Riyadh, developed by Qiddiya Investment Company (QIC), a wholly owned subsidiary of the Public Investment Fund (PIF) [20,21]. The project is being delivered in phases through 2035, with Six Flags Qiddiya City — the largest theme park in the Middle East — opening in December 2025, followed by the Aquarabia water park in April 2026; further assets under active construction include the Prince Mohammed bin Salman Stadium (capacity approximately 47,000), a Formula One-grade motorsport circuit, and an extensive sports and arts precinct [4,24,27,29]. Jeddah Central is a SAR 75 billion ($20 billion) urban waterfront regeneration project covering 5.7 million m^2 in central Jeddah along a 9.5-km Red Sea shoreline, developed by the Jeddah Central Development Company (JCDC), another PIF subsidiary, and launched by the Crown Prince in December 2021 [30]. Its four landmark facilities are an Opera House, a FIFA standard Sports Stadium for world cup 2034, an Oceanarium and Coral Farms, and a Museum, complemented by 17,000 residential units, 2,700 hotel rooms, a world-class marina and 2.1 km of public beach; Phase 1, covering approximately 45% of total scope, is targeted for completion by end of 2027.

These projects combine remote highlands, island and urban locations, phased construction packages, high-volume civil works, utilities, transport infrastructure, buildings, public realm assets and specialist systems. Contractors must coordinate large material flows across ports, factories, warehouses, highways and construction sites while maintaining

quality, schedule certainty, documentation control and sustainability evidence. This strengthens the relevance of 3PL providers because they can connect procurement decisions with transport planning, consolidation, expediting, warehousing, delivery sequencing and supplier performance monitoring. In Saudi giga and mega projects, the ability to manage these interfaces directly affects whether sustainable material procurement can be achieved in practice.

Saudi construction projects face recurring delivery risks including time overrun, cost escalation, design changes, shortage of skilled resources, fragmented subcontracting and supply chain uncertainty [7,8,9,16,17]. Material procurement is deeply implicated in these risks. A delayed façade shipment may block envelope completion; late electrical switchgear may delay testing and commissioning; poor storage may damage gypsum board, insulation or sensitive mechanical and electrical equipment; and uncoordinated deliveries may congest the site and disrupt programme sequencing. Sustainable procurement cannot succeed if material flows remain unreliable. In this respect, 3PL providers are not peripheral service firms. They are potential risk managers that can link purchase orders to supplier readiness, shipping documents, customs status, warehouse receipts, inspection records, site call-offs and final installation plans.

The Saudi context also gives procurement a localization and industrial development purpose. National programmes encourage local production, domestic supply chain resilience and knowledge transfer. The reviewed procurement literature identifies industry localization and knowledge transfer as important features of newer procurement models [1,5,14,15,18]. Local sourcing can reduce transport distance, create employment and build supplier depth, but it also requires rigorous supplier qualification, technical support and performance monitoring. A 3PL provider can help by mapping domestic suppliers, validating logistics readiness, organizing milk-run collections, providing shared warehousing for small manufacturers and aggregating demand across project packages. Such coordination can make local content practical rather than symbolic.

Sustainable material procurement criteria

Sustainable material procurement in construction involves a structured evaluation of product origin, technical compliance, lifecycle performance, logistics intensity, waste profile and supplier conduct. For bulk materials, sustainability may depend on alternative binders, recycled content, quarry proximity, water consumption and batching efficiency. For manufactured systems, it may depend on energy performance, durability, maintainability, replaceability and documentation quality. For imported equipment, the logistics footprint, packaging requirements, customs reliability and spare parts availability become central. Sustainable procurement policy has been linked with better construction and demolition waste management because early purchasing decisions influence material reuse, segregation and reverse flows [19].

A recurring weakness in project procurement is the separation between specification and logistics. Designers may specify sustainable products, but procurement teams may award to suppliers with weak delivery reliability; contractors may buy from low price vendors, but later incur expediting costs and waste; logistics teams may receive materials without knowing their environmental or certification status. 3PL providers can close these gaps by converting sustainability criteria into operational data fields. Examples include supplier location, transport mode, pallet type, packaging recyclability, delivery frequency, temperature or humidity sensitivity, batch traceability, inspection status, return possibilities and carbon calculation factors. When these data are captured from the first purchase order, sustainability reporting becomes a by-product of disciplined logistics execution rather than a manual exercise at project closeout.

Digital transformation research in logistics suggests that technology, human capabilities and supply chain processes interact to improve performance and sustainable impact [2,21,22,27]. This is relevant to material procurement because sustainable decisions require reliable information. A 3PL provider may operate transport management systems, warehouse management systems, supplier portals and analytics dashboards that integrate with contractor procurement platforms. These systems can support electronic booking, delivery slot allocation, barcode or radio frequency identification, nonconformance reporting, material status visibility and supplier scorecards. However, technology alone is insufficient. The provider also needs procurement literacy, construction planning knowledge, quality control understanding and a disciplined escalation culture. Without these capabilities, digital tools may only accelerate poor coordination.

Roles of 3PL providers across the procurement lifecycle

The first role of a 3PL provider is pre-procurement logistics advisory. Before tender award, the provider can review material categories, assess supply risk, estimate transport demand, identify consolidation opportunities and propose packaging or storage standards. This early role is essential because many sustainability gains are designed into

the procurement strategy. For example, selecting locally available precast components may reduce site waste and transport frequency, but only if lifting plans, yard capacity and delivery sequencing are coordinated. Similarly, a decision to use modular mechanical skids may reduce on-site labour but increase requirements for protective storage and precise delivery timing. Early logistics input helps procurement teams understand the total cost and sustainability consequence of alternative material strategies [6,10,24].

The second role is supplier qualification support. Traditional supplier evaluation focuses on price, technical compliance and financial capacity. Sustainable procurement requires additional evidence, including environmental management, labour practices, safety performance, packaging policy, traceability capability, local content contribution and willingness to share data. 3PL providers can audit logistics readiness, evaluate loading methods, inspect supplier warehouses, assess transport contractor competence and test documentation flows. This does not replace technical consultant approval; it complements it by revealing whether the supplier can deliver the promised material reliably and responsibly. The approach aligns with research showing that public procurement reform requires transparency, competition and clearer evaluation criteria [1,11,18].

The third role is procurement execution and expediting. In large projects, purchase orders may be issued by multiple contractors, each working under different packages. A 3PL provider can maintain a material control tower that tracks approved submittals, manufacturing milestones, inspection points, shipping readiness, customs documents, warehouse receipts and delivery bookings. Expediting should not be understood as chasing suppliers after a delay. It is a preventive discipline that identifies weak signals such as missing drawings, late advance payments, incomplete test certificates, insufficient packing lists or factory capacity conflicts. By connecting procurement status with project look-ahead planning, the 3PL provider helps prevent emergency freight, duplicate orders and site idleness.

The fourth role is warehousing and consolidation. Construction sites often suffer from uncontrolled deliveries, material loss, double handling and damage. A well-designed consolidation centre allows suppliers to deliver in economical loads while the project receives sequenced call-offs. It also creates a controlled environment for inspection, labelling, kitting and packaging reduction. Studies on construction logistics arrangements show that dedicated logistics setups can improve site productivity when responsibilities are clear and when suppliers and transport providers understand the operating rules [3,4]. For Saudi projects with high heat, long distances and remote sites, warehousing design must also address material sensitivity, dust, humidity, security and labour welfare.

The fifth role is reverse logistics and circular material recovery. Sustainable procurement requires pathways for surplus materials, reusable packaging, pallets, offcuts, defective products and end-of-life components. A 3PL provider can operate return loops, consolidate recyclables, track supplier take-back obligations and maintain records for waste diversion. This capability is important because circular procurement principles require not only selecting recyclable materials, but also organizing the flows that make recovery possible [19,23,25]. In infrastructure projects, reverse logistics may include temporary works materials, cable drums, formwork, containers, pallets and packaging. The provider can quantify avoided waste, document reuse and connect contractors with approved recycling or resale channels.

Digital integration and traceability

Digital integration is the backbone of 3PL-enabled sustainable procurement. Electronic tendering platforms can create initial transparency, but sustainability benefits depend on data continuity from tender to purchase order, supplier production, transport, warehousing, installation and closeout. Research on Saudi electronic procurement emphasizes improved governance, electronic bidding and tender management [1,11,13]. Research on 3PL sustainability emphasizes the need to integrate digital tools with organizational capabilities and sustainable practices [2,22]. Combining these insights suggests a digital material passport for each critical material category. The passport would include approved supplier, origin, certification, batch number, logistics route, delivery status, inspection record, packaging type, storage condition, carbon estimate and final installation location.

Traceability is particularly important for materials that influence structural safety, building performance or sustainability certification. Steel, concrete components, fire stopping products, insulation, façade panels, cables and mechanical equipment require clear evidence of conformity. A 3PL provider can capture receipt photographs, scan certificates, record batch details and link them to delivery notes and installation zones. This reduces disputes and supports audits. Digital traceability can also protect against counterfeit or nonconforming products, a risk that grows when demand is high and supply chains are stretched [28]. For Saudi projects competing for the same suppliers and labour

resources, reliable material status information can support portfolio-level planning across multiple sites.

Digital tools also support environmental measurement. Transport management systems can estimate emissions by route, vehicle type, load factor and distance. Warehouse systems can track damage, returns and dwell time. Procurement dashboards can compare local versus imported sourcing, supplier delivery reliability and packaging recovery. Yet the review indicates that technology adoption must be governed by clear responsibilities [27,29,30]. If contractors, consultants, suppliers and 3PL providers use separate systems without common data standards, visibility remains partial. The proposed approach therefore requires data governance rules covering master material codes, supplier identifiers, delivery event definitions, inspection status and sustainability metrics.

Supplier performance management

Supplier performance management is the mechanism that turns sustainable procurement into continuous improvement. In many projects, suppliers are evaluated at award stage and then judged informally when problems arise. A stronger model uses periodic scorecards covering on-time delivery, documentation accuracy, quality defects, corrective action closure, packaging compliance, safety incidents, local content contribution, carbon intensity, waste recovery and collaboration behaviour. 3PL providers are well positioned to supply evidence because they observe material flows daily. They know whether a supplier books deliveries correctly, loads safely, labels materials accurately, responds to expediting requests and accepts return obligations.

Performance management should distinguish between supplier fault and system fault. A supplier may appear late because design approvals were delayed; a contractor may create congestion by releasing too many call-offs; a logistics provider may cause damage through poor handling; a client may specify imported materials without realistic lead times. A fair scorecard therefore requires root cause coding and shared review meetings. This is consistent with recent thinking on digital and sustainable supply chains, where data are valuable only when they support capability development and collaborative decisions [2,20,26,27]. For Saudi projects, supplier scorecards can also feed localization strategies by identifying domestic suppliers that require technical support, financing assistance, capacity development or long-term framework agreements.

The 3PL provider's independence must be managed carefully. If the provider is contracted only by a main contractor, suppliers may perceive the scorecard as punitive. If the provider is appointed by the client or program manager, it may become a neutral logistics integrator across packages. The best governance model depends on project scale, contract structure and risk allocation. In all cases, the provider's performance should also be measured. Metrics should include delivery reliability, damage rate, inventory accuracy, truck utilization, average waiting time, emissions per tonne-kilometre, percentage of reusable packaging, incident frequency, data completeness and user satisfaction. Sustainable procurement is therefore a network performance issue, not only a supplier compliance issue.

Conceptual framework

The proposed framework positions the 3PL provider as a sustainable material procurement integrator. It begins with client policy, project specifications and procurement rules. These requirements are translated into supplier qualification criteria, logistics service levels and data fields. During execution, the 3PL provider operates a control tower connecting procurement, warehousing, expediting, quality verification, transport and reverse flows. Outputs are measured through supplier scorecards and sustainability dashboards. The framework recognizes that sustainable procurement decisions must be made before materials are ordered, but their value is only realized when logistics execution protects quality, timing and traceability. This lifecycle view expands the role of 3PL providers from delivery contractor to governance partner.

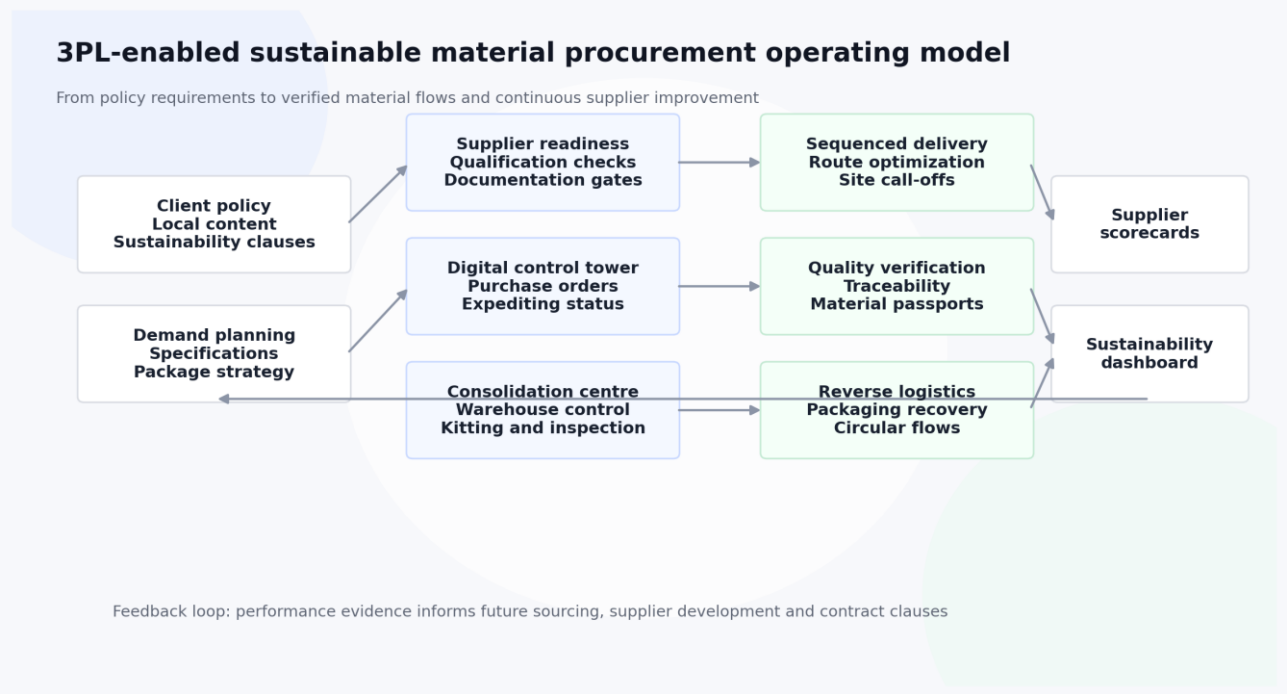

Figure 1: Integrated operating model for 3PL-enabled sustainable material procurement.

Figure 1 illustrates this operating logic. The left side captures procurement inputs: demand planning, material specifications, local content targets and contract requirements. The centre shows 3PL integration capabilities: supplier readiness checks, digital tracking, consolidation, expediting, warehousing, quality gates and reverse logistics. The right side presents project outcomes: reduced disruption, lower waste, improved supplier accountability, better local supplier participation and more reliable sustainability reporting. The framework also includes a feedback loop from performance data to future procurement packages. This loop is important because mega and giga projects often consist of repeated assets and phases. Learning from one package can improve supplier selection, packaging design, delivery strategy and contract clauses in later packages.

The framework also clarifies the relationship between environmental, economic and social sustainability. Environmental value comes from fewer emergency deliveries, higher truck utilization, route optimization, reduced waste, packaging recovery and improved material circularity. Economic value comes from fewer delays, lower inventory loss, more predictable cash flow, better supplier competition and reduced rework. Social value comes from safer site logistics, local supplier development, training, labour welfare in warehouses and improved community outcomes when traffic congestion and nuisance are controlled. A 3PL provider can influence all three dimensions, but only if contracts define sustainability responsibilities explicitly and allow the provider access to procurement data early enough.

DISCUSSION

The review indicates that 3PL providers can make sustainable material procurement operationally credible in Saudi construction and infrastructure projects. Procurement reform creates the governance environment, but projects still need execution systems that translate policy into daily decisions. A sustainability clause in a tender is insufficient if the project cannot track material origin, verify packaging recovery, monitor supplier lead times or measure transport impacts. The 3PL provider supplies the missing operational layer. This finding extends the attached Saudi procurement study, which identifies transparency, sustainable development, contract models and local content as central public works issues [1]. It also extends 3PL sustainability research by applying digital and organizational capability logic to construction material procurement rather than general logistics operations [2].

The first implication is that clients should involve 3PL expertise before procurement packages are finalized. Early involvement allows logistics constraints and sustainability criteria to influence sourcing strategy, not merely delivery execution. The second implication is that contractors should treat consolidation centres and material control towers as productivity investments. Although they create visible costs, they reduce hidden costs from waiting time, damage, lost materials, rework and emergency freight. The third implication is that suppliers should

be evaluated on data-sharing capability and logistics discipline as well as price. A technically strong supplier that cannot provide accurate documents or meet booking rules may create major downstream risk. The fourth implication is that policy makers should encourage procurement templates that include measurable logistics and sustainability obligations.

Table 2: Control matrix for sustainable material procurement managed with 3PL support.

Phase	3PL control	Sustainability objective	Primary KPI	Governance risk
Pre-procurement	Material flow assessment and logistics feasibility review	Avoid unsustainable sourcing and hidden delivery costs	Total landed cost and forecast emissions	Late involvement limits design influence
Supplier qualification	Logistics readiness audit and documentation test	Select suppliers able to deliver compliant materials responsibly	Supplier readiness score	Price-only tender evaluation
Order execution	Expediting milestones and exception alerts	Prevent emergency freight, delay and rework	Milestone adherence	Unclear responsibility for late approvals
Warehousing	Consolidation, inspection, kitting and controlled storage	Reduce damage, double handling and site congestion	Damage rate and inventory accuracy	Warehouse location may add distance
Site delivery	Delivery booking, route optimization and call-off sequencing	Improve safety and reduce waiting emissions	Truck waiting time and load factor	Multiple contractors bypass booking rules
Closeout and circularity	Returns, surplus recovery and packaging take-back	Reduce waste and support circular material flows	Waste diversion and packaging recovery	Weak markets for reusable materials

There are also trade-offs. Local sourcing may reduce transport distance and support domestic industry, but not every local supplier can immediately satisfy quality, capacity or documentation requirements. Off-site consolidation can reduce site congestion, but poor warehouse location may add distance. Digital tracking improves visibility, but too many platforms can burden suppliers. Strict sustainability scorecards improve accountability, but they must avoid penalizing suppliers for delays caused by design changes or client decisions. Therefore, the recommended model is not a rigid checklist. It is a governance system based on shared data, root cause analysis and continuous improvement. The provider should support rather than replace professional judgement.

For Saudi projects, the most promising applications are high-volume and high-risk material categories. Cementitious materials, precast elements, steel, façade systems, modular assemblies, electrical equipment, mechanical plant, pipes and finishing materials all benefit from coordinated logistics. A project may begin with critical materials and then expand the system as data maturity increases. The 3PL provider can also support programme-wide visibility where several contractors draw on the same ports, roads, warehouses and suppliers. This is especially important when multiple projects compete for scarce components or when international shipping uncertainty threatens schedules. The supplier performance dashboard proposed in this paper can help clients compare packages fairly and identify systemic bottlenecks.

Research gaps and future agenda

The literature still contains several gaps. First, there is limited empirical evidence from Saudi construction projects showing quantified savings from 3PL-enabled sustainable procurement. Future research should measure delivery reliability, waste reduction, carbon outcomes and local supplier development across live projects. Second, few studies examine contractual models for appointing 3PL providers as neutral integrators across multiple contractors. Third, there is a need for data standards linking electronic procurement, building information models, warehouse systems and supplier scorecards. Fourth, social sustainability in construction logistics remains underdeveloped. Research should examine labour welfare, driver safety, training, community traffic impacts and fair treatment of smaller local suppliers. Fifth, circular material flows require stronger evidence on the practical economics of take-back schemes, reuse markets and packaging recovery in Saudi conditions. These gaps show that the topic is not merely logistical; it is a governance, technology and sustainability research agenda.

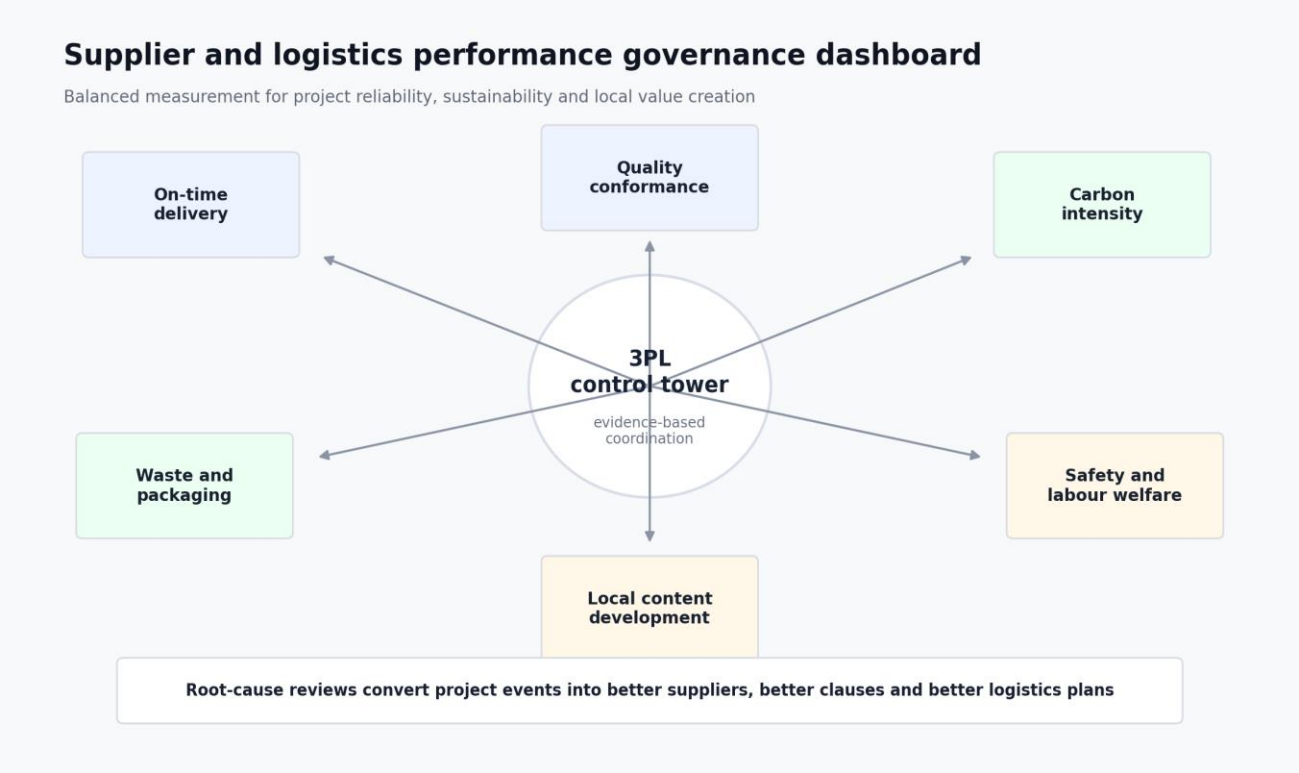

Figure 2: Balanced supplier and logistics performance governance model

A final gap concerns incentives. Many sustainable logistics measures create project benefits that are distributed unevenly across the client, contractor, supplier and logistics provider. A consolidation centre may lower total congestion and waste, yet its direct cost may sit with one party. A supplier may invest in reusable packaging, yet the return loop may be controlled by another party. A contractor may prefer urgent deliveries to protect its own programme, even when the portfolio would benefit from shared transport capacity. Future studies should therefore examine contract incentives, gain sharing, service credits and joint performance boards that make sustainable procurement financially rational for all participants. Saudi projects are suitable settings for this research because their scale makes fragmented incentives visible and because repeatable project phases allow learning to be embedded in later packages. Evidence from such studies could help develop standard clauses, benchmark cost models and maturity assessments for 3PL-enabled sustainable procurement. It would also support clearer separation between logistics service costs, procurement savings, avoided disruption and measurable environmental value, which is necessary when boards compare conventional purchasing with integrated sustainable material control arrangements. Such evidence can reduce hesitation and make improved logistics practice part of procurement governance rather than an optional operational convenience for individual contractors alone.

CONCLUSION

This review has examined the role of 3PL providers in sustainable material procurement for Saudi construction and infrastructure projects. The central conclusion is that 3PL providers can become strategic enablers when they are integrated into procurement planning, supplier qualification, warehousing, expediting, digital traceability, reverse logistics and supplier performance management. Sustainable procurement depends on more than selecting environmentally preferable materials. It requires material flows that are reliable, transparent, safe, locally supportive and measurable throughout the project lifecycle. The Saudi procurement environment is increasingly supportive of these goals through electronic tendering, contract modernization and local content priorities [1]. However, projects need practical operating systems to turn those goals into daily execution. A capable 3PL provider can supply that operating system by linking data, logistics discipline and performance evidence. The framework proposed in this paper offers clients and contractors a basis for designing 3PL roles, selecting providers, measuring supplier performance and aligning procurement with environmental, economic and social outcomes. Future empirical studies should test this framework in live Saudi projects and refine sector-specific metrics for different material categories.

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