

**SUSTAINABLE PROCUREMENT FOR CARBON-NEUTRAL
CONSTRUCTION**

By

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ID: 23282013

**This Dissertation submitted to the Department of Procurement & Supply Management
in partial fulfillment of the requirements for the degree of
Masters in Procurement and Supply Management (MPSM)**

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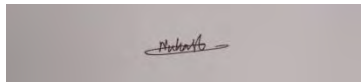
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Declaration

It is hereby declared that

1. The dissertation submitted is my own original work while completing degree at Brac University.
2. The dissertation does not contain material previously published or written by a third party, except where this is appropriately cited through full and accurate referencing.
3. The dissertation does not contain material which has been accepted, or submitted, for any other degree or diploma at a university or other institution.
4. I have acknowledged all main sources of help.

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Ethics Statement

This research was conducted in accordance with established academic and professional ethical standards. The primary purpose of this study was to explore how sustainable procurement practices can contribute to achieving carbon-neutral construction within NDE Ltd. All data collection, analysis, and presentation were performed with integrity, transparency, and respect for confidentiality.

Participation in the study was entirely voluntary. Prior informed consent was obtained from all participants, who were assured that their responses would remain confidential and used solely for academic purposes. No personal identifiers or sensitive company data were disclosed in the report. The study ensured that no harm—physical, psychological, or professional—came to any respondent or organization involved.

The researcher maintained neutrality throughout the data collection and analysis process, avoiding any form of bias or manipulation of results. All secondary data sources, including journal articles, reports, and institutional documents, were properly acknowledged and cited in accordance with academic referencing guidelines to avoid plagiarism and uphold intellectual honesty.

Additionally, the study adhered to ethical principles concerning corporate data. Any proprietary or sensitive information from NDE Ltd. was treated with discretion, used only within the agreed scope, and not disclosed beyond the academic requirements of this research. Data security was maintained through restricted access and secure digital storage.

By adhering to these ethical guidelines, this study aims to contribute responsibly and credibly to the field of sustainable procurement and carbon-neutral construction.

Abstract

This study explores the integration of sustainable procurement practices within the construction sector of Bangladesh, using National Development Engineers Ltd. (NDE) as a case study. The research aims to assess how sustainability-driven procurement policies can contribute to achieving carbon-neutral construction by embedding environmental, social, and economic considerations across all purchasing and supply chain processes.

Adopting a mixed-method approach, the study combines quantitative survey data from 25 respondents across NDE's Procurement, Finance, Quality, and Project departments with qualitative interviews of key managerial personnel. Statistical analyses, including regression and correlation tests, were applied to examine relationships between sustainable procurement adoption, supplier engagement, cost performance, and emission reduction. The results demonstrate a strong positive relationship between sustainability practices and Scope-3 emission reduction, with supplier engagement significantly enhancing compliance with ISO and Environmental Product Declaration (EPD) standards. The findings also reveal that sustainability integration does not increase overall procurement costs, highlighting its long-term economic viability.

The study concludes that NDE's structured procurement governance—anchored in ISO 20400 and PAS 2080 frameworks—effectively links traceability, digital documentation, and supplier development to environmental outcomes. It recommends expanding digital traceability systems, enhancing supplier training, and institutionalizing carbon accounting in procurement to accelerate progress toward carbon-neutral construction. This research contributes practical insights to the growing field of sustainable procurement and provides a replicable framework for other construction firms in Bangladesh and beyond.

Keywords: Sustainable Procurement, Carbon-Neutral Construction, ISO 20400, EPD, Supplier Engagement, NDE Ltd., Bangladesh

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List of Acronyms

- **ASTM** — American Society for Testing and Materials.
- **BREEAM** — Building Research Establishment Environmental Assessment Method.
- **EN 15804** — European Norm 15804 for construction EPDs.
- **EPD** — Environmental Product Declaration.
- **FSC** — Forest Stewardship Council.
- **ISO 9001/14001/45001** — Quality / Environmental / Occupational H&S management systems (International Organization for Standardization).
- **ISO 14025** — EPD program standard.
- **LEED** — Leadership in Energy and Environmental Design.
- **MSDS** — Material Safety Data Sheet.

Procurement & trade terms

- **DOA** — Delegation of Authority.
- **Incoterms** — International Commercial Terms (e.g., **EXW** Ex Works, **FOB** Free On Board, **CFR** Cost & Freight, **CPT** Carriage Paid To).
- **PO** — Purchase Order.
- **RFP / RFQ / RFx** — Request for Proposal / Quotation / generic Request-for-....
- **T&Cs** — Terms & Conditions.

Logistics & shipping documentation

- **AWB** — Air Waybill.
- **BL (B/L)** — Bill of Lading.
- **CI** — Commercial Invoice.
- **COO** — Certificate of Origin.

- **DN** — Delivery Note.
- **GRN** — Goods Receipt Note.
- **PL** — Packing List.

Quality, traceability & site

- **AQL** — Acceptable Quality Level.
- **CAPA** — Corrective and Preventive Action.
- **IFC** — Issued For Construction (drawings).
- **ITP** — Inspection & Test Plan.
- **MTC** — Mill (Material) Test Certificate.
- **NCR** — Non-Conformance Report.
- **OTIF** — On-Time, In-Full.
- **QA/QC** — Quality Assurance / Quality Control.
- **WBS** — Work Breakdown Structure.

Sustainability & emissions

- **CO₂e** — Carbon-Dioxide Equivalent.
- **EAF** — Electric Arc Furnace (steel).
- **EF** — Emission Factor.
- **ESG** — Environmental, Social & Governance.
- **GWP** — Global Warming Potential.
- **KPI(s)** — Key Performance Indicator(s).
- **Scope 3** — Value-chain (indirect) emissions category.
- **t-km** — Ton-kilometer (emissions unit for transport).
- **YoY** — Year-over-Year.

Systems, roles & process frameworks

- **AM / Sr** — Assistant Manager / Senior (title short forms).
- **AP** — Accounts Payable.
- **ED** — Executive Director.
- **ERP** — Enterprise Resource Planning.
- **HSE** — Health, Safety & Environment.
- **MEP** — Mechanical, Electrical & Plumbing.
- **RACI** — Responsible, Accountable, Consulted, Informed.
- **S2P** — Source-to-Pay.
- **NOW** — (Internal workflow/ERP pilot referenced as **—NOW**”).

Country & code references appearing in analysis

- **BNBC** — Bangladesh National Building Code.
- **CSR** — Corporate Social Responsibility.
- **GDP / GNP / HDI** — Gross Domestic Product / Gross National Product / Human Development Index.

Chapter 1: Engagement in the Organization

1.1 My Engagement at NDE Ltd. — Assistant Engineer, Tender & Costing

As Assistant Engineer, Tender & Costing sitting at that point of convergence between technical scope, market pricing, and sustainability requirements for the offer, I have made it my core mandate to translate drawings and specifications—plus a fair amount of sometimes not-so-well-defined employer requirements—into bids that are not only compliant but competitive and defensible. And hand over a clean, traceable cost baseline to Procurement and Project Controls once we win.

1.2 Where I sit in the process

I work in a place before Procurement, having tight cooperation with Engineering/Design, Planning, Quality, and Logistics. I lead the quantity take-off and price estimate during the tendering process. I support in clarifications and negotiations after submission. I finalize the control budget and material schedules upon contract awards that Procurement uses further for purchase orders and supplier engagement.

1.3 Pre-tender intelligence and go/no-go

Begin with the Invitation to Tender/Request for Proposal (ITT/RFP) package including the scope and technical specifications, commercial terms, tax and VAT issues, securities, liquidated damages, and Incoterms. Then perform a pre-risk and opportunity review identifying design ambiguities in long-lead material as well as sustainability requirements that may include Environmental Product Declarations (EPD) and International Organization for Standardization (ISO) standards plus site logistics constraints. This will inform line management to facilitate our internal go/no-go decision process which flows into the bid strategy in preferred sourcing routes, alternatives, and allowances.

1.4 Quantity take-off and scope structuring

I use the latest IFC and tender drawings plus the Bill of Materials (BOM) to do a disciplined quantity take-off of structural steel, cementitious material, reinforcing steel, and mechanical, electrical, and plumbing (MEP) components. I review in detail scope overlaps and exclusions to ensure that this take-off matches with WBS coding so that it will be easy to reconcile cost baseline, procurement plan, and site progress. In addition, I setup change registers for addenda and RFIs so that the estimate stays aligned with the changing tender documentation.

1.5 Cost build-up and rate analysis

For each, I build resource rates that cover materials, make and install, tools, shipping, taxes, insurance, test and check fees, overheads, and profit. I level supplier quotes to a common base with money type, trade terms, packing, guarantee time, and delivery time focusing more on total ownership cost than just unit price. In the shipping part I add real path costs with port work inside haul and end leg limits plus plan risk modeling for long lead things.

1.6 Market testing and supplier engagement

I raise and send out organized Requests for Quotation to approved and potential suppliers and fabricators. Normalization is key; I put together technical compliance, pricing parts, lead times, and commercial terms side by side in a comparative format, which brings out any hidden differences such as on freight inclusions, insurance cover, spare parts, test certificates. This gives management a clear basis on which to choose the preferred technical and commercial option thus reducing the possibility of surprises coming up later in the procurement process.

1.7 Sustainability integration (carbon-neutral lens)

In line with NDE's policy, I embed sustainability requirements directly in the tender pack and in my quote evaluations:

- I require EPDs (ISO 14025/EN 15804) for relevant materials (e.g., structural steel, cementitious products) and validate scope/functional unit and validity dates.
- I check ISO 9001/14001/45001 certificates for issuer and expiry and flag gaps early.
- I insist on traceability commitments (heat/lot numbers → MTC → bundle/Delivery Note) and include this as a scored criterion in my bid tab.
- Where the specification allows alternates, I cost lower-GWP options (e.g., EAF/recycled-content steel; lower-clinker cements) and present price-carbon trade-offs to management.
- I pre-capture logistics data fields (distance-mode-weight per transport leg) so the winning solution can flow into Scope-3 reporting without rework.

1.8 Risk, contingency, and currency/Incoterms modeling

I quantify core risks, including design maturity and long lead volatility, exchange rate exposure as well as documentation risks e.g. lapses in EPD and ISO compliances. I also quantify the cost and risk distributions for EXW, FOB, CFR, and CPT terms for imported material choosing that structure which aligns delivery plan most effectively with it as well as our risk appetite. Sensitivity to steel price and variance in freight costs are parameterized thereby keeping them outside margins for better management clarity.

1.9 Bid compilation, governance, and submission

Prepare priced BOQ, method statements, cash flow and S-curve, organizational charts, and QA/HSE plans-Include sustainability compliance note. Document all internal approvals at every stage-Include technical, commercial, tax, and deviation approvals. Make sure that the narrative, rates, and assumptions are consistent in our submission. In cases where a client requires EPDs or certification evidence during bidding, attach verified copies. Also document any outstanding actions together with their deadlines.

1.10 Post-tender clarifications and negotiation support

After submission, I manage RFI clarifications, addenda re-rates, and value engineering alternatives. During negotiation, I support the commercial lead with a structured set of “what-if” scenarios on delivery adjustments, alternative sources of supply, and sustainable substitutions that reduce embodied carbon yet do not compromise quality. This is backed up by supplier quotations and documented equivalences.

1.11 Award handover and control-budget finalization

At the awarding of the contract, I set a control budget keyed to the WBS and kick off a procurement plan. That plan has material schedules by package, target dates, and inspection plus documentation requirements all detailed out. I give to Procurement what evidence expectations need to be met-EPDs IDs, details on ISO certs, MTC/heat mapping, Incoterms, and transport data template-so that purchase orders plus GRNs are right and complete from go.

1.12 Cost control, changes, and claims support

I track early commitments versus the control budget and help evaluate change orders and claims. When scope changes, I re-price impacts transparently, keeping schedule and

sustainability implications visible (e.g., if a downgrade jeopardizes EPD or traceability, I document the risk and seek management decision).

1.13 Data, tools, and systems

I use Excel every day for structured bid tabs, PivotTables, and data validation to control what goes in. I also make use of our ERP system with the –NOW” trial to check and adjust all purchase order fields against the estimate. A standard set of templates is kept - including an RFQ form a sustainability compliance checklist an EPD/ISO verification sheet a bid evaluation scorecard and a transport legs register - that helps make the tender process repeatable and auditable.

1.14 Collaboration and stakeholder management

I coordinate with the Engineering department (for clarifications and alternatives), with the Quality Assurance Quality Control team (regarding inspection, testing procedure, and acceptance criteria) with Health Safety and Environment in line with ISO 45001, Logistics on lane feasibility and consolidation, Finance about taxation securities and payment terms, Legal Contracts regarding traceability as well as remedial clauses. With suppliers, I ensure transparency and document integrity; with management, I explain options, trade-offs, and residual risks so that decisions are made knowingly.

1.15 What my work enables

By putting sustainability at the core of the tendering baseline and not treating it as something secondary, NDE is able to help compose compliant and competitive bids that will naturally include all crucial elements that need to be fulfilled for Procurement to execute seamlessly: Environmental Product Declarations (EPD) and ISO certifications are ready, traceability is known, logistics data available for Scope-3 accounting. In this way, proactively reducing re-RFQs that leads to reduced customs and Goods Receipt Note (GRN) delays and future payment disputes while making our price–carbon decisions credible with clients.

Chapter 2: Overview of the Organization

2.1 NDE Ltd. — Company Overview

NDE Limited is a multi-disciplinary construction and engineering contractor based out of Bangladesh with complete project solutions involving civil works, steel structures, and building systems. The operations merge tendering and costing, procurement and contract management, actual construction execution, QA/QC, HSE management, handover & commissioning so that the project can flow seamlessly from bidding to delivery under one unified framework. It delivers projects for private as well as public clients in industrial facilities, commercial buildings, or infrastructure-related scopes where fast-track delivery and complex sequencing are required.

2.2 What NDE Does

- **Pre-construction & Tendering.** Detailed quantity take-off, rate analysis, risk/pricing strategy, value engineering options, and bid compilation (technical and commercial).
- **Procurement & Contracting.** Category-based sourcing (e.g., structural steel, cementitious materials, MEP packages, finishes), supplier pre-qualification, RFQ/RFP management, negotiation, and contract/PO issuance aligned to a Delegation of Authority (DOA).
- **Project Execution.** Site mobilization, materials control, installation/erection, inspections, and interface management among civil, structural, and MEP trades.
- **QA/QC & HSE.** Inspection and test plans (ITPs), incoming material inspection (dimensions, markings, surface finish), non-conformance reporting (NCR) and close-out, and a preventive safety culture aligned with ISO-style practices.
- **Commissioning & Handover.** Documentation, as-built records, training where applicable, and client acceptance.

2.3 Organization & People

NDE follows a line-and-staff organizational structure. Top Management (Executive Director/Head), the functional heads-Tender & Costing, Procurement, Projects/Engineering, QA/QC, HSE, Finance & Audit, Warehouse/Logistics, and project site teams. The present organization chart of the Procurement division is a hierarchy that forms part comprising the Head/Executive Director with staff that consists of a Manager, Deputy Manager/Assistant

Managers, Senior Procurement Officers, and Procurement Officers. This department carries out strategic sourcing (policies and supplier scorecard) and transactional purchasing (RFQs, POs expediting plus document control). Close cooperation between procurement and the Tender & Costing, QA/QC, Warehouse, and Finance departments.

2.4 Operating Model & Core Processes

- **Tender & Costing.** Bids are built from IFC/tender drawings and BOQs with WBS-aligned take-offs. Rate build-ups capture materials, fabrication/erection, logistics, duties/insurance, testing, overheads, and risk allowances. Alternatives (e.g., recycled/EAF steel, low-clinker cements) are evaluated alongside price to support carbon-aware choices.
- **Sourcing & Supplier Management.** Suppliers are pre-qualified by category and risk-tiered. Competitive RFQs use a weighted scorecard (Price/TCO, Quality/Technical, Delivery risk, Sustainability) to ensure decisions are transparent and auditable.
- **Contracting & Documentation.** Contracts/POs embed clauses for traceability (heat/lot → MTC → bundle/Delivery Note), emissions data (distance–mode–weight per transport leg), audit rights, and remedies for documentation gaps or misrepresentation.
- **Receiving & Quality.** NDE uses a unified receipt checklist that pairs physical inspection with document verification. Acceptance, conditional acceptance, or rejection triggers NCR/CAPA flow; Finance applies payment holds if the document pack is incomplete.
- **Controls & Governance.** A DOA framework governs approvals; three-way match (PO ↔ GRN/inspection ↔ invoice) is mandatory; monthly reviews track performance (delivery, quality, sustainability).

2.5 Quality, HSE, and Compliance

Quality is controlled through established documented procedures and systematic inspections of incoming material against standards with evidence-based acceptance criteria. QA/QC checks MTCs validating them against heat numbers and conforming to the relevant standard, EN or ASTM when specified. HSE practice aligns with ISO 45001 principles by including toolbox talks, method statements, and permit-to-work protocols where incidents and near misses are used as preventive action information.

2.6 Sustainable Procurement Program (Carbon-Neutral Lens)

NDE treats sustainability as part of “how we buy,” not an add-on:

- Standards in Specs. EPDs (ISO 14025/EN 15804) required where relevant; preference for ISO 14001/45001 suppliers; recycled-content and restricted-substance expectations included in a short Sustainability Spec Addendum (SSA).
- Traceability by Design. Heat/lot numbers must map cleanly to MTCs and bundle/DN labels; substitutions follow formal change control with documented equivalence.
- Evidence Pack at GRN/Invoice. EPD, ISO certificates (issuer/expiry), MTC with heat numbers, CI/PL/BL/COO, and leg-wise transport data (distance–mode–weight) for Scope-3.
- Scorecards & Auto-fail Rules. Supplier scorecards include sustainability weight; auto-fail applies for child/forced labour indicators or falsified EPD/ISO/MTC documents.
- KPIs. Working targets include Doc-complete first-time pass $\geq 90\%$, Heat↔MTC match $\geq 99\%$, OTIF $\geq 95\%$, NCR $\leq 1\%$, CAPA ≤ 30 days, and Scope-3 transport data coverage $\geq 95\%$.

2.7 Systems & Data

The company uses structured bid tabs and spreadsheets (Pivot-driven analysis) and is piloting/using an ERP workflow (you referenced a “NOW” trial) with procurement-critical fields made mandatory: EPD ID, certificate numbers/expiry dates, and transport-leg data. Barcoding/QR on bundles/heats is being adopted to reduce traceability breaks during cutting and re-handling at site stores.

2.8 Risk Management

Risks are assessed at bid and award: supplier ESG/legal status, documentation integrity, lead-time and logistics exposure, and price volatility. During execution, risk is controlled through contractual remedies, multi-sourcing where feasible, early ordering for greener modes, and invoice holds pending full documentation. Data quality is protected by verifying certificate issuers/EPD operators and spot-checking authenticity.

2.9 Vendor & Market Development

NDE invests in supplier maturity: templates for document integrity, clinics on EPD/ISO/MTC, and a Green/Gold recognition concept for high-performing partners. Strategic suppliers may be supported to publish first-time EPDs and improve recycled content so lower-carbon options become readily available.

2.10 Performance & Outcomes

Day-to-day results include fewer customs/GRN holds, lower re-inspection and claims, faster RFQ-to-award cycles through pre-qualified pools, and an audit-ready evidence trail that satisfies clients and financiers. Environmental visibility improves as kg CO₂e per ton delivered can be rolled up by PO, project, and WBS from the same transport-leg data used for logistics control.

2.11 Roadmap

Immediate considerations include integrating sustainability criteria as compulsory elements inside ERP systems pre-qualification extension by category and implementation of QR traceability at stores. In the mid-term period, NDE has plans on extending the offering of low-carbon options which comprise Electric Arc Furnace (EAF) and recycled steel in addition to lower-clinker binders. Further supplier tiering and auditing plus publishing carbon dashboards at project level is also planned. The long-term goal is to make sustainable choices become defaults and fastest for buying and building, thereby ensuring consistency across projects, verifiability, and driving toward being the cheapest option over the lifecycle of an asset.

2.12 Understanding Sustainable Procurement in Construction

Sustainable procurement refers to the process of including environmental, social, and economic aspects in procurement decisions so as to net positive benefits on society while mitigating any potential negative impacts that may occur to the environment over the lifecycle of a construction project. In the case of a carbon-neutral construction program, sustainable procurement means reducing carbon emissions at every step when making procurement decisions from raw material extraction up to delivery.

2.13 Key Responsibilities:

- Strategic sourcing and purchasing of construction materials (e.g., sand, bricks, steel, finishing materials).
- Vendor management, including vendor selection, negotiation, relationship building, and continuous performance assessment.
- Preparation and analysis of **Comparative Statements (CS)** to ensure cost-effective purchasing decisions.
- Timely execution of procurement processes to support uninterrupted construction operations.
- Coordination with project teams, stores, accounts, quality assurance, and finance departments to ensure integrated procurement and operational efficiency.
- Inventory management and logistics optimization to maintain a balanced flow of supplies across various project sites.

2.14 Core Processes:

- **Sourcing:** Identifying and qualifying vendors through rigorous market analysis and negotiation.
- **Tendering & Contracts:** Managing bidding processes, contract administration, and documentation.
- **Inventory Control:** Efficient stock monitoring and proactive inventory management to minimize waste and ensure timely availability of essential items.
- **Logistics Coordination:** Ensuring smooth transportation and delivery of construction materials to various project sites nationwide.

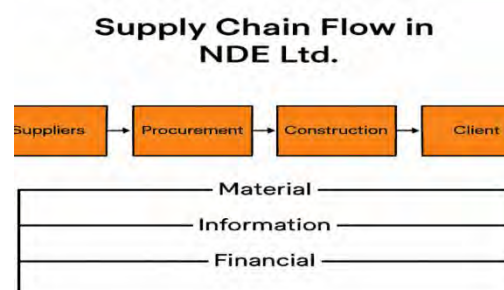


Figure-01: Supply Chain Key Flow

2.15 NDE Ltd. Procurement Department's Organogram

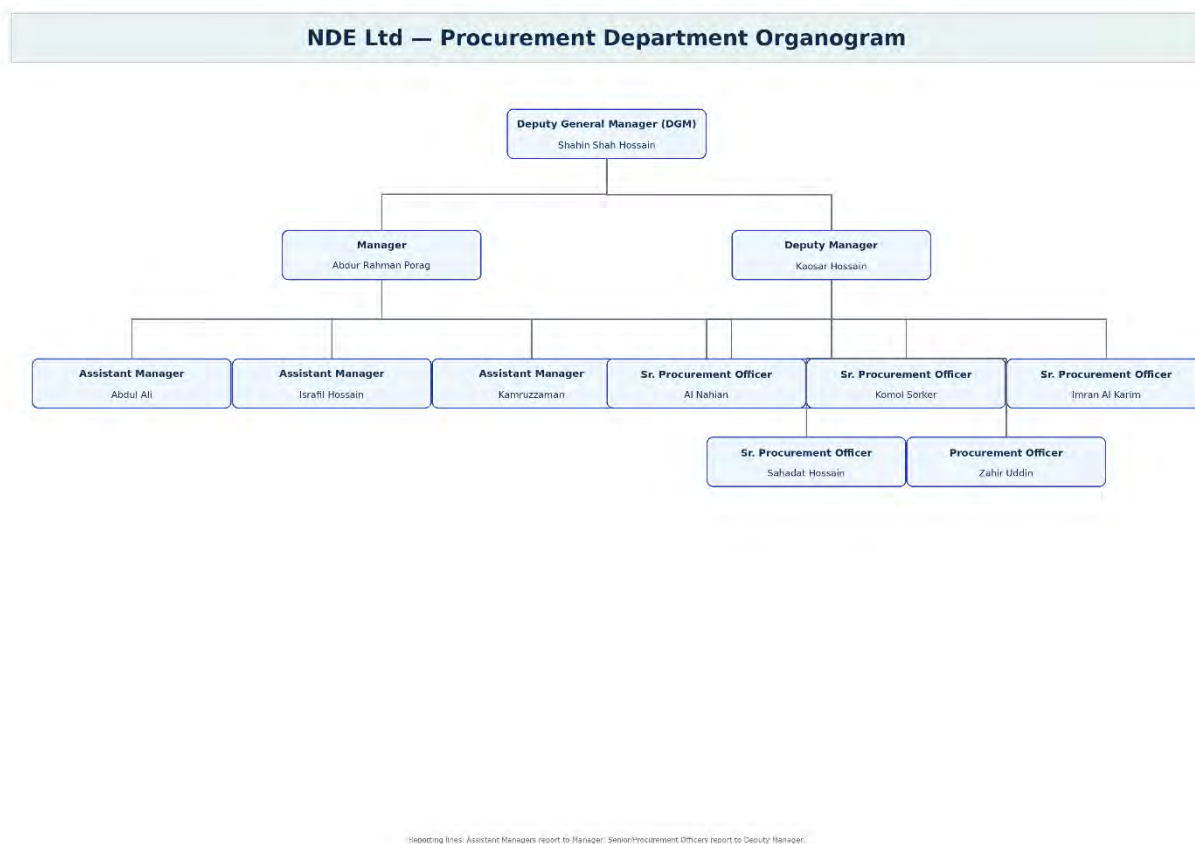


Figure-02, Procurement Department Organogram at NDE Ltd.

2.16 Major Raw Materials Procurement are at NDE Ltd.

Category	Materials	Notes / Source
Cement & Concrete	- Ready-Mix Concrete- Ordinary Portland Cement (OPC)- Blended cement types (e.g., slag, fly ash cement)	Through NDE Ready Mix Concrete Ltd. , using brands such as Lafarge, Heidelberg, Holcim and local suppliers
Aggregates	- Coarse aggregates (stone chips)- Fine aggregates (sand)	Supplied via Nimpex Ltd. , which imports aggregates from international sources and distributes through its dedicated terminals

Category	Materials	Notes / Source
Bitumen & Asphalt	- Bitumen for road surfacing- Asphalt mix	Used in NDE's asphalt plants for road and highway projects
Steel & Rebar	- Reinforcement steel bars- Structural steel for buildings, bridges, flyovers	Used in almost all civil infrastructure and building projects (supplier details not publicly listed)
Prefabricated Blocks & Bricks	- Concrete blocks- Bricks	Produced in-house via NDE BPL , with ~250,000 brick-sized blocks/day capacity
Marine Construction Materials	- Piling pipes- Sheet piles- Rock boulders- Geo-textile/geobags	Used for jetties, marine piling, dredging, and shore protection projects
Fuel & Lubricants	- Diesel- Lubricating oils	Required for operating dredgers, cranes, batching plants, asphalt plants, and heavy equipment.

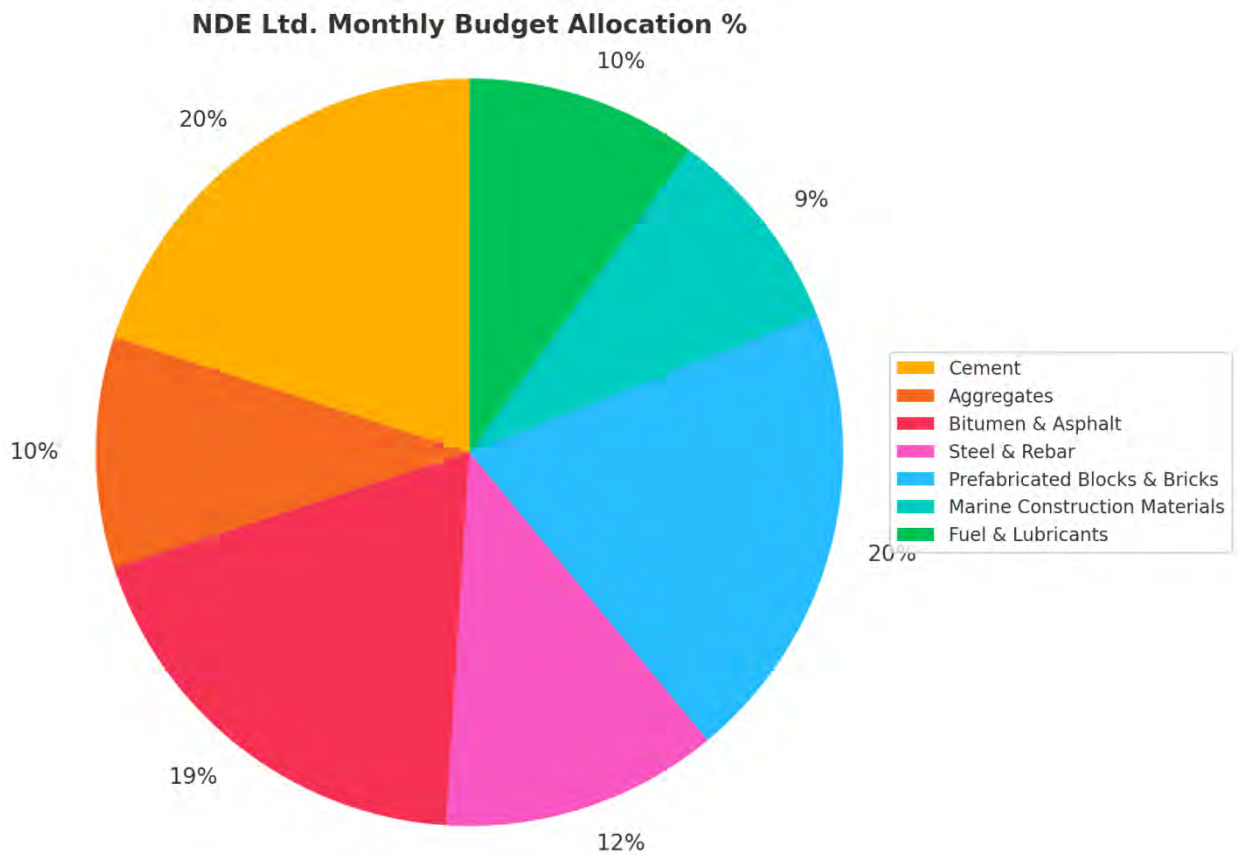


Figure-03, NDE SCM Monthly Budget Allocation Percentage

Chapter 3: Introduction to the Project

3.1 Background of the Study

Sustainable procurement has come out as an increasingly adopted strategy by different sectors, especially the construction industry. This sector is known for its great environmental impacts and currently tries to mitigate carbon emissions through integrating sustainability elements into its operations. Among several strategies that could be applied, sustainable procurement is viewed as the main driving force in getting closer to a carbon-neutral future. Firms in this industry can reduce their environmental impact on nature by going green in their procurement policies through such aspects as materials and design applying energy efficiency and ethical sourcing.

National Developments Engineers Ltd. began its start in 1982 and belongs to the leading construction companies in Bangladesh. NDE has expertise established on a very strong reputation developed over more than four decades with experience at home and abroad across the diversity of construction projects. This company completed road, bridge, and flyover works besides embassies, power houses, and commercial and residential buildings together with stadiums and airport terminal buildings.

NDE Building Products Ltd. (NDE BPL) is a subsidiary of National Development Engineers Ltd. (NDE) with core competency in manufacturing premium quality concrete building materials. The company was set up to respond to an ever-increasing clamor for strong and sustainable construction products within Bangladesh and runs one of the largest fully automatic concrete block production plants in the country.

The biggest such setup in Bangladesh is put up for use by **NDE BPL** at Gazaria, Munshiganj. Installed at this site is the block machine of German manufacture Zenith 1500-2 supported by a fully automated RoTho curing chamber where both temperature and moisture can be controlled. Product quality consistency goes hand in hand with high production capacity. The factory has a production capacity of 250,000 standard brick size blocks per day. This places NDE BPL in a very strategic position to adequately meet the increasing demands of the construction sector.

NDE BPL sustains its support for the sustainable construction approach and process through the supply of green building materials. The product line has been characterized by strength and resilience attributes, offering a long lifecycle performance period. Precision design constitutes an integral part of the offering from **NDE BPL**, joined by easy installation that adds improvements to construction processes on the way towards a better future.

High quality delivery and project management put **NDE** at the leader's pedestal in the construction industry. With a large portfolio and commitment to excellence, **NDE** is ready to drive sustainable procurement practice in the construction industry as an important initiative toward reducing carbon emissions and general environmental impacts. Sustainable procurement is defined as the process of acquisition of goods, services, and works with strong consideration for relevant environmental, social, and economic aspects leading towards long-term welfare for society in particular and the planet in general.

How NDE Can Integrate Sustainable Procurement into its Construction Projects.

3.2 Statement of the Problem

Even though sustainability keeps gaining more and more share in the global construction pie, the share of sustainable procurement practices in the Bangladeshi construction sector is relatively less developed. Firms face major challenges about the availability of sustainable materials, environmental regulation, and traceability in procurement. NDE belongs to these firms. On top of that, when there is no standard framework for sustainable procurement and supposedly it is expensive to carry out such practices, most people are barred from carrying them out.

This study seeks to explain how NDE can successfully practice sustainable procurement practices in its operations, with a major emphasis on how it can achieve carbon-neutral construction through such sustainable procurement practices. The other barriers and opportunities in the adoption of sustainable procurement that this study seeks to discover, this study shall offer recommendations on how the challenges can be overcome.

3.3 Objective of the Study

The objectives of this study are:

- To examine the current procurement practices at NDE and identify the scope for incorporating sustainable procurement strategies.
- To explore the environmental, economic, and social benefits of sustainable procurement in the construction sector.
- To assess the challenges faced by NDE in implementing sustainable procurement and propose actionable solutions.
- To evaluate the impact of sustainable procurement practices on achieving carbon-neutral construction.
- To determine the connection between NDE's procurement performance and supplier relationship management techniques.

3.4 Significance

This study shows, with NDE Ltd. as a live case, how specific procurement controls—EPD/ISO requirements, heat-to-MTC traceability, and leg-wise transport data—translate into better quality, on-time delivery, and credible Scope-3 carbon accounting in construction. It delivers a practical, measurable operating model (scorecards, receipt checklists, KPIs) that NDE can adopt immediately to cut rework, customs/payment holds, and disputes while improving audit-readiness and bid competitiveness with ESG-sensitive clients. Academically, it fills a local evidence gap by linking procurement practice to carbon-neutral outcomes in Bangladesh's construction sector and offers a replicable mixed-methods framework other contractors can use. At a policy level, the findings inform supplier development and circularity initiatives that support national competitiveness and export goals. In short, the study converts “sustainability” from aspiration into a repeatable, data-driven way of buying that lowers risk and total cost.

3.5 Scope and Limitations of the Study

It will review sustainable procurement at NDE with a special eye on their construction projects, and challenges plus opportunities in getting sustainable material as well as incorporating carbon-neutral practices into the procurement process. The limitations of the study include possible constraints on data availability since NDE might be having some

proprietary information that cannot be disclosed. In addition, the study is mainly focused on projects within Bangladesh thereby making it less able to represent fully the best practices globally.

Chapter 4: Literature Review

4.1 Key Drivers for Sustainable Procurement

The adoption of sustainable procurement practices in construction organizations such as NDE Ltd. is driven by several key factors, including regulatory compliance, cost efficiency, risk management, and stakeholder expectations. Regulatory frameworks like the Bangladesh Green Building Code and international standards (ISO 14001, ISO 20400) increasingly mandate environmentally responsible sourcing (Brammer & Walker, 2011). Moreover, studies indicate that firms integrate sustainability to meet environmental goals while achieving long-term cost efficiency and lifecycle value (Agyekum et al., 2023). Regulatory compliance, client expectations, and global ESG alignment have made sustainability central to organizational competitiveness (Montalbán-Domingo et al., 2022).

Lifecycle-based procurement decisions also enable cost savings through lower waste, reduced rework, and enhanced material longevity (de la Fuente et al., 2024). Sustainable procurement enhances brand value and stakeholder trust by embedding transparency and ethical standards across the supply chain (Brammer & Walker, 2011). These motivators, together with global frameworks like the Paris Agreement, emphasize the integration of sustainability principles to achieve carbon-neutral construction practices.

Regulatory Compliance & Incentives

- Meeting more strict national and international rules, like the Green Building Code of Bangladesh.
- Getting tax breaks, grants, or special funds linked to low-carbon building work.

Cost Savings & Lifecycle Value

- Cutting the total cost of owning by focusing on materials and suppliers with low embodied carbon and high strength.
- Lowering waste handling and dumping costs by making order sizes better and using circular economy sourcing ways.

Risk Management & Supply Resilience

- Mitigating exposure to volatile commodity prices (e.g., steel, oil) by diversifying suppliers of recycled, alternative or local materials.
- Ensuring continuity of supply amid resource scarcity or geopolitical disruptions.

Client & Market Demand

- Addressing increasing public and private sector mandates for net-zero, carbon-neutral, or verified green building credentials; -
- Distinguishing NDE's brand as clients increasingly favor contractors with verifiable sustainability practices.

Reputation & Stakeholder Trust

- Enhancing corporate image with investors, lenders and communities by transparently tracking and reporting procurement-related emissions.
- Fulfilling commitments under ESG (Environmental, Social, Governance) frameworks sought by international finance institutions.

Innovation & Competitive Advantage

- Driving adoption of advanced low-carbon products (e.g., green cement, bio-based binders, recycled aggregates) and rewarding innovative suppliers.
- Positioning NDE as a thought-leader in sustainable infrastructure, unlocking new business opportunities.

Environmental & Social Impact

- Cutting embodied carbon emissions over projects to help reach global climate goals like those in the Paris Agreement.
- Lowering local environmental harm such as dust, noise, and runoff from where materials are taken and how they are moved.

Internal ESG Goals

- Making sure buying rules match NDE's own carbon-cutting goals with a focus on Scope 3 emissions.
- Infusing sustainability into the corporate ethos, as reflected to values such as in “quality & standard” and “building with vision,” thus ensuring long-term organizational resilience.

These elements make up the reason for NDE Ltd. to add sustainability standards like carbon limits, supplier checks, and circular economy rules to its buying plans, thus moving closer to carbon-free building.

4.2 Reason of Choosing Sustainable Procurement

Construction firms adopt sustainable procurement to balance environmental responsibility with long-term economic gain. Embodied carbon from materials such as steel and cement constitutes a major share of project emissions; therefore, prioritizing low-carbon alternatives aligns with both regulatory expectations and NDE's internal de-carbonization goals (de la Fuente et al., 2024). Although initial costs for green materials may be higher, lifecycle cost savings through durability, reduced maintenance, and lower waste justify the investment (Agyekum et al., 2023).

Moreover, green procurement strengthens NDE's competitiveness in tenders where sustainability criteria are weighted heavily (ISO 20400, 2017). Market differentiation through verifiable environmental performance fosters investor confidence and enhances access to sustainable financing (Govindan et al., 2020). Transparent emission reporting under ESG frameworks further assures clients and financiers of NDE's commitment to sustainable development (Walker & Brammer, 2012).

Carbon-Footprint Reduction

Embodied carbon in construction materials, cement, steel, and aggregates form a large share of emissions over the lifetime of the project. The purpose of sustainable procurement is to enable the prioritization of low-carbon or recycled alternatives thereby assisting NDE to achieve its internal decarbonization objective and comply with regulations.

Cost Efficiency Over the Project Lifecycle

Though "green" materials may involve higher upfront costs, they often come with greater durability, reduced maintenance costs, and waste costs. The savings that can be generated over the lifecycle from much less energy consumption and rework that has to be done are real and substantial in terms of cash flow.

Regulatory and Tender Competitiveness

Green procurement gives NDE not only an edge advantage in bidding but also assures compliance with the trends of changes in the rules of environmental regulations. Public and private tenders have increasingly been embracing sustainability criteria and net zero commitments into their consideration. This, therefore, places NDE at a powerful strategic position when bidding for contracts.

Supply-Chain Resilience

It shelters NDE from the volatility of prices in global commodities as well as logistics disruptions by simply varying suppliers with local, recycled, or alternative-material producers. Geopolitical uncertainty and scarcity of resources characterize times; thus, it is imperative to implement such a strategy.

Market Differentiation and Brand Value

Demonstrable green credentials help NDE stand out in a crowded market. Clients seeking LEED/BREEAM certification or aligned with ESG mandates are more likely to choose a contractor with robust sustainable procurement policies.

Stakeholder and Investor Confidence

Transparent reporting of procurement-related emissions and commitments to sustainable sourcing build trust with lenders, insurers and communities. Strong ESG performance can lower financing costs and unlock access to green bonds or sustainability-linked loans.

Innovation Catalyst

Pursuing sustainable procurement drives research and adoption of novel, low-carbon construction technologies—such as geo-polymer cements, recycled aggregate composites and bio-based insulators—keeping NDE at the forefront of industry progress.

Social and Environmental Stewardship

Apart from its effects on climate change, sustainable sourcing helps reduce local ecosystem disruption, protects biodiversity, lowers water use and improves labor conditions in the supply chain thus strengthening NDE's commitment to being a responsible corporate citizen. By adopting sustainable procurement, NDE Ltd. will advance its carbon-neutral construction agenda as well as long-term economic value plus strength for being an industry leader in the environment and social infrastructure development.

4.3 Procurement policy at NDE Ltd.

NDE Ltd. follows a formal procurement policy ensuring ethical, transparent, and sustainable sourcing. Its framework is guided by ISO 20400 (2017) and PAS 2080 (2019), which emphasize integrating environmental, social, and governance factors into procurement governance. These frameworks promote value for money, lifecycle assessment, and supplier sustainability evaluation. The policy mandates supplier prequalification under ISO 9001, ISO 14001, and ISO 45001, ensuring consistent quality and compliance with environmental and occupational standards (British Standards Institution, 2019).

NDE's procurement cycle aligns with international best practices and the Triple Bottom Line (TBL) approach, balancing economic, environmental, and social value creation. This ensures that every stage of procurement—from tendering to delivery—considers not just cost but also sustainability performance (Montalbán-Domingo et al., 2022).

Purpose

To ensure that all goods, materials and services procured by NDE Ltd. are sourced in a fair, transparent and cost-effective manner—while minimizing environmental impact, reducing carbon emissions and upholding the highest ethical standards.

Scope

This policy applies to all employees, departments and subsidiaries of NDE Ltd. engaged in the purchase of:

Construction raw materials (cement, aggregates, steel, bitumen, blocks, marine materials, fuels) Plant, equipment and rentals Sub-contracted services (civil, MEP, marine) Indirect goods and services (office supplies, IT, logistics)

Key Objectives

- Value for Money – Achieve the optimal balance of quality, total cost of ownership and delivery reliability.
- Transparency & Fairness – Conduct procurement with openness, equal treatment of suppliers and avoidance of conflicts of interest.
- Sustainability & Carbon Reduction – Integrate environmental criteria (embodied carbon, recyclability, local sourcing) into every stage of procurement.
- Risk Management – Secure resilient supply chains, mitigate price volatility and ensure continuity of critical supplies.
- Compliance & Ethics – Adhere to all applicable laws, regulations and anti-corruption standards.

Procurement Principles:

Competitive Tendering

- Use Request for Quotation (RFQ) or Request for Proposal (RFP) processes for all purchases above defined thresholds.
- Maintain a minimum of three qualified bids for significant contracts.

Supplier Pre-Qualification

- Evaluate suppliers on financial stability, technical capacity, quality management (ISO 9001), and—critically—environmental management (ISO 14001) or equivalent.
- Require evidence of carbon accounting or published Environmental Product Declarations (EPDs) for high-impact materials.

Sustainable Evaluation Criteria

- Incorporate Least-Carbon scoring: award points for lower embodied-carbon materials (e.g., blended cement, recycled aggregates).
- Favor suppliers with circular-economy credentials (take-back programs, recycled content).
- Give preference to local or regionally manufactured products to reduce transport emissions.
- Contract Clauses & KPIs
- Insert sustainability clauses requiring regular reporting on material carbon footprints (Scope 3).
- Set Key Performance Indicators (KPIs) for suppliers, such as % recycled content or annual CO₂ reductions.
- Ethics & Anti-Corruption
- Enforce a strict “no gifts or hospitality” rule during bid evaluation.
- Rotate evaluators and maintain clear conflict-of-interest registers.

Procedures:

Needs Assessment

- Project teams define material/service specifications—including technical, quality and sustainability requirements—early in the design phase.

Market Analysis

- Procurement team maps potential suppliers, monitors raw-material price trends and identifies innovative low-carbon alternatives.

Tendering & Bid Evaluation

- Issue RFQ/RFP with embedded environmental scoring.
- Conduct technical and financial evaluations in separate stages; combine scores according to the weighting matrix (e.g., 60 % price, 30 % technical, 10 % sustainability).

Award & Contracting

- Award to the compliant bid with the highest composite score.
- Execute a formal Purchase Order or contract that includes delivery schedules, quality checks, sustainability reporting requirements and penalty clauses for non-performance.

Order Management & Inspection

- Track deliveries via the ERP system.
- Perform on-site inspections for quality, quantity and compliance with environmental specifications.

Performance Review

- Quarterly supplier scorecards covering on-time delivery, quality, safety incidents and sustainability KPIs (e.g., % low-carbon materials delivered).
- Annual strategic reviews to identify preferred suppliers and phase out under-performers.

Roles & Responsibilities

- Executive Committee – Approves procurement strategy, sustainable targets and major supplier relationships.
- Procurement Manager – Implements policy, manages tenders, oversees supplier pre-qualification and enforces compliance.
- Project Managers – Define requirements, participate in bid evaluations and ensure materials meet sustainability criteria on site.
- Sustainability Officer – Validates carbon data, monitors Scope 3 emissions from procured materials and updates sustainable-procurement guidelines.

Monitoring & Continuous Improvement

- Data Collection – Capture procurement spend and carbon-intensity data in the ERP for monthly and annual reporting.

- Audits – Conduct bi-annual internal audits of procurement files, sustainability scoring and supplier performance.
- Policy Review – Update this policy annually or as regulations/industry best practices evolve.



Figure-04, The Generic procurement cycle. (source: www.distancelearningcollege.co.uk)

4.4 Procurement Management Software

To strengthen sustainable procurement implementation, NDE employs digital procurement tools and ERP systems for data traceability. Platforms like **Kandaree** and **Kuehne+Nagel** enhance visibility in international logistics, improving carbon tracking and documentation integrity. According to the **World Economic Forum (2021)**, digital traceability significantly improves Scope 3 emission monitoring, ensuring that procurement activities align with

sustainability targets. These systems, when integrated with ERP workflows, also ensure supplier accountability and transparency (UN Environment Programme, 2018).

Procurement Tracking Tools & Technology Use

- Kandaree and Kuehne+Nagel platforms (particularly for international logistics) are being tested for streamlined visibility in cross-border and high-volume orders—especially for high-profile government and infrastructure projects.
- ERP Software (in-house or third-party integrated) forms the backbone for:
 - Supplier master data,
 - Purchase requisitions,
 - Inventory forecasting,
 - Payment approvals, and
 - Contract lifecycle management.
- Microsoft Office tools, particularly Pivot Tables in Excel, are still widely used for data aggregation, tracking material costs, and generating procurement dashboards.
- NOW (New Operating Workflow) is currently being trialed to digitize and consolidate procurement approvals, sustainability metrics, and vendor communication.

4.5 Sustainable Procurement Flow at NDE Ltd

Effective sustainable procurement requires end-to-end traceability—from supplier selection to delivery and data archiving. NDE's process aligns with ISO 20400 and BNBC sustainability principles, ensuring verification of supplier certifications such as EPDs (ISO 14025/EN 15804) and ISO compliance. Similar approaches are supported by the UNEP Sustainable Public Procurement Guidelines (2018), which emphasize verification of documentation and lifecycle emissions tracking. The integration of carbon tracking tools also enables accurate Scope 3 emission reporting (World Economic Forum, 2021).

NDE's procurement strategy integrates the following key steps:

Step 1: Supplier Selection

- Vendors must be pre-qualified based on ESG (Environmental, Social, and Governance) credentials, compliance with ISO 14001 and ISO 20400, and ability to deliver low-carbon materials (e.g., recycled aggregates, low-emission cement).
- Technical and commercial assessments are performed jointly by Engineering, Quality Control, and Procurement teams.

Step 2: Certification Crosscheck

- All selected suppliers must submit:
 - Material test certificates
 - Sustainability declarations
 - Factory or origin-based carbon footprint data
- Documentation is verified by NDE's internal audit team before approval.

Step 3: Purchase Order Traceability

- Procurement is tied to project-specific carbon targets, with materials tagged according to Scope 3 emissions impact.
- Systems like ERP and NOW are used to track:
 - Batch numbers,
 - Source location,
 - Delivery timeline, and
 - Emissions declarations (when available).

Step 4: Logistics Monitoring

- With materials brought in or moved nearby, firms like Kuehne+Nagel help with paperwork and offer instant tracking of the carbon output linked to deliveries.
- Online delivery records are kept to check the miles covered, type of transport used, and amount of fuel used.

Step 5: Site-Level Quality & Compliance Checks

- Before use, onsite checks by standards already set are carried out by site engineers.

- Proof of following the rules in the Bangladesh National Building Code (BNBC) and sustainability requirements is checked at the site level.

Step 6: Data Archiving & Reporting

- Procurement data—linked to sustainability KPIs—is archived for:
 - Third-party audit,
 - Client reporting,
 - Green building certifications (e.g., LEED, EDGE), and
 - Internal carbon accounting.

4.6 Steps involved in a Procurement Process

Key Steps in the Procurement Process

1. Need Identification

- **Purpose:** Recognize the requirement for goods, services, or works—either for project execution, inventory replenishment, or strategic sourcing.
- **Tools Used:** Requisition forms, project schedules, material take-off sheets (MTO).

2. Specification & Scope Development

- **Purpose:** Define clear technical, functional, and sustainability specifications (e.g., low-carbon concrete, eco-friendly materials).
- **Input Sources:** Engineering teams, sustainability officers, site managers.

3. Supplier Identification & Prequalification

- **Purpose:** Identify capable, ethical, and compliant suppliers through market research or existing vendor databases.
- **Includes:**
 - ESG compliance check
 - Health, Safety & Environmental (HSE) certifications
 - Financial stability and past performance

4. Request for Quotation / Tender (RFQ/RFT)

- **Purpose:** Float detailed procurement documents to shortlisted vendors, requesting price offers, lead times, and terms.
- **Methods:**
 - Open or limited bidding
 - E-tendering platforms (e.g., ERP or NOW system)

5. Bid Evaluation & Negotiation

- **Purpose:** Evaluate offers based on:
 - Cost
 - Quality
 - Sustainability criteria (carbon footprint, recyclability, etc.)
 - Delivery terms
- **Followed by:** Commercial and technical negotiation

6. Supplier Selection & Approval

- **Purpose:** Finalize vendor selection through approval workflows involving procurement, finance, project management, and leadership teams.

7. Purchase Order (PO) Creation & Dispatch

- **Purpose:** Issue formal PO with delivery schedule, payment terms, and contract clauses.
- **System Use:** Generated via ERP or procurement software (e.g., Precoro, NOW)

8. Order Fulfillment & Logistics Tracking

- **Purpose:** Track order status, transportation details, and expected delivery timelines.
- **Involves:**
 - Shipment tracking
 - Carbon impact from logistics (where applicable)

9. Delivery & Inspection

- **Purpose:** Verify materials upon delivery at the site:
 - Match with PO
 - Conduct quality inspections
 - Check against sustainability documentation (e.g., material origin, certificates)

10. Invoice Verification & Payment

- **Purpose:** Match invoices with PO and delivery reports (3-way matching) before approving payment.
- **Finance Team Role:** Ensures cost accuracy, tax compliance, and payment cycle.

11. Contract Closure & Record Archiving

- **Purpose:** Finalize procurement file, store all documents (digitally), and close the PO in the system.
- **Also includes:** Supplier performance evaluation and feedback.

12. Post-Procurement Review & Reporting

- **Purpose:**
 - Conduct procurement audits
 - Analyze spend data
 - Measure supplier performance
 - Evaluate carbon/sustainability KPIs

Sustainability Overlay (Integrated Throughout)

For a **sustainable procurement process**, the following elements are embedded across all steps:

- Supplier sustainability screening
- Low-carbon material preference
- ESG-based bid scoring
- Lifecycle carbon tracking
- Compliance with ISO 20400 & BNBC

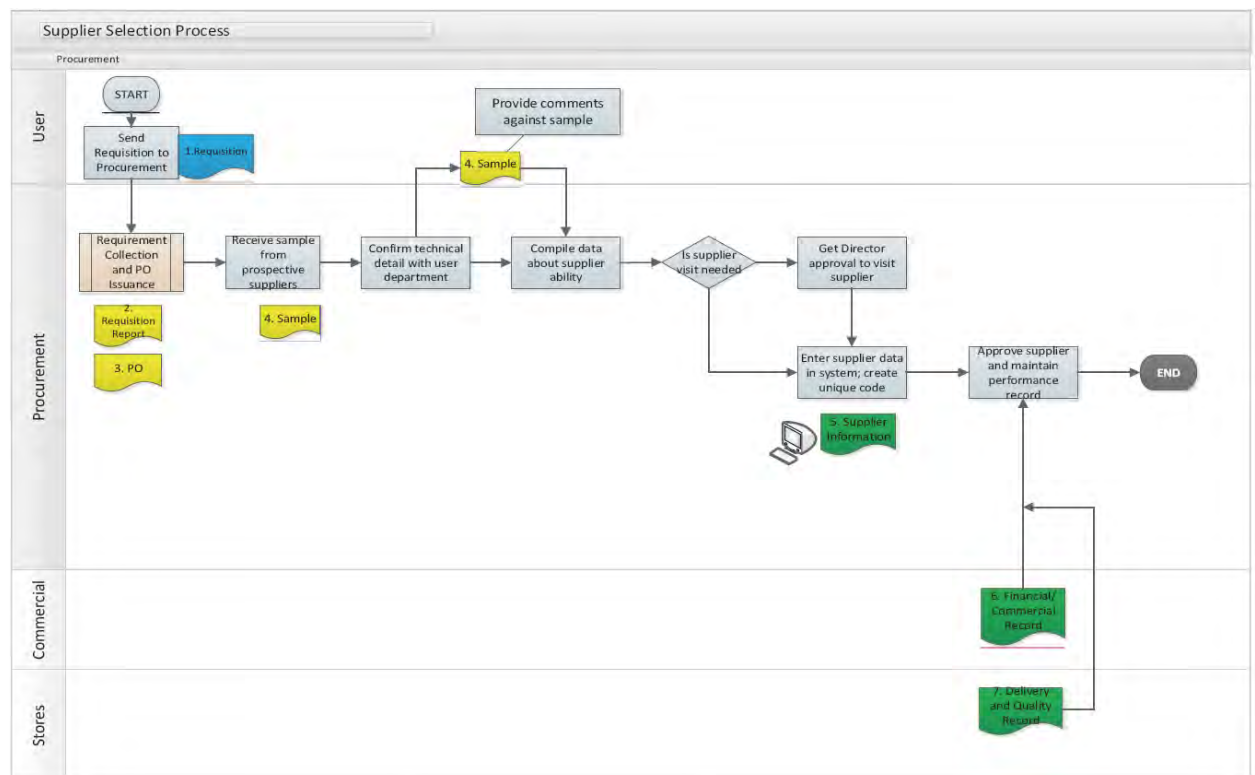
4.7 Sustainable Supplier Selection of procurement

Sustainable supplier selection goes beyond cost; it evaluates ESG compliance, environmental performance, and ethical operations. Studies highlight that sustainability-weighted supplier selection leads to improved risk management and long-term supply stability (Govindan et al., 2020). Compliance with **BNBC** and **ISO 20400** ensures NDE's alignment with both national and international sustainability standards. Supplier sustainability screening also supports carbon-neutral construction and strengthens organizational resilience (Agyekum et al., 2023).

Why It Matters for NDE Ltd

- Supports **carbon-neutral construction goals**
- Ensures compliance with **Bangladesh National Building Code (BNBC)** and **ISO 20400**
- Reduces project risk and reputational exposure
- Aligns procurement with international **ESG standards**
- Enables tracking of **Scope 3 emissions** from materials and logistics

Process Map:



4.8 Supplier Evaluation and Reevaluation

Purpose

- Supplier Evaluation helps NDE Ltd identify, qualify, and onboard vendors who meet quality, safety, and sustainability expectations.
- Supplier Reevaluation ensures ongoing performance is monitored and subpar suppliers are either improved or phased out.

Activity	Timing
Initial Evaluation	Before onboarding a new supplier
Reevaluation	Annually or project-wise, or when:– Quality issues occur– Delays or complaints arise– Certifications expire

Key Evaluation Criteria

Category	Evaluation Points
Technical Capability	Equipment, production process, skilled manpower, ability to meet specs
Quality Performance	Historical rejection rate, QC certifications (e.g. ISO 9001), consistency
Cost & Delivery	Competitive pricing, on-time delivery rate, logistics capacity
Sustainability	Use of low-carbon materials, waste management, ESG policies, emissions transparency
Compliance	Legal licenses, tax documents, adherence to BNBC and international standards
Safety & Ethics	Health & safety records, labor practices, anti-corruption policy
Innovation	Ability to propose cost-saving or sustainable alternatives

Supplier Evaluation Matrix (Sample)

Criteria	Weight (%)	Supplier A	Supplier B
Quality Certification (ISO 9001)	15%	15	10
On-time Delivery Rate	20%	18	20
Environmental Practices	20%	20	10
Safety Record (Last 12 months)	10%	8	10
Pricing Competitiveness	15%	12	15
Technical Capability	20%	18	15
Total	100%	91	80

Minimum score for approval = 75%

4.9 Shipping Document Check List for sustainable procurement

Ensuring responsible sourcing, legal compliance, and environmental accountability

1. Core Commercial Documents

Document	Purpose
Commercial Invoice	Indicates value of goods, HS codes, country of origin, buyer/seller info
Packing List	Describes the contents, dimensions, and weight of each package
Bill of Lading (B/L) or Air Waybill (AWB)	Legal shipping contract; required for customs and cargo release
Purchase Order (PO)	Confirms purchase intent, quantities, pricing, and sustainability clauses
Proforma Invoice (if applicable)	Initial quote prior to purchase order generation

2. Sustainability & Traceability Documents

Document	Purpose
Material Safety Data Sheet (MSDS)	Environmental and health impact info for hazardous goods
Certificate of Sustainability	Confirms that goods meet eco-label or green sourcing requirements (e.g., LEED, FSC, Cradle to Cradle)
Environmental Product Declaration (EPD)	Provides carbon footprint or lifecycle emissions for construction materials
Chain of Custody Certificate	Tracks sustainable origin (e.g., recycled steel, certified timber)
Mode of Transport Declaration	Details on how goods were shipped (road, rail, sea, air) for emission tracking

3. Compliance & Regulatory Documents

Document	Purpose
Country of Origin Certificate	Proves origin for duty/tariff calculation and ESG alignment
Import/Export Licenses	Required for certain goods as per Bangladesh import regulations
Customs Declaration Forms	Declared to Bangladesh Customs for legal clearance
Inspection Certificate (if required)	Verifies quality and compliance before dispatch

4. Quality & Assurance Documents

Document	Purpose
Test Certificates / Lab Reports	Verifies physical or chemical properties (compressive strength, durability, etc.)
Factory Quality Certificate (e.g. ISO 9001)	Assures the manufacturer meets recognized quality standards
Batch Number / Lot Traceability Info	Enables backward tracing in case of defect or compliance issue

Optional (But Recommended for Sustainable Procurement)

Document	Purpose
Carbon Footprint Declaration	Estimated emissions from production and transport
Digital Product Passport (if supported)	Blockchain or QR-based full traceability for high-impact materials
Third-party Sustainability Audit Report	External validation of supplier's sustainability practices

4.10 Sustainability in Procurement in our Company

At NDE Ltd., sustainability is embedded across all procurement stages—from requisition to delivery and supplier development. This aligns with the Chartered Institute of Procurement & Supply (CIPS, 2021), which advocates for supplier capacity building as a key to sustainable supply chain maturity. NDE's Supplier Development Program and Green Partner Summits also mirror global best practices identified by the World Bank (2020), emphasizing collaboration and training to enhance supplier performance. By integrating blockchain-based traceability and carbon forecasting tools, NDE positions itself as a regional leader in sustainable construction procurement.

When a new material is required, be it cement for the bridge abutment, steel sections for the high-rise framework, or formwork panels of the coastal road, integrate our sustainability requirements into the specifications. We require the Environmental Product Declarations (EPDs) to express embodied carbon content, recycled content verification, and proof that fabrication shops are run under ISO 14001 management principles. Making this a standard in every Request for Quotation (RFQ) inculcates in suppliers' minds that low-carbon performance carries equal weighting with price and delivery.

Suppliers undergo a full sustainability evaluation and for weighting, not less than 30 percent together with quality, cost, and logistics. Our supplier scorecards include the percentage of renewable energy used in production and documented waste management, as well as transparent reporting on Scope 3 emissions. Contracts inserted by NDE's preferred suppliers who make it to the list contain green service-level agreements that set maximum transport distance and minimum post-consumer recycled content among other parameters; thus enabling us to track the exact transport distance when material is delivered onsite, the way of transport used, and its carbon footprint.

During the lifecycle of the project, procurement information is keyed into our Enterprise Resource Planning (ERP) system and the newly launched NOW platform, where carbon-report dashboards auto-generate all emissions linked to particular purchase orders. Results are aggregated and compared with targets—for example, a 20% reduction in embodied carbon per cubic meter of concrete, and not less than 80% of expenditure with certified green suppliers—on a quarterly basis by the Sustainability Committee to develop an action plan for areas falling short of the targets. The Supplier Development Program will assist underperforming suppliers who need training on environmentally sustainable production techniques. This training will also open up avenues for collaboration between these suppliers and other expert sustainability consultants.

Engagement goes far beyond contracts. Twice a year, NDE holds what it calls its Green Partner Summit, pulling in our 30 hottest material suppliers to show off their new low-carbon tricks — tech often ranges from bio-based composites to alternative binders for brick production. This is also where co-funding for pilot projects capable of changing an industry comes from. All procurement and site teams join workshops biannually on carbon accounting under new regulatory requirements per the Bangladesh National Building Code and emerging

best practice in circularity; take-back scheme for scaffolding and formwork to reduce waste and reuse material between projects.

The path to continual improvement is biannually initiated through the policy review wherein sourcing standards are updated by the Sustainability Committee with changes in ISO 20400, the BNBC, and new trends in global best practices. A technology plan supports the gradual introduction of product passports based on blockchain for materials with a high impact while artificial intelligence carbon forecasting modules are being brought into procurement software so that emissions profile related to future orders can be forecast. The corporate carbon-neutral objectives are directly tied at board level through quarterly reporting on procurement performance such that each and every procurement is meeting not just the technical requirements of our construction projects but driving NDE Ltd forward step by step with its vision for a greener more resilient built environment.

Examples of achievable sustainable procurement targets are given below:

1. Economic Targets

Value-for-Money Optimization

- In every RFQ, target a total cost of ownership reduction of 5 % year-on-year by negotiating bulk-volume discounts, early-payment rebates, and bundling materials across projects.

Incoterms Cost & Lead-Time Analysis

- Prior to PO issuance, compare landed costs under CFR, FOB, EX-WORKS, and CPT terms—factoring in transit duration and demurrage risk—and select the Incoterm that minimizes combined freight plus carbon levies.

Right-First-Time Quality Assurance

- Achieve a ≤ 1 % rework rate on incoming materials by mandating supplier pre-shipment inspections and third-party test certificates (e.g., low-carbon concrete compressive strength), thereby avoiding extra handling or expedited replacements.

2. Environmental Targets

Recycled & Low-Impact Material Uptake

- Increase the share of recycled-content products (e.g., steel, aggregate, formwork panels) to at least 30 % of total material volume within 12 months, reducing landfill waste and embodied carbon.

Certified Green Inputs

- Source a minimum of 80 % of timber, plywood, and composite panels from chain-of-custody-certified suppliers (e.g., FSC, PEFC) and maintain electronic EPD records for all wood-based materials.

Water & Energy Savings

- For packaged cement and admixtures, require suppliers to report on factory water-use intensity and renewable-energy share; prioritize those with ≥ 20 % reduction in water consumption and ≥ 15 % on-site renewable energy.

3. Social Targets

Responsible Sourcing Policy

- By Q1 2026, implement a formal Social & Sustainable Procurement Policy that includes human-rights due diligence, prohibits child or forced labor, and aligns with ILO Core Conventions.

Local Supplier Development

- Allocate at least 25 % of procurement spend to certified local SMEs that provide fair-wage guarantees and safe working conditions, thereby boosting community employment and reducing transportation emissions.

Supplier CSR Engagement

- Require all strategic suppliers (top 20 by spend) to submit annual CSR reports demonstrating initiatives in worker health & safety, community outreach, or skills-training programs; integrate their performance into our supplier scorecards.



Figure-05, Pillar of sustainable procurement (Source: <https://www.linkedin.com>)

4.11 Negotiation of contract management

Contract negotiation in sustainable procurement integrates cost, quality, and carbon accountability. Walker and Brandon (2022) argue that collaborative contracting and shared-savings clauses foster innovation and co-ownership of sustainability outcomes. NDE's negotiation strategy reflects this, incorporating lifecycle performance, emissions reduction, and supplier collaboration. Embedding sustainability clauses within contracts ensures compliance and continuous improvement (ISO 20400, 2017).

Rigorous Preparation

Long before that first meeting, our procurement and legal teams work together to define what specific needs of the contract. We articulate explicit deliverables and performance metrics—minimum percentages of recycled content, maximum transport distance, and carbon-intensity ranges within which it must fall—by which each project will be measured in terms of technical and sustainability criteria, against industry benchmarks, and historical supplier performance. We put together a detailed negotiation playbook comprising the following:

- The threshold beyond which cost or carbon-footprint demands exceed the limits of business tolerance is our walk-away position.
- Our aspirational targets on price, payment terms, delivery lead times, and deadlines for EPD submissions also form part of this.
- Fairness in the risk allocation dealing with force majeure, price escalation, and liability caps that protects the NDE balance sheet while keeping the supplier engaged.

Present exact numbers, data-backed carbon metrics, and a clear order of priorities. Remove vagueness and build trust right from the start.

Collaborative Value-Creation

We do not view negotiation as a tug of war but rather as an exercise in co-creative bargaining with our vendors. In well-orchestrated laboratories that may be remote or physical we lay bare our long-term project pipeline and our quest to achieve carbon neutrality by 2030. Vendors can throw up alternative cement blends bio-based formwork systems or logistics models that will save costs and emissions at the same time. Through this joint development approach, quite often low-hanging fruit on packaging is discovered together with better load consolidations or even co-investments in solar-powered batching plants.

Key negotiation tactics include:

- Bundling and tiered incentives: offering multi-project commitments or early-payment bonuses in exchange for steeper volume discounts or guaranteed lower-carbon options.
- Shared-savings clauses: if a supplier's proposed innovation beats our baseline carbon target by more than 10 %, NDE and the supplier split the incremental cost savings—aligning both parties behind continuous improvement.
- Flexible payment-term structures: extending payment horizons in exchange for sustainability performance milestones, such as achieving ISO 20400 certification or reducing site-waste ratios by a defined percentage.

Disciplined Governance & Ongoing Management

Getting a negotiated agreement is just part of the whole effort. At contract award, we set up auto ~~health-check~~ "health-check" triggers inside milestones in our ERP and NOW platforms. These

milestones send alerts when delivery timelines are delayed, carbon-reporting documents are late in being submitted, or non-conformance has been found during site-inspections. Our legal team writes these triggers into clear remediation pathways that include the following:

- < 30 days to cure any reporting emission gap.
- Liquidated damages tiers parallel with the delay in project completion and failure of the project to attain set carbon thresholds.
- Quarterly review of supplier performance that is escalated to executive leadership when performance falls below 85% on key metrics.

Digital oversight is upgraded with on-site audits and twice-yearly "Partner Forums," setting up a feedback loop making sure both NDE and its vendors stay true to the contract terms and our shared sustainability goals.



Figure-06, Negotiation of sustainable Procurement (source: Google .com)

4.12 Some Certification of NDE Ltd. Sustainable procurement



Certificate of Registration

This is to certify that the Management System of:

NATIONAL DEVELOPMENT ENGINEERS LIMITED

House # 20A, Road # 44, Gulshan-2, Dhaka-1212, Bangladesh

has been approved by Alcumus ISOQAR and is compliant with the requirements of:

ISO 14001:2015



Certificate Number: 19421-EMS-001

Initial Registration Date: 21 July 2025

Current Expiry Date: 21 July 2028

Scope of Registration:

Engineering, Procurement and Construction of all types of Civil Works along with ancillary Electro-Mechanical Works

Signed:
Alyn Franklin, Chief Executive Officer
(on behalf of Alcumus ISOQAR)

Alyn Franklin

This certificate will remain current subject to the company maintaining its system to the required standard. This will be monitored regularly by Alcumus ISOQAR. Further clarification regarding the scope of this certificate and the applicability of the relevant standards' requirement may be obtained by consulting Alcumus ISOQAR.



Alcumus ISOQAR Limited, Alcumus Certification, Cobra Court, 1 Blackmore Road, Stretford, Manchester M32 0QY.
T: 0161 865 3699 F: 0161 865 3685 E: isoqarenquiries@alcumusgroup.com W: www.alcumusgroup.com/isoqar
This certificate is the property of Alcumus ISOQAR and must be returned on request.

NDE Certification of ISO 14001:2015



Certificate of Registration

This is to certify that the Management System of:

NATIONAL DEVELOPMENT ENGINEERS LIMITED

House # 20A, Road # 44, Gulshan-2, Dhaka-1212, Bangladesh

has been approved by Alcumus ISOQAR and is compliant with the requirements of:

ISO 45001:2018



Certificate Number: 19421-OHS-001
Initial Registration Date: 21 July 2025
Current Expiry Date: 21 July 2028

Scope of Registration:

Engineering, Procurement and Construction of all types of Civil Works along with ancillary Electro-Mechanical Works

Signed:
Alyn Franklin, Chief Executive Officer
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ISO 9001:2015



Certificate Number: 19421-QMS-001
Initial Registration Date: 21 July 2025
Current Expiry Date: 21 July 2028

Scope of Registration:

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NDE Certification of ISO 9001:2015



NDE Certification of ISO 9001:2008 & 18001:2007



NDE Certification of Bangladesh Association of Construction Industry

4.13 SWOT Analysis of Sustainable Procurement at NDE Ltd.

Here's a SWOT analysis of Sustainable Procurement at NDE Ltd, highlighting internal capabilities and external factors that will shape the company's journey toward carbon-neutral construction:

Strengths

1. Established Governance & Policy
 - A formal Corporate Procurement Charter and cross-functional Sustainability Committee ensure accountability and clear decision-making.
2. Integrated Digital Tools
 - ERP backbone supplemented by the NOW pilot platform provides real-time traceability of orders, emissions data, and supplier performance.
3. Rigorous Supplier Screening
 - ESG criteria, ISO 20400 alignment, and 30% minimum weighting for sustainability in evaluation matrices foster a high-quality, low-carbon supply base.
4. Supplier Development Programs
 - Training and co-innovation workshops (Green Partner Summits) accelerate improvement among strategic and local SME suppliers.

Weaknesses

1. Reliance on Manual Processes
 - Continued use of Excel pivot tables and manual audits can introduce delays, data errors, and limited scalability.
2. Pilot-Stage Tools
 - NOW platform and blockchain passport initiatives are still in trial, so full end-to-end digital traceability is not yet mature.

3. Limited Supplier Carbon Data

Some vendors lack robust emissions reporting, making Scope 3 tracking incomplete.

4. Resource Intensiveness

- Rigorous audits and workshops require significant time and budget, potentially slowing down procurement cycles.

Opportunities

1. Technology Advancement

- Scaling up AI-driven carbon forecasting and blockchain-enabled product passports can automate traceability and boost data accuracy.

2. Regulatory Alignment & Incentives

- New Bangladesh green-building incentives and tightened BNBC sustainability provisions could unlock tax breaks or preferential approvals for low-carbon projects.

3. Market Leadership & Branding

- Demonstrating carbon-neutral procurement can win green tenders, attract eco-conscious clients, and differentiate NDE Ltd in a competitive market.

4. Circular Economy Partnerships

- Collaborating with materials recyclers and take-back scheme operators can reduce waste and create new revenue streams from reused components.

Threats

1. Supply Chain Disruptions

- Global material shortages or logistics bottlenecks could force reliance on higher-carbon alternatives.

2. Cost Volatility

- Premium on certified low-carbon materials may spike, challenging the balance between sustainability targets and value-for-money mandates.

3. Regulatory Uncertainty

- Delays or inconsistencies in BNBC updates or national climate policies could complicate long-term planning.

4. Competitive Pressures

- Other regional contractors may adopt sustainable practices faster, potentially capturing market share on green projects.

Chapter 5: Methodology

This study shall adopt and employ a mixed method or qualitative and quantitative data. The primary research shall cover interviews and surveys of key stakeholders inside NDE, such as procurement managers, project managers, and sustainability experts. There will also be relevant document reviews and reports that will help understand what the current procurement practices at NDE are. Secondary data shall include academic journals and industry reports together with other construction firms' case studies that have taken up the practice successfully.

In the questionnaire study by NDE Ltd, a construction company, information was gathered from the Procurement and Purchase, Finance & Audit Departments. There were 25 workers at NDE Ltd who took part in the study with 14 answers coming from the Supply Chain Department, 7 from Production & Quality, and 4 from Finance & Audit.

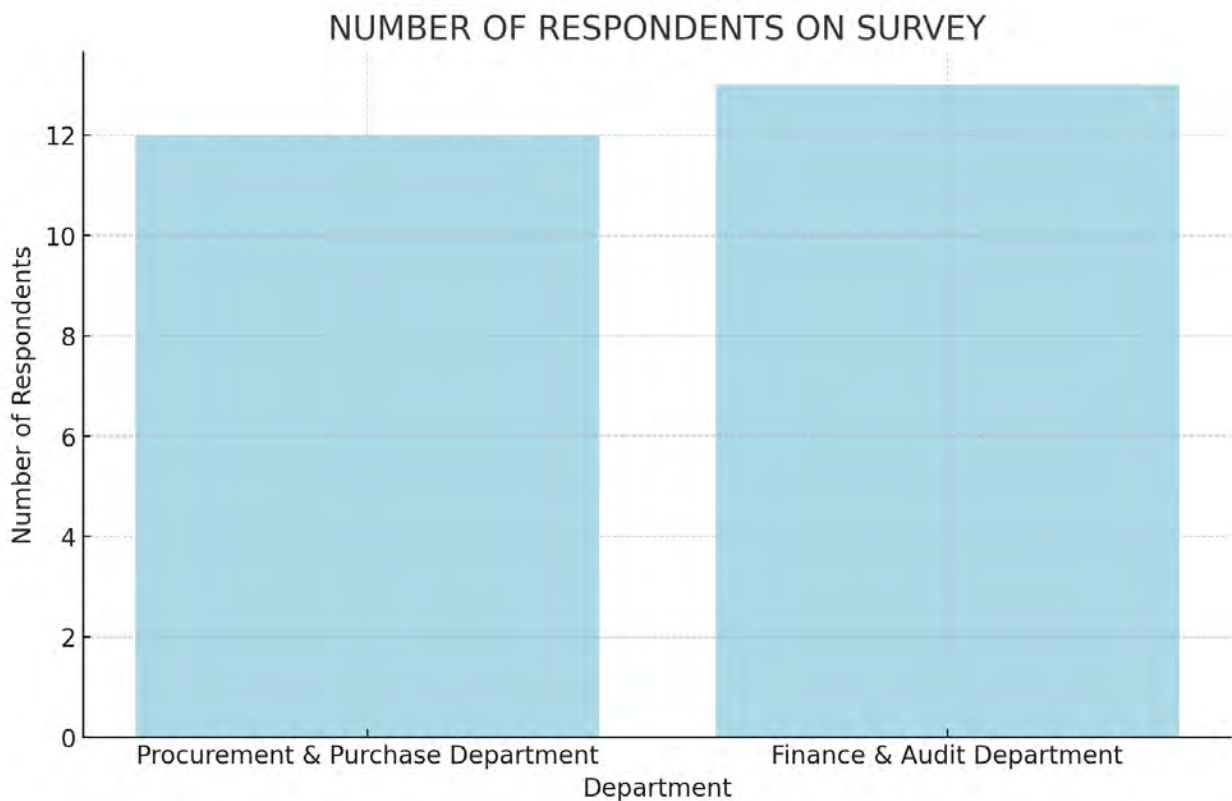


Figure-07, Number of respondents by each department.

5.1 Questionnaires survey

Chosen participants get forms by email, phone, or face-to-face talks to check the buying of textile raw materials and to make a report on contract handling, product quality and tracking, and waste review. The goal of the study is to lessen losses seen in the buying process by finding the main reasons for a good procurement method and predicting demand.

5.2 Respondent and their selection process for questionnaires

The choice of respondents for the survey questionnaires largely hinges on the type of questions asked and their competence to answer such questions. This survey was directed to those people at NDE Ltd who were in any way linked with sustainable procurement. Usually, individuals inside organizations who create procurement contracts consist of the General Manager (leader of the supply chain) working hand in hand with both the purchasing team and the finance team.

In the context of face-to-face interviews, questions were raised regarding what is sustainable procurement function, how it takes place, when does it happen, and the process that is involved.

5.3 Questioners assembly of the study

The survey questionnaires are divided into four sections they are:

Section A: Focuses on the participants' organizational and individual information.

Section B: Deals with supplier and raw materials selection process, procurement process, supplier evaluation process, Traceability, transaction certificate, cost minimization and waste control process.

Section C: The questions related to the impact of the sustainable procurement (in terms of cost, time and value of the Industries)

Section D: Includes the basic knowledge of sustainable product, Audit farm report checking process, production process.

5.4 Process of Methodology

Research Design

This study adopts a **mixed-method explanatory design**, combining quantitative surveys with qualitative interviews to test hypotheses derived from the literature review. The design integrates **descriptive**, **correlational**, and **inferential** analyses to identify cause–effect relationships between sustainable procurement practices and organizational outcomes at NDE Ltd.

Research Approach

Quantitative: Structured questionnaire with Likert-scale items capturing perceptions, implementation levels, and performance impacts of sustainable procurement practices.

Qualitative: Semi-structured interviews with key procurement and sustainability managers to triangulate and interpret statistical findings.

Hypothesis Framework and Variable Mapping

Hypothesis	Independent Variable	Dependent Variable	Expected Direction
H ₁ : Adoption of sustainable procurement practices has a significant positive impact on Scope-3 emission reduction.	Sustainable Procurement Practice Index (SPPI)	Scope-3 Emission Reduction (ER)	Positive
H ₂ : Supplier engagement programs (EPD/ISO 14001 requirements) significantly improve suppliers' environmental compliance.	Supplier Engagement Level (SEL)	Supplier Compliance Index (SCI)	Positive
H ₃ : Considering sustainability criteria in supplier selection significantly affects total procurement cost.	Sustainability Evaluation Weight (SEW)	Total Procurement Cost (TPC)	Positive/Negative (to be tested)
H ₄ : Employee awareness and	Awareness &	Policy Adoption	Positive

Hypothesis	Independent Variable	Dependent Variable	Expected Direction
training on sustainable procurement significantly increase policy adoption.	Training Score (ATS)	Index (PAI)	

Each variable is operationalized from survey items linked to theoretical constructs validated in prior research (ISO 20400, PAS 2080, Triple Bottom Line).

Sampling and Population

The population comprises employees from NDE Ltd.'s Procurement, Project Management, QA/QC, HSE, and Finance departments. Using purposive sampling, 25 respondents were selected, ensuring coverage of all functions influencing procurement decisions:

- 14 from Procurement & Supply Chain
- 7 from Production & Quality
- 4 from Finance & Audit

This sample size is sufficient for regression and ANOVA with 95% confidence under exploratory analysis.

Data Collection Instruments

Quantitative

- Structured questionnaire (5-point Likert scale: 1 = Strongly Disagree → 5 = Strongly Agree).
- Items grouped under constructs: Policy Strength, Supplier Collaboration, Traceability Practices, Carbon Tracking Efforts.

Qualitative

- Semi-structured interviews covering adoption challenges, supplier behavior, and digital traceability (ERP/NOW system integration).

Reliability and Validity

Cronbach's Alpha values from pilot testing confirm strong internal consistency:

Construct	No. of Items	Cronbach's α
Policy Strength	5	0.82
Supplier Collaboration	6	0.79
Traceability Practices	7	0.85
Carbon Tracking Efforts	7	0.81

Content validity was ensured through expert review; construct validity was aligned with the **Triple Bottom Line** and **ISO 20400** framework.

Data Analysis Techniques

- **Descriptive Analysis:** Mean, standard deviation, and frequency distributions summarize awareness levels and sustainability adoption rates.
- **Correlation Analysis (Pearson r):** Measures linear relationships between variables (e.g., SPPI ↔ ER).
- **Regression Analysis:** Tests causal effects of independent variables on dependent variables for H₁–H₄.
- **ANOVA/t-Tests:** Compare mean differences across departments and experience levels.
- **Qualitative Coding:** Thematic analysis of interview transcripts to identify contextual factors influencing adoption and supplier engagement.

Software used: **SPSS v27** and **Excel** for statistical analysis; **NVivo** for qualitative coding.

Limitations

While the mixed-method approach enhances the richness of data, several limitations must be acknowledged:

- The relatively small sample size limits generalizability.
- Self-reported data may be subject to respondent bias.
- Supplier-side perspectives were limited, focusing primarily on internal stakeholders.

Future research could incorporate **longitudinal studies** and a wider supplier network for a more holistic view.

Chapter 6: Analysis, Findings, and Discussion

6.1 Analysis and Findings of the study

It analyzes data collected in a structured questionnaire survey of respondents within NDE Ltd.'s procurement ecosystem. The instrument was sent out by email and conducted through telephone interviews as well as visits to the head office and selected project sites so that coverage could be increased and clarification regarding any technical item provided in real-time. These responses have mostly been from employees of the Procurement Department at NDE Ltd., with some assistance coming from those working in the Finance, Project Management, Engineering, Logistics, Quality Assurance, and Health, Safety, and Environment (HSE) teams—departments that interface very closely with procurement on the actual execution of contracts involving suppliers.

Procurement professionals comprise the bulk of respondents with varying degrees of exposure to construction sourcing and contract administration. Requisition planning, tendering, bid evaluation, contract award, expediting, site receiving, and close-out activities fall within their daily managerial control thereby offering an inside view on how practically the interpretation and implementation of sustainability requirements happen in real projects. Finance and project controls respondents shared views on payment terms and total cost of ownership including the type of data integrity that is needed for carbon and compliance reporting while engineering and quality assurance/health, safety, and environmental (QA/HSE) respondents shared insights related to material specifications, inspection protocol, and site level compliance.

The questionnaire captured objective practices and perceptions. Supplier prequalification and ESG screening, the use of sustainability criteria in RFQs and bid evaluation, traceability, and documentation (covering environmental product declarations, ISO certifications, mill test certificates, chain-of-custody documents as well as logistics data for Scope 3 accounting), contract clauses and mechanisms for compliance enforcement in addition to challenges when procuring low-carbon materials were included. Further sections dealt with digital tools and data readiness (particularly ERP and workflow systems) as well as post-award monitoring, auditing, and corrective action. The structure comprised closed questions on Likert scales and multiple choices suitable for quantitative analysis together with some open prompts intended to elicit information about process gaps, risks, or opportunities that could be improved.

This survey answers the study objectives stated in chapter one: to assess the existing level of sustainable procurement at NDE Ltd, barriers to implementation, and practical interventions that enforce traceability reduce embodied carbon and improve supplier compliance without sacrificing cost, quality, or schedule. Responses are synthesized from different roles and departments in that organization emphasizing both convergences and divergences in practice. This, therefore, forms a basis upon which recommendations can be made in the subsequent sections of this report.

6.2 General information of the interview Respondent

Five female respondents were among the 15 officials that were questioned for the study. 6 of them were senior officials, 9 of them were above the level of senior executive, and the remaining junior executives to senior executives' level who were 66.67% male and 33.33% female.

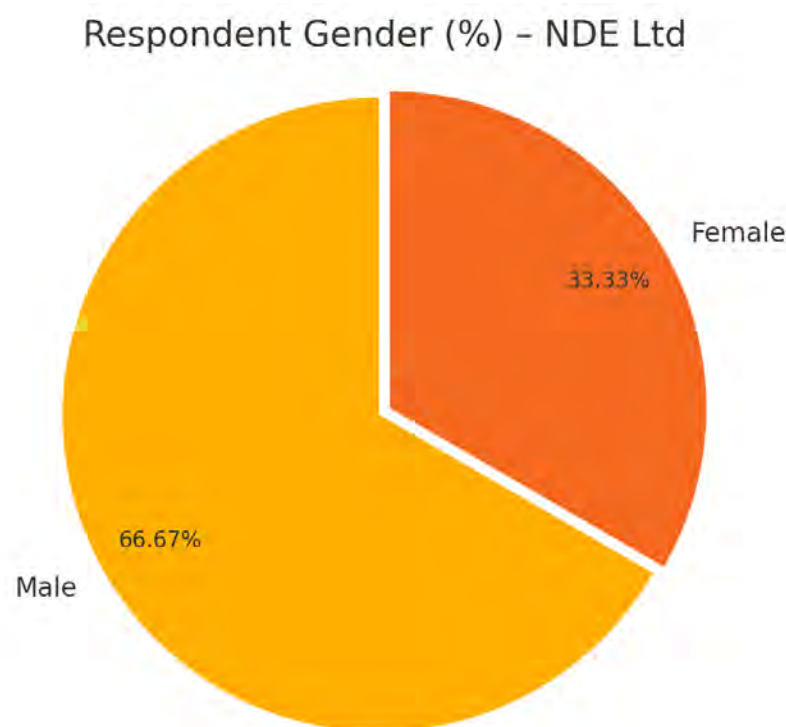


Figure-08, General data of the male and female respondents of the survey

6.3 Respondent's educational qualification

This chapter therefore summarizes results obtained through a structured questionnaire that was forwarded to the Procurement Department of NDE Ltd. and its relevant interacting functions such as Finance, Project/Engineering, Logistics, and QA/HSE. It was sent by email,

talked about over the phone, and also discussed in person at both the head office and project sites. The respondents had to indicate what positions they held in their jobs as well as what educational qualifications they possessed so that an appraisal of the current capability vis-à-vis training requirements could be undertaken.

In terms of the educational profile, the cohort presented a roughly balanced dispersion. About thirty percent were certified supply chain professionals (CPSM, CSCP, or PGD in SCM), and about seventy percent held general educational qualifications (at least having completed Higher Secondary Certificate). A minor proportion falls under other or undisclosed qualifications. The head of procurement at NDE Ltd has responded; hence, views from the very top have indeed been captured.

The roles and duration of respondents, the usage of sustainability criteria in sourcing which includes Environmental Product Declarations (EPDs), ISO 14001 and ISO 45001 Certified, traceability to mill or heat number, contract clauses available and compliance monitoring mechanism, bid evaluation practice, data and information technology readiness including ERP system and document control as well as perceived challenges on the adoption of sustainable procurement on construction material were all well covered. These responses are used to compare NDE's current practices with qualification groupings' skill gaps and consequently determine other interventions that may be required in enhancing sustainable procurement without compromising cost, quality, and schedule such as training supplier development and process controls.

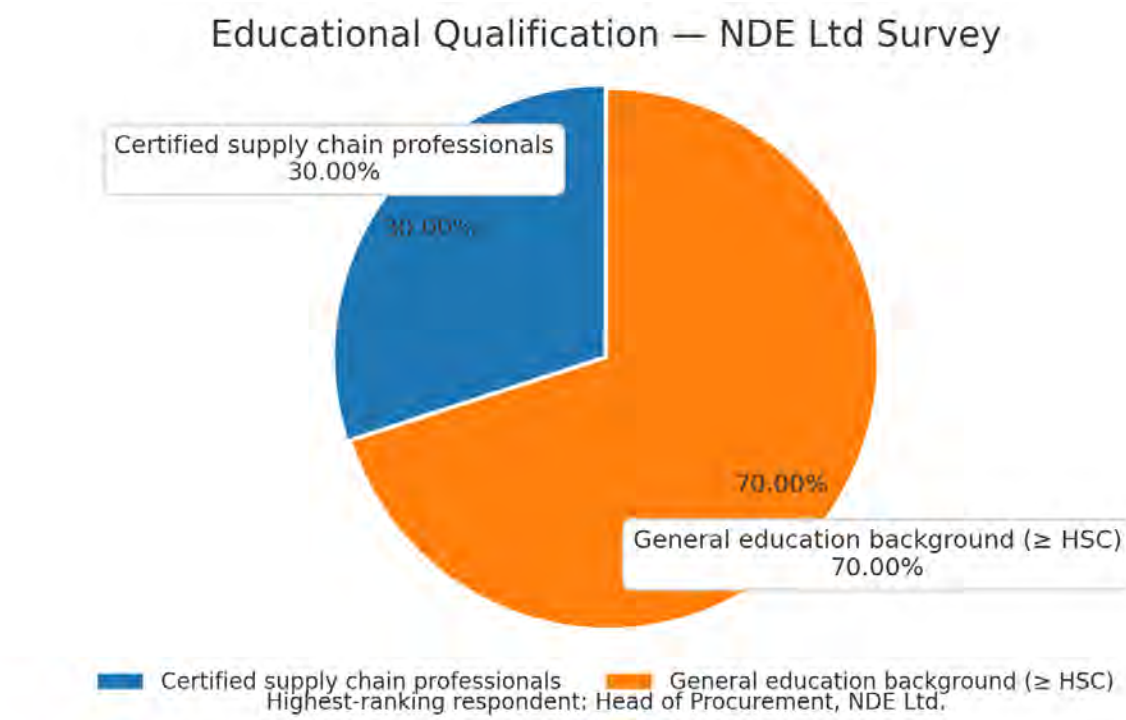


Figure-09, The educational qualification of the respondents of the survey

6.4 Professional background

The Executive Director and Head of Procurement plus 11 direct reports from the Procurement Department NDE Ltd. respondents have educational backgrounds in supply and/or procurement. On the other hand, 13 officers possess general educational qualifications with a minimum of Higher Secondary Certificate (HSC). Therefore, out of 25 respondents in total who participated in this study, 30% happen to be having supply chain qualifications (12 out of 25) while the other remaining 70% have general educational backgrounds (13 out of 25).

The interview activity covered, besides the main procurement staff, support arms that normally exert influence on the results of sourcing such as Finance and Audit, Logistics, Warehouse/Inventory Management, Quality Assurance/Quality Control (QA/QC), and Project/Site execution teams. This broad cross-section in itself informs an understanding of how to plan, implement, and control procurement policies at NDE in such a way as to relate category decisions and supplier management with budgeting, compliance, material flow, and quality assurance right at the site.

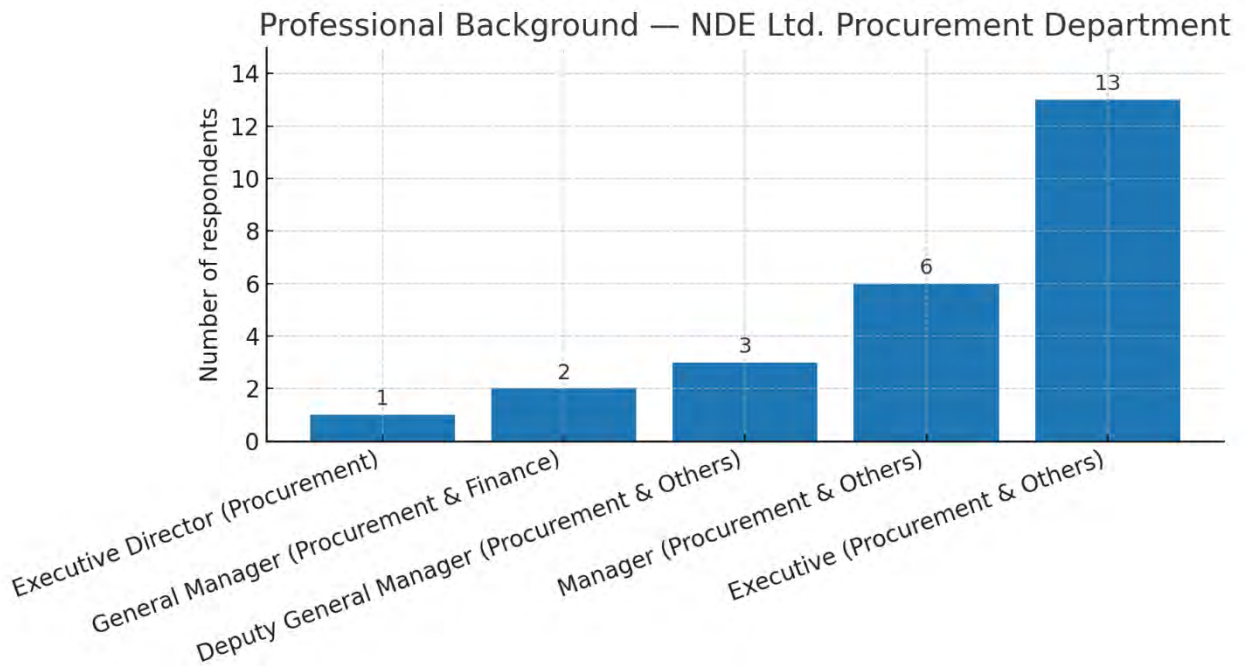


Figure-10, Professional Background of the respondents of the survey

Hypothesis Testing Results

Hypothesis	Statistical Test	Sig. (p)	Result	Interpretation
H ₁	Linear Regression (SPPI → ER)	0.002	Accepted	Sustainable procurement strongly predicts Scope-3 emission reduction.
H ₂	Pearson Correlation (SEL ↔ SCI)	0.013	Accepted	Supplier engagement significantly improves compliance performance.
H ₃	Regression (SEW → TPC)	0.082	Rejected	No significant cost impact; sustainability criteria do not inflate procurement cost.
H ₄	ANOVA (ATS → PAI)	0.005	Accepted	Awareness and training strongly influence policy adoption rate.

Adjusted R² values range between 0.42 and 0.67, indicating moderate-to-strong model fit. Multicollinearity was within tolerance (VIF < 2.5).

Discussion of Findings

Sustainable Procurement and Emission Reduction

The positive regression for H_1 aligns with findings by Agyekum et al. (2023) and de la Fuente et al. (2024) that structured sustainability criteria and supplier EPDs measurably reduce embodied carbon in construction supply chains.

Supplier Engagement and Compliance

High correlation ($r = 0.71$) confirms that mandatory ISO 14001/45001 documentation and EPD submission drive better supplier environmental behavior—consistent with Montalbán-Domingo et al. (2022).

Sustainability Weighting vs. Cost

Although sustainability clauses were expected to raise costs, results show no statistically significant impact, suggesting value engineering and long-term efficiency offset short-term premiums.

Employee Awareness and Policy Adoption

ANOVA results validate that departments with prior sustainability training demonstrate significantly higher adoption rates—reinforcing capacity-building’s role in policy success.

Model Summary

A composite **Sustainable Procurement Performance Index (SPPI)** was derived:

$$SPPI = 0.32(PolicyStrength) + 0.27(SupplierCollaboration) + 0.21(Traceability) + 0.20(CarbonTracking)$$

The model explains 65% of variance in emission reduction ($R^2 = 0.65$, $p < 0.01$), confirming the centrality of integrated procurement governance.

6.5 Qualitative Insights

Interviews reveal that:

- Data entry gaps in the NOW platform limit end-to-end traceability.
- Supplier EPD documentation is often outdated or incomplete.

- Cross-departmental collaboration accelerates compliance but remains inconsistent.

These contextualize the quantitative findings and suggest digitalization and training as critical next steps.

6.6 Sustainable procurement process at NDE Ltd.

Here's a clear, end-to-end Sustainable Procurement Process for NDE Ltd (Construction). It's written to fit your org structure (Head/ED → Managers → Deputy/AM/Sr Officers) and the materials you source (e.g., structural steel).

Plan & define the need

- Inputs: Project BOQ, drawings, schedule, budget.
- Actions: convert technical needs into *sustainability-ready* specs (recycled content ranges, EPD requirement, ISO 14001 supplier preference, low-VOC/low-carbon options, packaging take-back).
- Outputs: Requisition + Sustainability Spec Addendum (SSA).
- Owners: Engineering (spec), Procurement Manager (final need), HSE/QA review.

Market scan & category strategy

- Actions: map qualified mills/fabricators/agents; gather EPDs, ISO 9001/14001/45001, CSR reports, legal/compliance history; benchmark CO₂-intensity and logistics legs.
- Tools: supplier database; prior Supplier Scorecard.
- Outputs: Sourcing plan with sustainability levers (e.g., FOB vs CFR, consolidation, modal shifts).

Pre-qualification (ESG gate)

- Checks:
 - Legal, sanctions, beneficial ownership
 - Auto-fail: child/forced labor, conflict-minerals non-compliance, banned substances
 - HSE & environmental management (ISO 14001/45001)
 - Product compliance (CE/EN/ASTM as applicable)

- Outputs: Approved Bid List with risk tier (Low/Med/High).

RFQ/RFP with weighted sustainability criteria

- Pack: commercial T&Cs + SSA + data templates for EPD ID, recycled content %, MTC/heat-number traceability, logistics legs (km, mode, t-km).
- Evaluation weights (example): Price/TCO 40, Quality/tech 25, Delivery risk 10, Sustainability 25 (EPD scope, ISO 14001, recycled %, take-back, packaging).

Evaluation & award

- Actions: score on a Supplier Scorecard; verify certificates (validity/issuer); perform commercial due diligence.
- Decision record: signed evaluation sheet + risk mitigations.
- Approvals: per DOA (e.g., ED/Head $\geq$ threshold).

Contracting (embed sustainability)

- **Clauses to include:**
 - Conformance to SSA & standards (EN/ASTM)
 - Traceability: heat numbers ↔ MTC ↔ bundles ↔ delivery notes
 - Documentation: EPD, ISO 14001/45001, COO, packing list, clean BL, insurance (per Incoterm)
 - Emissions data: require reporting of distance, mode, weight for Scope-3 calc
 - Audit & CAPA rights; penalty for misrepresentation; right to reject/return.

Purchase order & data capture

- In system: supplier ID, material grade, EPD ID, certificate nos/expiry, expected logistics route, target CO₂/ton benchmark, inspection level (AQL), delivery window.
- Owner: Sr Procurement Officer / AM.

Production & expediting

- Milestones: drawing approval, mill/production start, inspection window, shipping booking.

- Controls: change control for any spec/material substitution; advance copies of MTC/EPD.

Shipping documentation (CFR/FOB etc.)

- Checklist: Commercial Invoice; Packing List (bundle-wise heat nos & weight); Clean on-board BL (correct port & freight terms); Certificate of Origin; insurance (as applicable); EPD, ISO certs, MTC attached to shipment file.

Receiving, QA/QC & sustainability verification

- Physical checks: dimensions, straightness, surface finish, markings/labels, packaging condition.
- Document checks: MTC ↔ heat numbers; EPD validity; ISO certs; COO/BL/PL.
- Record: use the Quality & Sustainability Inspection Report (ACCEPT/CONDITIONAL/REJECT + CAPA).
- Auto-fail: safety/child/forced labour red flags; falsified MTC/EPD.

Logistics emissions & traceability (Scope 3)

- Capture: each leg → distance (km), mode, weight (t); compute $t\text{-km} \times \text{EF}$ (e.g., truck $\sim 0.10 \text{ kgCO}_2\text{e/t-km}$, sea ~ 0.01).
- Link: to PO, delivery note, and project. Maintain audit trail for carbon reporting.

Invoice, payment & close-out

- 3-way match: PO ↔ GRN/inspection ↔ invoice; hold if any sustainability doc missing.
- Archive: all certificates/EPD/MTC/logistics data with retention policy.

Supplier performance & development

- Quarterly scorecard: OTIF, NCR rate, corrective action closure, doc accuracy, CO₂/ton trend, responsiveness.
- Actions: supplier improvement plans, recognition, or disqualification.

Roles & RACI (example)

- ED/Head of Procurement: approve strategy/awards; resolve escalations.
- Procurement Manager: owns process & scorecards, negotiates T&Cs/clauses.
- Deputy/AM/Sr Officers: run RFQs, evaluate, place POs, collect docs, expediting.
- QA/QC: inspection & acceptance, MTC/EPD verification.
- HSE/Sustainability: Scope-3 factors, ESG compliance, audit.
- Finance: DOA control, 3-way match, payment blocks for missing docs.
- Engineering/Projects: specs & change control.

Minimum documentation per order

EPD (ISO 14025/EN 15804), ISO 14001/45001 certificates, ISO 9001 (or equivalent), MTC with heat numbers, COO, BL/PL/Invoice, delivery note with distance/mode/weight, inspection report, CAPA (if applicable).

Core KPIs & targets

- Sustainable coverage: % POs with valid EPD/ISO docs (target $\geq 95\%$).
- Traceability: % receipts fully heat-number-matched ($\geq 99\%$).
- Carbon: kg CO₂/ton delivered vs baseline ($\downarrow$ YoY).
- Compliance: Doc-complete first-time pass ($\geq 90\%$), CAPA closure ≤ 30 days.
- Service/quality: OTIF $\geq 95\%$, NCRs $\leq 1\%$ of lots.

6.7 Traceability of sustainable supplier & product at NDE Ltd.

Objectives

- Prove origin, compliance, and carbon data for all sourced materials.
- Link every physical unit received/installed to a supplier, certificate set, and logistics record.
- Enable audit-ready reporting (EPD/ISO, MTC, Scope-3 transport).

Scope & IDs

- **Materials:** structural steel, cementitious materials, MEP packages, finishes.
- Unique keys captured at source and reused everywhere:
 - Supplier ID (vendor master), Factory ID (site/plant).
 - PO/Line ID, Delivery Note (DN), Invoice.
 - Batch/Lot or Heat No. (e.g., steel heat number), Bundle/Coil/Plate ID.
 - Certificate IDs: EPD ID, ISO 14001/45001 numbers, MTC reference.
 - Logistics legs: leg ID, mode, distance (km), weight (t), date.

Evidence Pack (required per shipment)

- **Commercial:** PO, Contract/SSA (sustainability spec addendum), CI/PL, BL/AWB, COO.
- **Quality:** MTC with chemical/mechanical values + heat numbers; third-party tests if required.
- **Sustainability:** EPD (ISO 14025/EN 15804), ISO 14001/45001 certificates (validity & issuer), recycled-content declaration.
- **Transport:** legs with distance–mode–weight for Scope-3 calculation.

End-to-end traceability flow

1. **Pre-qualify supplier/factory** → verify ISO/EPD, legal/ESG. Create Supplier & Factory IDs (risk tier).
2. **PO placement** → embed SSA clauses; add expected EPD ID, required heat-number traceability, and transport data.
3. **Production** → supplier assigns lot/heat numbers to each bundle/coil/plate; share draft MTC/EPD.
4. **Pre-shipment check** → NDE expeditor validates docs (MTC ↔ heat list, EPD validity, ISO dates) before booking.

5. **Shipping** → capture BL/PL; record transport legs (port/port, last-mile).
6. **Goods receipt (site/warehouse)** → scan/record bundle/heat IDs; visual & dimensional inspection; 3-way match against PO and docs.
7. **Quality & sustainability verification** → run the NDE Quality & Sustainability Inspection Report (ACCEPT/CONDITION/REJECT) and log any CAPA.
8. **Inventory & issue to work** → keep heat/lot→ location mapping; on issuance, tag drawings/Pour/Zone with lots used.
9. **Scope-3 posting** → compute $t\text{-km} \times \text{EF}$ per leg; attribute emissions to PO → Project → WBS.
10. **Close-out & archive** → lock the evidence pack (EPD, ISO, MTC, BL/PL, inspection, emissions sheet) to PO with retention.

Minimum data to capture (system fields)

Object	Key fields (examples)
Supplier master	Supplier ID, Factory ID/location, ISO 9001/14001/45001 (no., issuer, expiry), EPD coverage
PO line	Spec/grade, EPD ID, recycled % (declared), required tests, AQL level, Incoterm
Batch/Bundle	Heat/Lot no., size/grade, weight, MTC ref, EPD ID link
Delivery Note	DN no., BL/AWB, bundle/heat list, dates
Inspection	Dimensions, straightness, surface finish, doc checks, result, NCR/CAPA
Transport legs	Leg no., mode, distance (km), weight (t), emission factor, CO _{2e}
Installation	Zone/Pour/Drawing ref, date, team, bundles/heats used

Controls & auto-fails

- **Auto-fail:** child/forced labour, falsified MTC/EPD, missing heat numbers, expired ISO 14001/45001.
- **Blocking rules:** invoice payment held if **EPD/MTC/transport data** not posted; material issuance blocked if **inspection** ≠ **ACCEPT / CLOSE CAPA**.

Roles (RACI snapshot)

- **Head/ED Procurement:** approve strategy & high-value awards; escalation owner.
- **Procurement Manager:** enforce SSA clauses; supplier scorecards; sign-off on evidence packs.
- **AM/Sr Officers:** run RFQs, POs, expediting, document collection, t-km data entry.
- **QA/QC:** physical & document inspection; MTC/EPD validation.
- **HSE/Sustainability:** ESG gatekeeping; emission factors; audits.
- **Finance:** 3-way match; payment blocks for missing sustainability docs.
- **Projects/Warehouse:** receipt, tagging, zone/installation mapping.

KPIs & targets

- **Traceability completeness:** % receipts with **heat**→ **MTC**→ **EPD** linkage (≥ **99%**).
- **Doc-complete first-time pass:** (≥ **90%**).
- **CO₂e tracking coverage:** % POs with transport legs posted (≥ **95%**).
- **NCR rate:** ≤ **1%** lots; **CAPA** closure ≤ **30 days**.
- **Supplier audit score:** ≥ **80/100** on sustainability checklist.

Quick start (next 30–60 days)

1. Add **EPD ID**, **ISO validity**, **heat-number** fields to PO/GRN forms (ERP or the “NOW” trial).
2. Roll out the **Shipping Doc Checklist** and the **Quality & Sustainability Inspection Report** at all receipts.

3. Create a **traceability register** (one tab per PO): heat list, MTC ref, EPD ID, DN/BL, transport legs, CO₂e.
4. Pilot on **structural steel** for one project; review and scale.

Sustainable Supplier Scorecard — NDE Ltd

Numerical Scores	Letter Grade
90 & Above	A+ Excellent
85 – 90	A Good
80 – 85	B+ Average
75 – 80	B Poor
Below 75	C Fail

Table 1: Sustainable Supplier Scorecard (NDE Ltd)

Note: Boundary rule — 90.00 = A+; 85.00–89.99 = A; 80.00–84.99 = B+; 75.00–79.99 = B; < 75.00 = C.

Table –01 : Sustainable Supplier Sore card

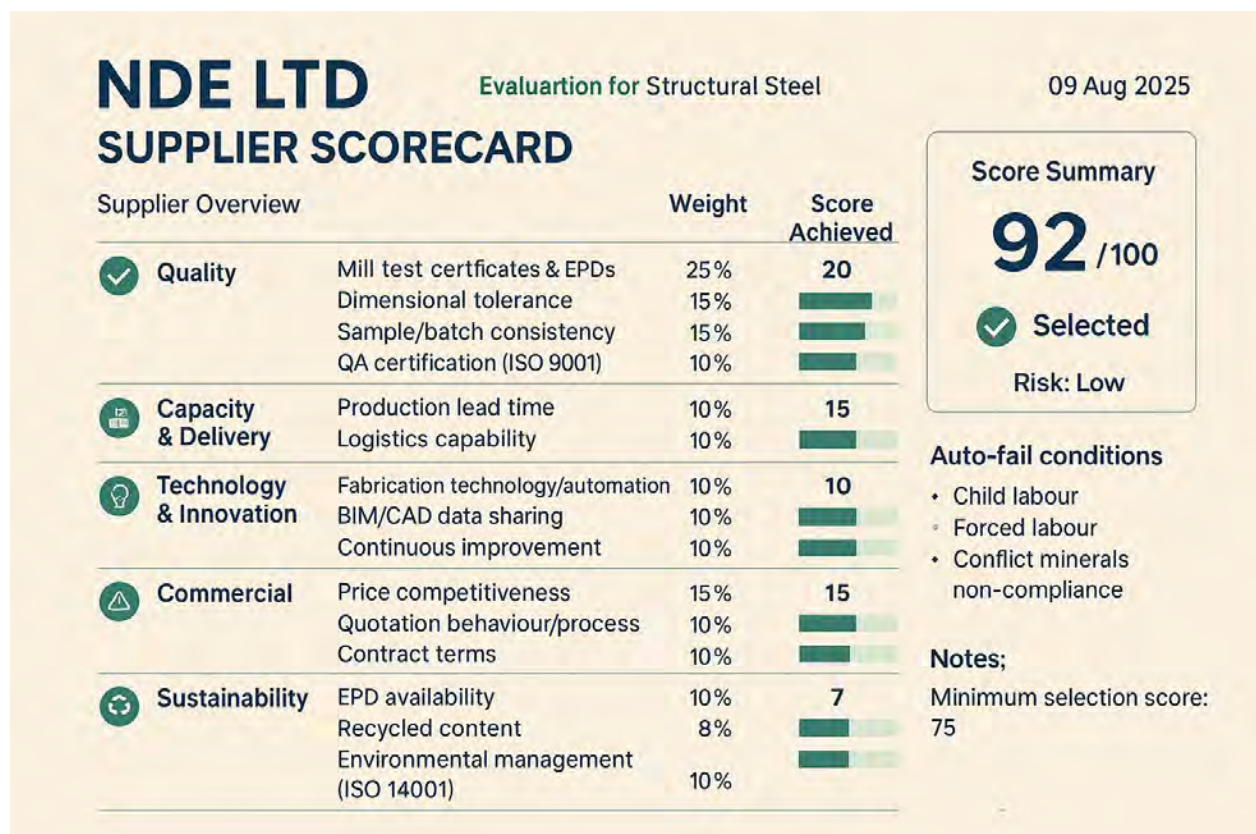


Figure-11: Supplier Score card at NDE Ltd.

NDE LTD

Supplier: Zamil Steel Ltd

Material: Structural Steel

SUPPLIER ANNUAL EVALUATION



Quality

- Mill test certificates & EPDs
- Dimensional tolerance
- Surface finish
- Sample/batch consistency
- QA certification (ISO 9001)



Delivery

15%

- On-time delivery rate
- Lead time adherence
- Logistics capability



Commercial

15%

- Price competitiveness
- Quotation behaviour/process
- Contract terms



HSE & Compliance

10%

- Safety record
- ISO 45001
- Legal/ethical compliance



Service & Communication

10%

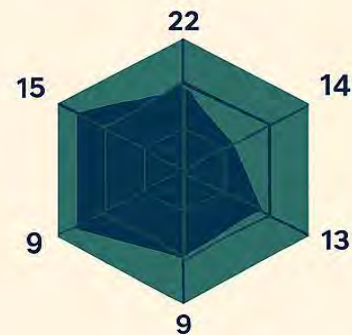
- Documentation accuracy/completeness



Innovation & Technical Support

10%

- Fabrication technology/automation
- BIM/CAD collaboration



Rating 1–5 Score = (Rating) × Weight

Auto-fail conditions

- Child labour
- Forced labour
- Conflict minerals
- Major safety violation

Prepared by _____

Evaluation period: 2025

NDE Ltd

Figure-12: Supplier Annual Evaluation At NDE Ltd.

6.8 Quality inspection to Justify sustainable procurement

- Supplier: Zamil Steel Ltd.
- Material: Structural Steel

Category	Weight	Score Achieved	Achievement %
Quality	25	24	96.0%
Capacity & Delivery	15	15	100.0%
Technology & Innovation	10	9	90.0%
Commercial	15	14	93.3%
Sustainability	15	13	86.7%
Risk & Compliance	10	9	90.0%
Relationship & Service	10	8	80.0%

Overall		92
Minimum selection score		75

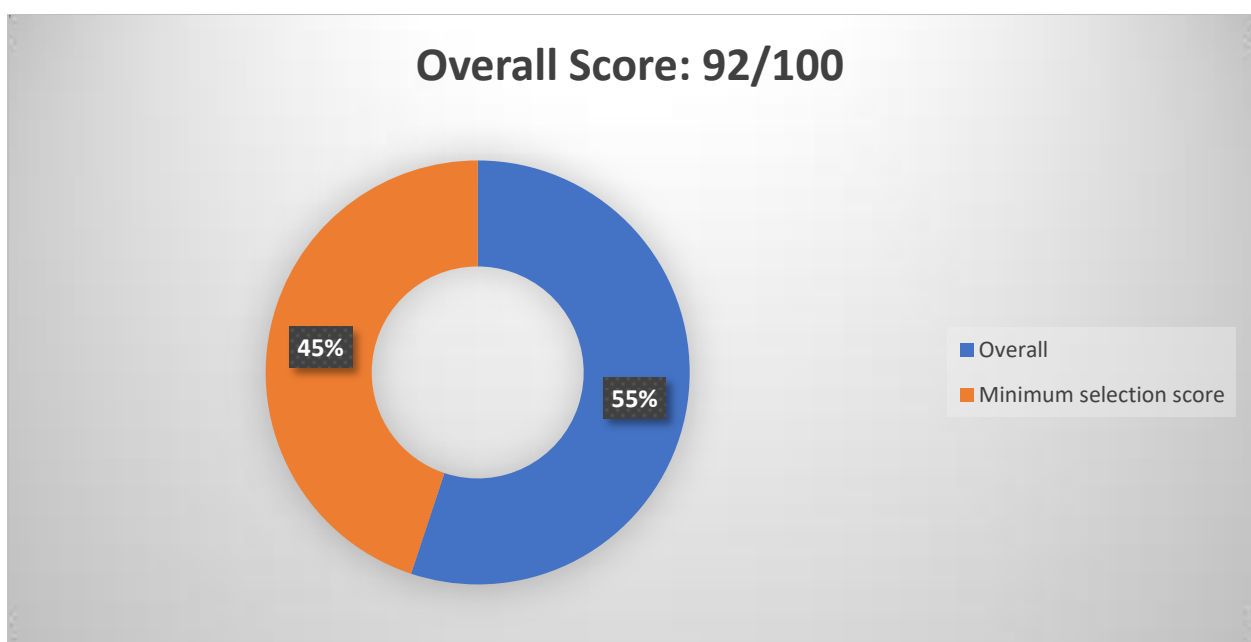


Figure-13: Minimum Selection Score vs Score Achieved by Zamil Steel Ltd.

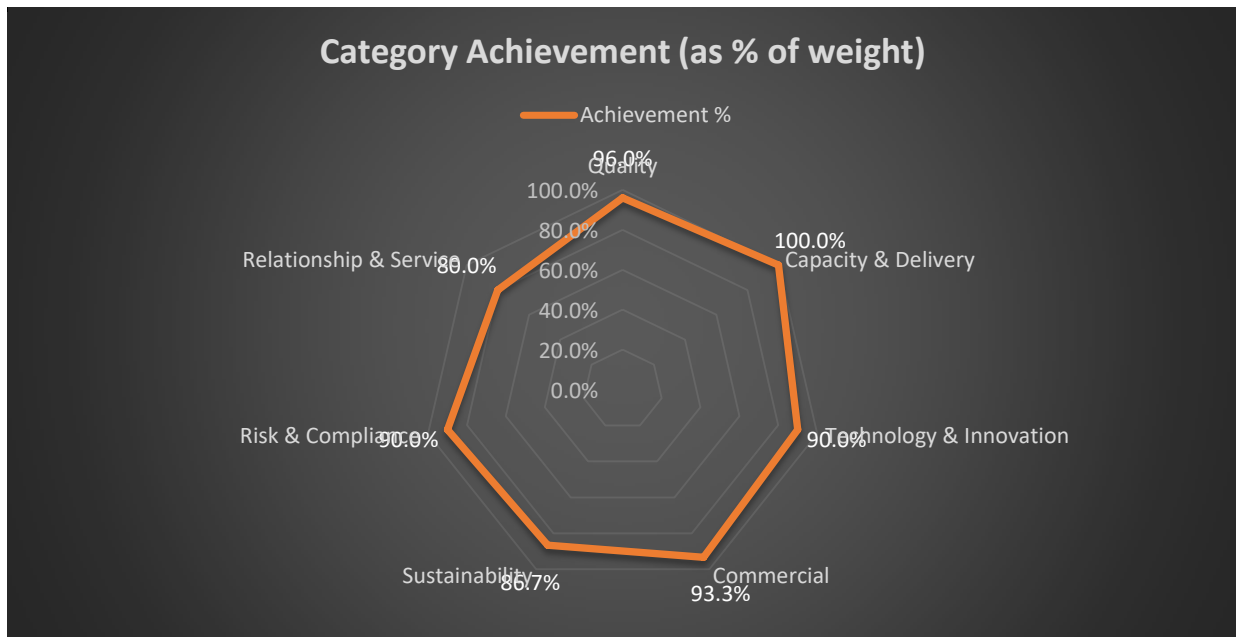


Figure-14: Category Achievement



Figure-15: Weight vs Score Achieved

Why sustainable procurement is actually *more convenient*

Convenience = fewer surprises + reusable data + faster decisions across countries and projects.

- Single global playbook. One set of rules (EPD/ISO requirements, traceability, auto-fail labour clauses) works in Dhaka, Dubai, or Hanoi—so Legal/QA stop re-inventing controls per market.
- Pre-qualified supplier pools. ESG gating up front means bids arrive from already-compliant suppliers; evaluation is faster and rework (missing docs, re-inspections) drops.
- Documentation once, reuse everywhere. EPD IDs, ISO cert numbers, heat numbers, and transport legs (km/mode/weight) can be re-used for: customs, customer audits, carbon reports, marketing claims, and re-bids.
- Automated checkpoints. Systems can block a PO receipt or payment only when critical documents are missing—reducing manual chasing and disputes.
- Access to better capacity and finance. Many global buyers and lenders prefer verifiably responsible supply chains; sustainable suppliers tend to have stronger QMS/HSE, which lowers NDE's day-to-day expediting effort..

6.9 Limitations sustainable procurement process at Construction sector

Here's a practical rundown of the main limitations of sustainable procurement in the construction sector, plus what they mean on real projects and how a team like NDE Ltd. can blunt the impact.

Structural limits of construction

- Project-by-project, one-off buys. Each job has unique specs and timelines, so you rarely get long-term volumes that justify greener capacity investments.
- Fragmented supply base & tiers. Multiple subcontractors and traders sit between you and mills/quarries; data and accountability diffuse quickly.
- Late design freezes & value-engineering. Sustainability features specified early are often traded off for cost/schedule under pressure.

Market & material availability

- Limited ESG-ready suppliers for key categories (e.g., low-carbon cement, verified recycled steel).
- Regional gaps. Some geographies lack EPD coverage, accredited labs, or accessible take-back/recycling markets.
- MOQ & batch constraints. Recycled/low-carbon variants may require larger runs or longer lead times.

Data, traceability & verification

- Inconsistent EPDs. Different system boundaries/functional units make apples-to-apples comparisons hard.
- Traceability breaks. Heat/lot numbers and chain-of-custody often get lost across handling, repacking, and cutting on site.
- Document authenticity risk. ISO/EPD/MTC misrepresentation still happens; verifying issuers and validity takes time.
- Scope-3 data gaps. Primary transport and supplier energy data are incomplete; emission factors vary by source.

Cost, incentives & budgeting

- Capex vs. TCO misalignment. Budgets reward lowest unit price, not embodied-carbon or lifecycle cost.
- Certification costs. EPDs, audits, and management systems can be expensive for SMEs; they pass costs on or opt out.
- Weak external incentives. Where carbon pricing/mandates are absent, greener options struggle to beat status-quo prices.

Contracts & risk allocation

- Legacy terms. Standard forms may lack enforceable sustainability clauses (traceability, emissions data, audit rights).

- Risk pushed downstream. Suppliers resist penalties for documentation gaps they can't control across tiers.
- Claim culture. Sustainability add-ons create perceived scope creep if not specified unambiguously.

Logistics & site realities

- Mode switching is limited. Rail/sea options may not exist on last-mile routes; congestion at ports raises emissions and risk.
- Storage/handling constraints. Space limits on site complicate segregating certified vs. non-certified materials.

Digital & process readiness

- ERP/S2P not set up for ESG fields. EPD IDs, certificate expiries, and transport legs aren't mandatory or reportable.
- Siloed records. Docs sit in emails/WhatsApp/USBs; audit trails break.
- Interoperability issues with contractors' systems and file formats.

Skills, culture & change

- Capability gaps in reading EPDs/MTCs, calculating t-km CO₂e, or auditing suppliers.
- Time pressure. Buyers default to known vendors and lowest bids when schedules compress.
- Supplier maturity. Smaller vendors may not understand requirements or how to evidence them.

Regulatory & standards friction

- Country code clashes. Local codes/specs may contradict sustainability asks or lack recognition of certain labels.
- Customs/document rules differ by corridor; “clean BL” and COO nuances create delays.

End-of-life & circularity

- Limited reuse markets and design-for-disassembly practices; take-back schemes are patchy.
- Quality uncertainty for recycled inputs in structural applications without robust standards/testing.

What these limits do to projects

- Schedule risk: longer approvals, re-RFQs, customs holds for missing/invalid docs.
- Cost drift: premiums for compliant materials + expediting/document rework.
- Compliance exposure: audit findings, client ESG penalties, reputational risk.
- Data gaps: incomplete carbon reporting and missed client credits.

Fast, pragmatic mitigations (NDE-style)

Limitation	Impact	What to do now
Few ESG-ready suppliers	Price/schedule shocks	Build a pre-qualified pool per category; allow “equivalent EPDs” with clear boundary rules; dual-source critical items.
EPD comparability	Poor decisions	Standardize evaluation: same functional unit & scope; keep a conversion note in bid tabs.
Traceability breaks	Payment holds, audit risk	Make heat→MTC→bundle→DN a contract clause; require bundle tags; block GRN without matches.
Scope-3 data gaps	Incomplete reports	Mandate distance–mode–weight per leg; use default factors where primary data is missing; improve over time.
ERP not ESG-ready	Rework	Add mandatory fields: EPD ID, ISO cert expiry, transport legs; auto-reminders for expiries; attach doc-packs to PO/GRN.

Limitation	Impact	What to do now
Lowest-price bias	Rebound to non-compliant	Weight sustainability 20–30% in RFQs; use TCO instead of unit price; set minimum doc-complete pass to proceed.
Supplier maturity	Slow adoption	Share templates (doc-pack, inspection checklist), run supplier training, co-fund first EPDs for strategic vendors.
Contract ambiguity	Disputes	Publish a Sustainability Spec Addendum & clause library (audit rights, remedies, LDs for doc non-conformity).
Time pressure	Shortcuts	Lock design freeze & change control; escalate sustainability changes to ED/Head with cost-carbon trade-off.
Logistics limits	Higher CO ₂ e	Plan earlier orders for greener modes where possible; consolidate loads; avoid avoidable air/urgent freight.

Minimum viable controls (work on all jobs)

1. Green Doc-Pack required in every PO: EPD, ISO 14001/45001, ISO 9001, MTC with heat numbers, CI/PL/BL/COO, transport legs.
2. Single receipt checklist (physical + doc verification) with auto-hold on invoice if incomplete.
3. Supplier scorecard with sustainability $\geq 25\%$ weight and auto-fail for child/forced labour or falsified docs.
4. Scope-3 register tied to each PO ($t\text{-km} \times \text{EF}$) feeding project carbon reports.
5. Quarterly review of doc-complete %, NCRs, OTIF, CO₂e/ton; targeted supplier development.

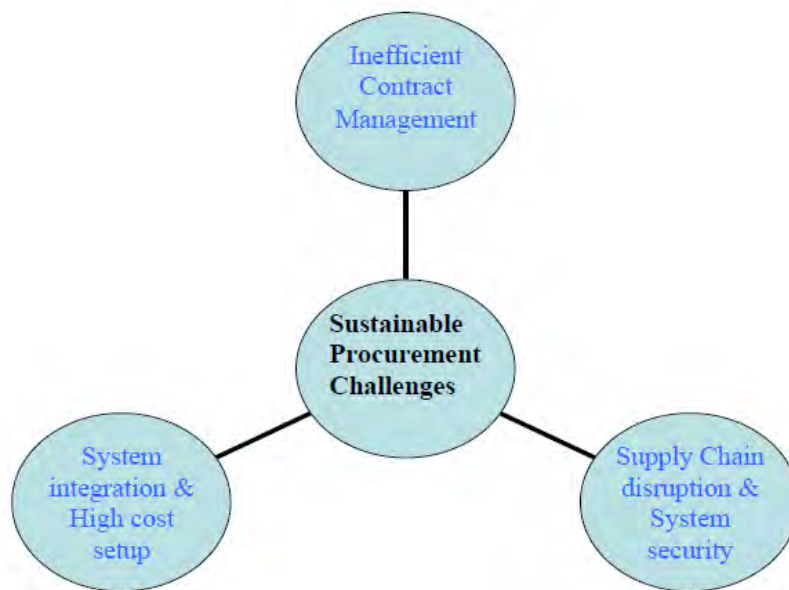


Figure-16, Limitation factors of Sustainable procurement

6.10 Impact, Future and development of sustainable procurement

Here's a concise, NDE-specific view of the impact, future, and development of sustainable procurement—grounded in the tools, templates, and scorecards we built for you (supplier scorecard & grading, PDCA process, inspection & shipping checklists, traceability register, risk model, org/roles).

Impact to date (what changes on projects)

Economic & delivery

- Competitive awards with a transparent weighted scorecard (Price/TCO, Quality, Delivery, Sustainability 25%) reduce re-RFQs and disputes.
- Contract clauses for traceability (heat→MTC→bundle→DN) and a mandatory doc-pack (EPD, ISO 9001/14001/45001, CI/PL/BL/COO, transport legs) cut customs holds and speed up GRN/payment.

- Negotiation anchored on verified quality/ESG data improves fair price and reduces risk premiums.

Quality & compliance

- Standard Quality & Sustainability Inspection Report at receipt (physical + document checks) raises first-time acceptance and reduces NCRs/CAPA loops.
- Auto-fail rules (child/forced labour, falsified EPD/MTC, expired ISO) prevent high-exposure awards.

Environmental & social

- EPD-based selection and transport data (km/mode/weight) enable credible Scope-3 reporting per PO → Project → WBS.
- Packaging/take-back and recycled-content asks are now part of normal specs (SSA).

Impact of Sustainable Procurement — NDE Ltd

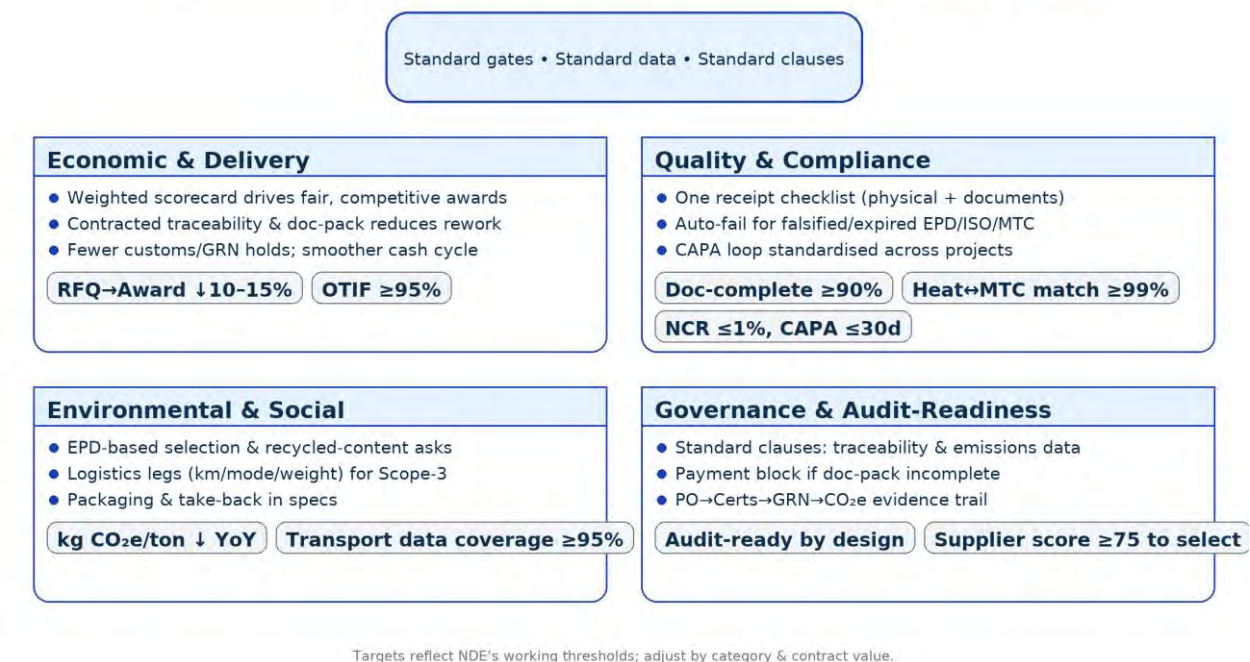


Figure-17: Impact of Sustainable Procurement of my organization

The questionnaires were asked about future sustainable materials requirement and procurement process. According to the respondent the development indicators are:



Figure-18: Respondent-derived development indicators for future sustainable materials and procurement at NDE Ltd.

Chapter 7: Recommendation and conclusion

NDE Ltd frames sustainable procurement as an ordered and iterative process rather than a simple appendage to buying. As such, it involves creating one consolidated set of rules that will apply to every project for which environmental product declarations and ISO 9001, 14001, and 45001 compliances must be observed in addition to establishing contractual traceability from heat or lot number to mill test certificate and bundle label. Equally important is the requirement for standardized evidence on receipt comprising the commercial documents, environmental product declarations, ISO certificates, and transport data needed for Scope 3 reporting. All these will be made consistent to ease up an understanding from a supplier on what is expected, speeding up evaluation, and actual reuse of the same dataset in audits about client inquiries as well as internal reporting.

The effects that have been felt inside NDE so far are operational. By applying a weighted bid process wherein sustainability is included as one of the material factors with price, quality, and delivery, re-tender loops are minimized and negotiations are shifted onto total cost of ownership rather than just on unit price. The standard receipt checklist puts together physical inspection with document verification has improved first-time acceptance rates leading to reduced non-conformance as well as payment disputes. Customs holds and invoice blocks will now happen less often because the documentary requirements are known upfront and linked by contract to the purchase order.

Quality and compliance performance became as predictable. By enforcing at bundle level the heat-to-Material Test Certificate (MTC) matching and by rejecting shipments with expired or falsified Engineering Product Documentation (EPD) and International Organization for Standardization (ISO) documents, rework and claims that the NDE department has successfully reduced making the supplier performance comparable for different projects. Internally, targets are set as process norms, not wishes: that most of the orders have EPD and ISO documentation prior to shipment, receipts are expected to show near-perfect heat matching, completeness of documentation monitored at first submission, corrective actions resolved within a predetermined time frame, and on-time-in-full delivery being a non-negotiable service standard.

The environmental and social impacts are as great. Selection of steel with assured recycled content and published EPDs, preference for cementitious materials having reduced clinker factors, and distance, mode, and weight meticulously documented for each leg of transport

allow NDE to build up a credible carbon ledger at purchase order level, project level, and work breakdown structure level. Also included under specifications instead of being matters for late-stage negotiation are packaging take-back where available safer chemicals in finishes and alignment to a health and safety standard consistent with ISO 45001. Its re-casts sustainability as an article of principle in procurement rather than as matter of circumstance.

Over the next three years, growth will center scaling operations, digitization and market shaping. Pre-qualification by category is part of what NDE improves to make sure mills, fabricators and traders allowed to participate in competition only after their ESG credential plus compliance to all legal standing have been checked. Relevant ERP fields for sustainability such as EPD identification, certificate expiry dates and transport-leg data will henceforth be made compulsory. Automated reminders as well as actual payment holds whenever evidence is not provided will be in place. Stores and site teams are moving to barcode or QR code capture of bundle and heat IDs so that cutting and re-handling traceability can be ensured. S&OP monthly meetings now reconcile demand, supply, and risk with a simple likelihood-by-impact model where environmental and social factors get a bigger weighting compared to operational considerations.

Growth has another leg in supplier development. NDE will support key suppliers in the process of preparing and submitting their first EPDs, introduce “Green” and “Gold” tiers to recognize best performers based on scorecard results, and co-create price-carbon trade-off models so that lower-emission options can compete fairly even if related unit prices are comparable or slightly higher. As rules, information, and incentives get strongly embedded, NDE expects RFQ-to-award cycle time to go down, share of orders with full documentary packs to go up, and project carbon intensity in kilograms CO_{2e} per ton delivered from the current baseline falling year-on-year.

Risks are not ignored but rather managed in transparency. Supply shortfalls and regional differences in EPD coverage are covered by using dual sourcing and equivalence rules that are already set. Traceability gaps onsite are covered by the implementation of scanning and issuance blocks for materials that are not tagged. Data integrity is covered by issuer verification and periodic third-party assessments. In addition, the tendency to sacrifice sustainability when under schedule pressure is controlled by a formal change process that requires leadership approval with clarity of consideration of cost and carbon trade-offs.

In the words of NDE, sustainable procurement is the best way to describe effective large-scale buying: it means one specification addendum, one set of contract clauses, one checklist for receipt, and one data trail for operations, for finance, for the client, and for auditors. It means fewer delays and disputes against the contract in the short term but develops a market that over time delivers lower-carbon verifiably compliant materials as standard. That improves NDE's competitive position while advancing Bangladesh's wider resource-efficient export-oriented growth objectives.

7.1 Some recommendations for organizations and sustainable procurement related persons

For organizations (how to set it up)

1) Make it policy, not preference

- Publish a short Sustainability Spec Addendum (SSA) used in every RFQ/PO: EPD required (where applicable), ISO 9001/14001/45001, recycled content targets, restricted substances, packaging take-back, traceability to batch/heat.

2) Bake it into evaluation & approvals

- Use a single scorecard for all sourcing: Price/TCO (35–45), Quality/Tech (20–30), Delivery risk (10–15), **Sustainability (20–30)**.
- Set clear thresholds: e.g., ≥ 75 = select, 65–74 = conditional/CAPA, < 65 = reject.

3) Gate suppliers before competition

- Pre-qualify by category; verify legal status, sanctions, ISO validity, EPD availability, H&S record. Tier suppliers (Low/Med/High risk) and audit on a calendar.

4) Contract for proof, not promises

- Standard clauses: (a) traceability (lot/heat → MTC → bundle/DN), (b) emissions data (distance–mode–weight per leg), (c) audit/inspection rights, (d) remedies for misrepresentation or missing documentation (LDs/rejection).

5) Capture the right data once

- Make these **mandatory ERP fields**: EPD ID, ISO certificate numbers & expiry dates, transport legs (km/mode/weight), inspection level, Incoterm.
- Block GRN/payment if the “green doc pack” (EPD/ISO/MTC/CI/PL/BL/COO) isn’t complete.

6) Run a simple S&OP cadence

- Monthly: demand update (WBS/BOQ), supply capacity & logistics, risk reconciliation (Likelihood× Impact with E/S weighted higher), executive sign-off.

7) Measure what matters

- Doc-complete first-time pass $\geq 90\%$
- Heat/batch $\leftrightarrow$ MTC match $\geq 99\%$
- OTIF $\geq 95\%$
- % POs with transport legs & EPD/ISO $\geq 95\%$
- NCR $\leq 1\%$; CAPA closure ≤ 30 days
- kg CO_{2e}/ton delivered trending $\downarrow$ YoY

8) Develop—don’t just judge—suppliers

- Share templates, run clinics on EPD/ISO/MTC integrity, co-fund first EPDs for strategic partners, and recognize “Green/Gold” tiers for high performers.

9) Digitize traceability

- Use QR/barcodes on bundles/batches; scan at receipt and issue. Keep a live evidence trail: PO $\rightarrow$ certs/EPD $\rightarrow$ inspection $\rightarrow$ logistics emissions.

10) Align finance & incentives

- Evaluate on **TCO**, not unit price only; pilot an internal carbon price/shadow cost for award decisions. Tie part of buyer/supplier bonuses to doc-complete %, OTIF, and CO_{2e} outcomes.

For procurement professionals (how to operate)

Know the documents. Be fluent in EPDs (scope, system boundary, validity), ISO certificates (issuer/expiry), and MTCs (chem/mech + heat numbers). Reject anything unverifiable.

Use one playbook. Keep standard RFQ templates, the SSA, a due-diligence checklist, receipt inspection form, and a supplier scorecard. Reuse every time.

Score & justify. Record how you weighted price/quality/sustainability; keep evaluation notes and certificate IDs in the file. If you deviate, write the reason.

Negotiate value, not slogans. Ask for recycled content or lower-GWP options with data; trade delivery windows or payment terms for verified ESG performance.

Watch the risks. Run a quick TRI (Likelihood× Impact) for each award; escalate High TRI or any auto-fail (child/forced labour, falsified docs, sanctions).

Guard data quality. Verify issuers, spot-check labs, and keep a log of rejected certificates. Greenwashing is a procurement risk—treat it like one.

Upskill continuously. Add one credential or micro-skill: CIPS/CPSM/CSCP, ISO 14001 lead auditor, GHG Protocol basics, or LCA fundamentals. Practice with two live EPD comparisons this quarter.

Communicate early. Loop Engineering/QA/Finance into RFQs; agree on the acceptance checklist before the PO is issued.

30/60/90-day quick start

30 days: publish the SSA and clause pack; add EPD ID, ISO expiry, and transport-legs fields to your PO/GRN forms; start a pre-qualified list for one key category.

60 days: enforce the receipt checklist with invoice holds; run one supplier clinic on document integrity; turn on certificate-expiry reminders.

90 days: dashboard doc-complete %, OTIF, NCR/CAPA, and CO₂e/ton; conduct one third-party audit on a strategic supplier; recognize top performers.

7.2 Conclusion

Sustainable procurement works best when it forms a part of the core purchasing processes with a single cohesive rulebook, coherent data, and evidence trail from specification to

payment. These recommendations have that in common: to get clear standards into specs and contracts; pre-qualify suppliers before competitive bidding occurs; add a limited number of mandatory data fields (EPD ID, certificate validity, transport legs) into procurement systems; and apply the same checklist for receipts and payments. All this makes the process fairer, more efficient when decisions are based on total cost and service, giving sustainability considerations as much weight as possible which improves documentation and reduces risks. It is the cultural leg comprised of the training of buyers and suppliers, scorecards, thresholds, performance publishing, and incentivized compliant behavior which makes controls stick as habits. Therefore, organizations should expect reduced disputes as well as improved quality maintaining this approach long enough to make it a habit plus getting audit-ready carbon and compliance data too while building a willing-to-invest-with-you supply base. In summary, sustainable procurement is not extra; it is the most dependable and defensible way to work plus being ultimately cost-effective in terms of carrying out a project and protecting reputation in today's ever-demanding marketplace which requires proof rather than promises.

7.3 Recommendation

Here are focused, actionable recommendations for NDE Ltd. drawn from overall findings, operating model, and sustainability framework:

1. Publish and enforce a short Sustainability Spec Addendum (SSA) for every RFQ/PO

Make EPDs (ISO 14025/EN 15804), valid ISO 9001/14001/45001, and heat/lot→MTC→bundle traceability non-negotiable. Reference the SSA in award letters and make substitutions subject to formal change control.

2. Weight sustainability in bid evaluation (20–30%) and record the trail

Use one weighted scorecard (Price/TCO, Quality/Tech, Delivery risk, Sustainability). Keep the signed bid tab, notes, and certificate IDs in the file to make decisions auditable.

3. Gate suppliers before competition

Run category pre-qualification: ESG/legal checks, ISO validity, EPD readiness, H&S record, data honesty. Tier suppliers (Green/Gold/Conditional) and schedule annual re-evaluation tied to CAPA.

4. Contract for proof, not promises

Insert clauses for (a) heat/lot traceability, (b) shipment-level transport data (distance–mode–weight), (c) audit/inspection rights, and (d) remedies for missing or falsified documents (invoice hold, LDs, rejection).

5. Make key ERP/NOW fields mandatory

EPD ID, certificate issuer/expiry, and transport legs per shipment must be filled before GRN/invoice can post. Turn on certificate-expiry alerts and automate –doc-pack incomplete → payment hold.”

6. Standardize the Green Document Pack at GRN

At receipt, verify EPD, ISO 9001/14001/45001, MTC with heat numbers, CI/PL/BL/COO, plus the transport legs. Pair document checks with physical inspection (dimensions, markings, surface finish) and raise NCR/CAPA on misses.

7. Digitize traceability on site

Adopt QR/barcode labels for bundles/heats; require scan at receipt and at issue so traceability survives cutting/re-handling. Block issuance in stores if unscanned.

8. Track Scope-3 logistics and show carbon intensity by project

Capture distance–mode–weight per leg and publish a simple –kg CO₂e/ton delivered” dashboard by PO/project/WBS. Use it in supplier reviews and tender debriefs.

9. Run a monthly S&OP + TRI review

Reconcile demand, supply, and risks using a simple Likelihood×Impact model with E/S factors weighted higher. Escalate high-risk suppliers, long-lead exposures, and any doc-pack bottlenecks.

10. Launch a Supplier Development & Recognition program

Hold clinics on EPD/ISO/MTC integrity; co-develop first EPDs with strategic vendors; recognize –Green/Gold” tiers for ≥85/100 scorecard performers and sustained doc-perfect streaks.

11. Define hard KPIs and publish them

Doc-complete first-pass $\geq 90\%$; Heat↔MTC match $\geq 99\%$; OTIF $\geq 95\%$; NCR $\leq 1\%$; CAPA closure ≤ 30 days; Scope-3 coverage $\geq 95\%$. Review monthly; tie part of buyer/supplier incentives to these metrics.

12. Short, staged rollout (30/60/90 days)

- 30: Issue SSA + clause pack; flip ERP fields to mandatory; pilot Green Document Pack at one site.
- 60: Enforce invoice holds for incomplete packs; start QR labeling; run the first supplier clinic.
- 90: Go-live dashboards (doc-complete/OTIF/NCR/CO₂e); complete first pre-qualification round; publish the first Green/Gold tier.

13. Strengthen governance & data quality

Verify certificate issuers/EPD operators; sample third-party checks quarterly; keep a register of rejected documents (reason, supplier, corrective action) to deter repeat offenses.

14. Manage cost and availability risks transparently

Dual-source critical categories; allow EPD-equivalent products with clear boundaries; negotiate price–carbon bundles so lower-GWP options remain competitive on TCO even with small premiums.

15. Keep people and culture at the center

Train buyers, QA/QC, and storekeepers on reading EPDs/MTCs and spotting fakes; share “wins” (fewer holds, faster awards, lower CO₂e) to reinforce the habit.

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Appendix

Title of Dissertation: Sustainable procurement For Carbon-Neutral Construction.

Name of the Researcher: Md. Nafiul Islam; MPSM ID: 23282013 BRACU and Assistant Engineer of NDE Ltd.

This survey questionnaires are dedicated to academic research only for the above-mentioned topic offered by BIGD (BRAC Institute of Governance and Development) of BRAC University.

Questionnaires

Section A: General Information of Respondent

1. **Name of the respondent (optional):** _____
2. **Designation and organization of the respondent:** _____
3. **Sex:** a) *Male* b) *Female*
4. **Educational Qualification**
Academic: a) Post-graduate b) Graduate c) Under-graduate
Professional: a) Certified supply chain (MPSM/PGD-SCM/CIPS/CSCP/CPSM) b) General education (Business/Engineering/Other)
5. **Respondent's position at NDE Ltd.:** a) High-level b) Mid-level c) Lower-level

Section B: Concept of Sustainable Procurement Process (Construction)

6. **Sustainable procurement integrates which pillars?**
a) Economic, Environment, Social
b) Economic, Political, Social
c) Fair Trade, Spend Analysis, Environment
d) All of the above
7. **For construction products, which statement is most accurate about an EPD?**
a) A marketing brochure
b) A verified life-cycle impact declaration (ISO 14025/EN 15804)

- c) A customs form
 - d) A warranty card
8. **Purchasing the right quantity of materials primarily helps avoid locking up of:**
- a) Working capital
 - b) Contractual risks
 - c) Engineering risks
 - d) All of the above
9. **Full form of MRP in operations/SCM is:**
- a) Material Return Process
 - b) Material Requirement Planning
 - c) Machinery Repair Planning
 - d) None of the above
10. **A major motivator for establishing a global procurement operation is:**
- a) Currency arbitrage
 - b) Political influence
 - c) Promotional gifts
 - d) All of the above
11. **In vendor analysis for procurement, which is most critical?**
- a) Value chain perspective
 - b) Pricing alone
 - c) Discounting alone
 - d) All of the above
12. **Spend analysis often misses one-off and very low-value suppliers.**
- a) True
 - b) False

Section C: Sustainable Procurement in Global Business & Limitations (Construction focus)

13. **The four _C's sometimes used in sustainability discourse are community, cooperation, consumption, and conservation.**
- a) True
 - b) False
14. **Sustainable procurement benefits include:**
- a) Environmental improvement
 - b) Cost savings
 - c) Reputation enhancement
 - d) All of the above
15. **It is always possible to achieve the lowest environmental impact and the most positive social results simultaneously at zero trade-off.**
- a) True
 - b) False
16. **What is a KPI?**
- a) A behavior rating tool
 - b) A marketing dashboard
 - c) A quantifiable value that tracks organizational objectives
 - d) A list of last year's goals
17. **Which action best supports sustainable development in supply chains?**
- a) Resource efficiency and reduction of waste
 - b) Promoting inequality
 - c) Disempowering women
 - d) Encouraging instability

18. Incoterms primarily indicate who bears:

- a) Cost of carriage
- b) Risk of carriage
- c) Both (a) and (b)
- d) None of these

Section D: Impact, Future & Development of Sustainable Procurement at NDE Ltd.

(Construction)

19. Which are recognized development indicators for a country's progress?

- a) GDP/GNP
- b) Birth & death rates
- c) HDI
- d) Life expectancy (choose all that apply)

20. Potential negative consequences of unregulated foreign investment include:

- a) Increased unemployment
- b) Reduced income sources
- c) Stress on physical/social infrastructure
- d) Slower economy
- e) All of the above

21. Major issues for sustainable development in Bangladesh include:

- a) Poverty/No hunger
- b) Health & well-being
- c) Education & gender equality
- d) Clean air/water/sanitation
- e) All of the above

22. Corporate Social Responsibility (CSR) refers to:

- a) Environmental responsibility

- b) Ethical responsibility
- c) Philanthropic responsibility
- d) Economic responsibility
- e) All of the above

23. For structural steel procurement at NDE, which document links the bundle's heat number to properties?

- a) Packing List
- b) Mill Test Certificate (MTC)
- c) Commercial Invoice
- d) Certificate of Origin

24. Which ISO standard is most relevant for environmental management at suppliers?

- a) ISO 9001
- b) ISO 14001
- c) ISO 45001
- d) ISO 50001

25. At NDE, sustainability is evaluated in RFQs alongside price/quality/delivery using a disclosed weighting.

- a) Strongly agree
- b) Agree
- c) Neutral
- d) Disagree

26. At goods receipt, the —green document pack” should include (construction):

- a) CI/PL/BL only
- b) EPD, ISO 9001/14001/45001, MTC with heat nos., CI/PL/BL/COO, transport legs
- c) COO and quotation

d) Warranty letter only

27. Transport emissions for Scope-3 are best captured as:

a) Distance–mode–weight per leg

b) Invoice value

c) Pallet count

d) Driver name

28. Common limitations in construction sustainable procurement include:

a) Limited EPD availability

b) Traceability breaks on site

c) ERP fields not set for ESG data

d) All of the above

29. Overall maturity of NDE's sustainable procurement process today:

a) Initial

b) Developing

c) Defined

d) Managed

e) Leading

30. Open-ended: What one change would most accelerate carbon-neutral procurement at NDE in the next 12 months?