

Role Of Procurement and Supply Chain Management in 4 MW Captive Power Plant Project Performance: A Case on Coca-Cola Bangladesh Beverages Ltd.

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A thesis submitted to Brac Institute of Governance and Development in partial fulfillment of
the requirements for Masters of Procurement & Supply Management

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It is hereby declared that

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2. The thesis 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 thesis does not contain material which has been accepted, or submitted, for any other degree or diploma at a university or other institution.
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List of Acronyms

Abbreviation	Full Form
ADB	Asian Development Bank
BoQ	Bill of Quantities
CIPS	Chartered Institute of Purchasing & Supply
Sqft	Square Feet
FAT	Factory Acceptance Testing
SAT	Site Acceptance Testing
LC	Letter of Credit
DG	Diesel Generator
MS	Mild Steel
Cu	Copper
GI	Galvanized Iron
RFT	Running Feet
SWG	Standard Wire Gauge
CCBBL	Coca-Cola Bangladesh Beverages Ltd.
BIGD	Brac Institute of Governance and Development

Executive summery

I am part of the Electric Power System Division at BanglaCAT, the exclusive distributor of CAT diesel gensets in the Bangladesh market. We provide Diesel and Gas captive power in the industrial zone of Bangladesh. BanglaCAT serves clients from Bangladesh's Spinning Mills, RMG sector and pharmaceutical industries. One of our stakeholder Coca-Cola International Beverages Ltd. issue a RFQ to all the captive power provider in Bangladesh to supply design and install a 4MW diesel power plant. As a very reputed company, BanglaCAT won the project and signed an agreement with Coca-Cola International Beverages Ltd. to complete the full supply, installation and commissioning of 4MW diesel Power plant. The supply chain for captive power plant installation involves the coordination of design, information, materials, labor, construction tools, and preliminary work, all managed by various stakeholders, including contractors, suppliers, subcontractors, engineers, and architects. The process of supplying, designing, and installing a captive diesel power plant is highly complex and unique. Any disruptions in this flow during project execution can hinder construction progress. This study aims to analyze the impact of procurement and supply chain activities on the design, supply, and installation of a diesel power plant. To achieve this, real-time data was gathered from various sources, including interviews with the procurement and supply chain teams, suppliers, contractors, engineers, and other project stakeholders. Additionally, I visited the ongoing construction site multiple times for first-hand observations. The findings revealed that issues with material flow and layout changes significantly disrupted project performance. Specifically, delays in the shipping of the Diesel Generator and material shortages at the site highlighted how supply chain problems can cause delays, negatively affecting the timely completion of the project. Based on these insights, the study proposes strategies to address these challenges and improve the performance of captive diesel power plant projects.

Keywords: Procurement, Supply chain, Captive Power Plant, Shipping time, delays.

Chapter One: Introduction

1.1 Background of the Study

BanglaCAT is one of the biggest power provider company in Bangladesh. Coca-Cola Bangladesh Beverages Ltd. (Valuka Plant) plans to set up a 4MW Diesel Captive Power Plant to support their expanded production capacity. To achieve this, the company has partnered with BanglaCAT, the exclusive distributor of Caterpillar, Inc. BanglaCAT's responsibilities include the design, supply, installation, and commissioning of the 4 MW Diesel Power Plant.

A dedicated cross-functional team has been formed to oversee the procurement of services, materials, and labor for this project. The team includes design consultants, architects, engineers, and workers hired under service level agreements. A service level agreement is a contract between the customer and service provider to outline the scope of services. The project is managed by a designated Project Manager who handles the supply of construction materials such as diesel generators, mufflers, flexible fittings, switchgear, synchronization panels, master control panels, 4mm MS sheets, copper rods, and hardware items like nuts and bolts. Construction activities are carried out in a structured manner, ensuring timely delivery of essential materials.

Timely delivery and maintaining the quality of these materials are critical to completing the installation within the agreed time frame. Any delay in material supply can disrupt the project, leading to increased costs and negatively impacting the quality of the power plant installation. Therefore, proper management of the procurement process is essential to ensure the completion of Coca-Cola Bangladesh Beverages Ltd.'s power plant project on schedule. This study explores the role of procurement and supply chain management in this project.

1.2 Objectives of the Study

The primary aim of this study is to explore the role of procurement and supply chain management in the successful supply, installation, and commissioning of the 4MW diesel power plant project, with a particular focus on Coca-Cola Bangladesh Beverages Ltd. The study will achieve this goal through the following objectives:

1. To identify the various types of procurement and supplies necessary for the design, supply, installation, and commissioning of the 4MW diesel power plant at Coca-Cola Bangladesh Beverages Ltd.
2. To describe how procurement and supply management are handled for this project.
3. To assess the impact of procurement and supply chain management on the timely completion and quality of the installation work.

1.3 Methodology of the Study

This study will review general literature on procurement and supply chain management, as well as project-specific documents related to the Coca-Cola Bangladesh Beverages Ltd. 4MW Power Plant project. Primary data will be collected through interviews with key project stakeholders, such as contractors, suppliers, and supply chain experts. Since the author is actively involved in the installation project, their personal insights and observations will also contribute to achieving the study objectives. A wide range of respondents will be interviewed for this research, as outlined in Table 1.1, with further details provided in Annex 1.

Table 1.1: General Categories of Participants Interviewed for This Study

Respondent Categories	Number of Respondents
Procurement and supply chain	7
Engineering team	5
Contractors	2
Suppliers	3
Labor force	2

1.4 Organization of the Report

The report is structured into six chapters. Chapter 1 introduces the study by outlining its background, objectives, and methodology. Chapter 2 provides a comprehensive overview of procurement and supply chain concepts, along with a detailed look at the activities within the procurement and supply chain department. In Chapter 3, the focus shifts to the procurement and supply processes at BanglaCAT, discussing the related challenges and issues encountered. Chapter 4 elaborates on the procurement planning process, supplier selection, contract awarding, the delivery of construction materials, and the quality control measures implemented for the Coca-Cola project. Chapter 5 highlights the critical role of procurement and supply

chain management in ensuring that the installation work is completed on schedule and meets quality standards. Finally, Chapter 6 summarizes the findings of the study and offers recommendations for improving the procurement and supply chain functions, along with suggestions for future research in this area.

Chapter Two:

A General Overview of Procurement and Supply Chain Management

2.1 Procurement and Its Management

Procurement refers to the process of acquiring goods, services, or works from external sources, typically through contracts. It is a critical function within any organization, as it ensures that the necessary resources are available to meet the organization's objectives. The procurement process involves various stages, including identifying needs, sourcing suppliers, obtaining quotations, negotiating contracts, and managing the delivery of goods or services. Effective procurement management involves strategic planning and coordination to ensure that resources are purchased at the best possible price, quality, and timeline. It also includes managing supplier relationships, assessing market conditions, and ensuring compliance with relevant laws and regulations. Procurement management ensures that all materials and services are acquired in a timely, cost-effective, and quality-compliant manner. This process often includes risk management, evaluating supplier performance, and ensuring that procurement activities align with the organization's strategic goals. Procurement encompasses activities before and after signing a contract, including:

- **Before the contract:** This phase involves forecasting, assessing needs, preparing technical specifications, and sourcing materials or services.
- **After the contract:** Key activities in this phase include managing the contract, ensuring delivery of the right quantities and quality on time, and overseeing the entire supply chain until the disposal phase.

Other important procurement tasks include building an optimal base of suppliers and contractors, managing supplier relationships, conducting risk assessments, and ensuring compliance with relevant government or company regulations.

In both public and private organizations, procurement typically involves three types of items: works, goods, and services. These are briefly described below:

- **Works:** Contracts in this category are made between employers and contractors for construction tasks, usually for short periods. These contracts are often complex and require skilled management and technical expertise. The scope and timeline of work are clearly defined in the contract.
- **Services:** These contracts involve hiring professional and knowledge-based experts. For construction projects, architects, engineers, and consultants are typically hired under service contracts. These professionals are engaged to meet specific objectives and support the existing team to satisfy customer demands.
- **Goods:** These contracts are made with suppliers for various goods. In construction, this includes materials like cement, steel rods, stone chips, bricks, etc. There are two main types of purchase agreements:
 - **Local Purchase:** This involves goods readily available in the local market, with short-term contracts and competitive supplier relationships.
 - **International Purchase:** These contracts are for strategic goods that are sourced from abroad because they are not available locally. These contracts usually last longer, and procurement personnel need to manage cross-border formalities and maintain strong relationships with suppliers.

2.1.1 Procurement Process

To obtain goods, services, and works, an organization adheres to a structured procurement process. The standard steps involved in this process are outlined below:

i) Need Assessment:

The first step in procurement is identifying the need for services, works, and goods. For a power plant installation project, it is crucial to define the scope of work based on the proposed design and drawings. The technical team evaluates the complete bill of quantities and prepares specifications that outline both the quantity and quality requirements.

ii) Price Database Preparation:

The procurement team reviews the overall market prices for works, goods, and services. Using this market analysis, they create a competitive price database for each category of procurement,

which helps in understanding market competition and enhancing internal resource development.

iii) Cost Analysis:

Cost analysis is critical before making any strategic decisions. Organizations aim to get value for money in their procurement processes and strive for competitive advantages. For construction projects, cost analysis plays a crucial role in decision-making.

iv) Supplier Selection:

Supplier selection is the initial stage in the supplier management process within the procurement cycle. The procurement department creates a database of potential suppliers for each type of work. As noted by Carter (2012), the following factors are taken into account when choosing suppliers:

- The supplier's competency and previous experience in similar tasks
- Ability to complete the task within the specified timeframe
- Commitment to responsibilities
- Control over the tasks
- Financial stability to implement the task
- Cost comparison of their materials with other suppliers
- Consistency and reliability in past supplies
- Compatibility with the buyer's organization culture
- Compliance with business regulations
- Communication channels between the buyer and supplier

After evaluating these factors, the best-performing suppliers or contractors are selected for ongoing supplies, while underperforming suppliers are removed. Additionally, new suppliers are added to the database based on evaluations.

v) Quotation Request:

The procuring organization invites competitive bids from appropriate suppliers or contractors. It provides details such as contract terms, the total bill of quantities, technical specifications, general and special conditions (if applicable), and relevant drawings. Suppliers or contractors

then submit their quotations based on the given scope of work, contract terms, and job specifications. The procuring organization prepares a comparative analysis of the submitted quotations for assessment.

vi) Negotiation and Contract Finalization:

The process begins with discussions between the buyer and suppliers to finalize the terms of the contract, including financial details. Key aspects like quality, delivery timelines, quantities, pricing, and schedules are negotiated. After reaching an agreement, a formal, legally binding contract is signed by both the supplier and the buyer.

vii) Contract Implementation:

This stage involves managing the contract. Contract management ensures that contractors, suppliers, employees, and other stakeholders fulfill their obligations. During this phase, the contractor executes the work according to the agreed terms. Both parties collaborate to prepare a roadmap for implementing the contract based on the work sequence. If variations arise, the contract is reviewed and amended. Effective contract management depends on completing tasks on time, with the right quality and quantity.

viii) Monitoring & Evaluation:

Contract monitoring ensures that suppliers or contractors perform their duties as agreed. On-site inspections verify that the work is on track and progressing as planned. Monitoring reports from these visits provide an overview of the project's progress. Based on this evaluation, higher authorities may make strategic decisions to address any issues or accelerate the work. Procurement and contractor performance are evaluated, and lessons learned are applied to future projects.

2.1.2 Performance of Procurement

The performance of procurement is primarily assessed based on three key factors: cost, quality, and time. The Chartered Institute of Purchasing and Supply (2010) introduced the "Five Rights" model, which outlines the fundamental goals of procurement and provides criteria for evaluating procurement performance. These five rights are:

1. **Right Quality**
2. **Right Quantity**
3. **Right Place**
4. **Right Time**
5. **Right Price**

Procurement performance is evaluated based on how well these five rights are met. In construction projects, the successful performance of procurement relies on purchasing goods and services that meet the required quality and quantity, as per the site's needs, and ensuring timely delivery at the correct location.

2.2 Supply Chain Management and Its Functions

A supply chain refers to the network of suppliers, manufacturing, assembly, distribution, and logistics functions involved in procuring materials and transforming them into intermediate and finished goods. In a power plant installation project, the supply chain is both unique and time-sensitive. It involves multiple contractors, suppliers, and importers (such as those for Diesel Generators, Switchgear, Synchronization Panels, and Master Control Panels), each handling different tasks. Since each power plant installation project is distinct, new materials and supplies may emerge during the project's execution.

Managing these various challenges requires close coordination among a cross-functional team, and ensuring smooth collaboration is vital for effective supply chain management. The involvement of various stakeholders in a power plant installation project adds complexity to the supply chain process. Timely completion of the project largely depends on the efficient flow of raw materials to the site. Any delays in material delivery can cause a ripple effect, leading to further delays and increasing project costs.

Supply chain management focuses on overseeing the network that moves goods and services, from procurement of raw materials to their transformation into finished products. According to Lambert (1998), supply chain management is defined as “the integration of business processes from the customer through to the original supplier, who provides goods, services, and information that add value for the customer.” Effective supply chain management streamlines

activities to enhance customer value and gain a competitive edge in the marketplace. It also helps build the reputation of a business by developing an efficient and reliable supply network. The Chartered Institute of Purchasing and Supply (2010) emphasizes that a key element of supply chain management is identifying the value chain and segmenting it to evaluate each part separately. By pinpointing value-added and non-value-added activities, organizations can eliminate inefficiencies and improve overall supply chain performance. This diagnostic approach allows businesses to refine specific segments of the supply chain, improving efficiency and enhancing value throughout the network.

2.2.1 Role of Supply Chain Management in an Organization

Supply chain management plays a vital strategic role within an organization. Its main function is to align project activities with the overall organizational strategy, starting from the design phase and continuing through to project completion. It serves as a link between buyers, suppliers, and end customers, ensuring the timely delivery of goods and services to meet customer needs.

The primary objectives of supply chain management include reducing non-value-added costs, improving quality, and promoting ethical, environmental, and social responsibilities. It also involves sharing risks with suppliers, who are better equipped to manage them, thus lowering overall risk for the organization. By making strategic risk management decisions, supply chain management helps to decentralize risks, enabling organizations to address potential challenges.

Each organization has its own approach to assessing risks and converting them into financial terms, helping to create a solid framework for managing those risks. Furthermore, effective supply chain management ensures that the benefits of successful partnerships with suppliers are shared.

2.2.2 Supply Chain Management for Captive Power Plant Installation

Vrijhoef and Koskela (2000) outlined four key roles of supply chain management in installation projects. These roles are not mutually exclusive and are often implemented together.

1. **Reducing Costs and Duration of Site Activities:** The first role focuses on how supply chain management impacts site activities, aiming to reduce both costs and the time required for these activities. This can be achieved by ensuring a steady and dependable

flow of materials and labor to the site, preventing interruptions in the workflow. A strong relationship between the site team and suppliers is key to this process.

2. **Reducing Costs in Logistics, Lead-Time, and Inventory:** The second role emphasizes the reduction of costs related to supply chain logistics, lead times, and inventory management. Both material and component suppliers are encouraged to adopt this focus to streamline the procurement process.
3. **Transferring Activities or Information Earlier in the Supply Chain:** The third role involves transferring tasks or information from the site to the earlier stages of the supply chain. By doing so, the supply chain can avoid the introduction of inferior items and can promote better coordination between activities, reducing technical dependencies. This ultimately helps lower both the cost and duration of the project.
4. **Integrated Project Management and Supply Chain Improvement:** The fourth role stresses the importance of integrated project management, which aims to improve both the supply chain and production processes on site. This integrated approach fosters better coordination and enhances overall project performance.

2.2.3 Logistics Support for Installation Projects

Silva and Cardoso (1999) outline the critical role logistics plays in installation projects, emphasizing its involvement in various processes such as supplying goods, warehousing, processing, transportation, inventory management, scheduling, and manpower supply. Logistics also encompasses the flow of materials, provision of necessary services, and communication of related information. These activities need to be effectively managed both before and during the installation phase. Supply logistics include resource planning for personnel, materials, cash flow, equipment, transportation, warehousing, and inventory management. On-site logistics support is essential, as it is directly linked to planning, organizing, directing, supervising, and monitoring activities across the site. Research by Vrijhoef and Koskela (1999), Hong-Minh et al. (2000), Akintoye et al. (2000), O'Brien (1999), and Ofori (2000) highlights that supply chains in installation projects are often disrupted. These

issues typically arise from challenges within various interfaces in the supply chain rather than from changes in the process itself. Common challenges include:

- Poor communication, cooperation, and commitment among suppliers, contractors, and employers in the supply chain.
- Design changes during implementation that cause material flow inconsistencies and project delays.
- Inadequate material deliveries that fail to meet demand, as well as substandard materials.
- Inefficient communication and information transfer.
- Insufficient performance measurement for suppliers.
- A lack of trust between suppliers and employers.

To mitigate these issues, the employer can achieve a competitive advantage by adding value, reducing costs, and integrating all stakeholders involved in the project. This integration ensures smoother project management and installation processes, ultimately meeting the expectations of both internal and external stakeholders.

Chapter Three:

Procurement and supplies of BanglaCAT for COCA-COLA Projects.

The Coca-Cola Bangladesh Beverages Power Plant project involves the import of key equipment such as CAT Diesel Generators, Switchgear, and Breakers, as well as the procurement of some local products. The procurement process for this project includes design services, material supply, installation of the power plant, and its subsequent commissioning. An engineering team is responsible for creating the technical specifications regarding the quantity, quality, and procedures for the project. Based on these designs and specifications, the project estimation is prepared. Once the estimation is complete, the procurement team moves forward with purchasing various goods and services according to the established schedules.

3.1 Procurement of Design Services for Installation Projects

Design services involve creative tasks performed by either in-house or contracted architects and engineers. The construction process relies on approved architectural plans, structural designs, and technical specifications. BanglaCAT has its own in-house design team responsible for creating the power house design for the 4MW power plant at Coca-Cola Bangladesh Beverages Ltd.

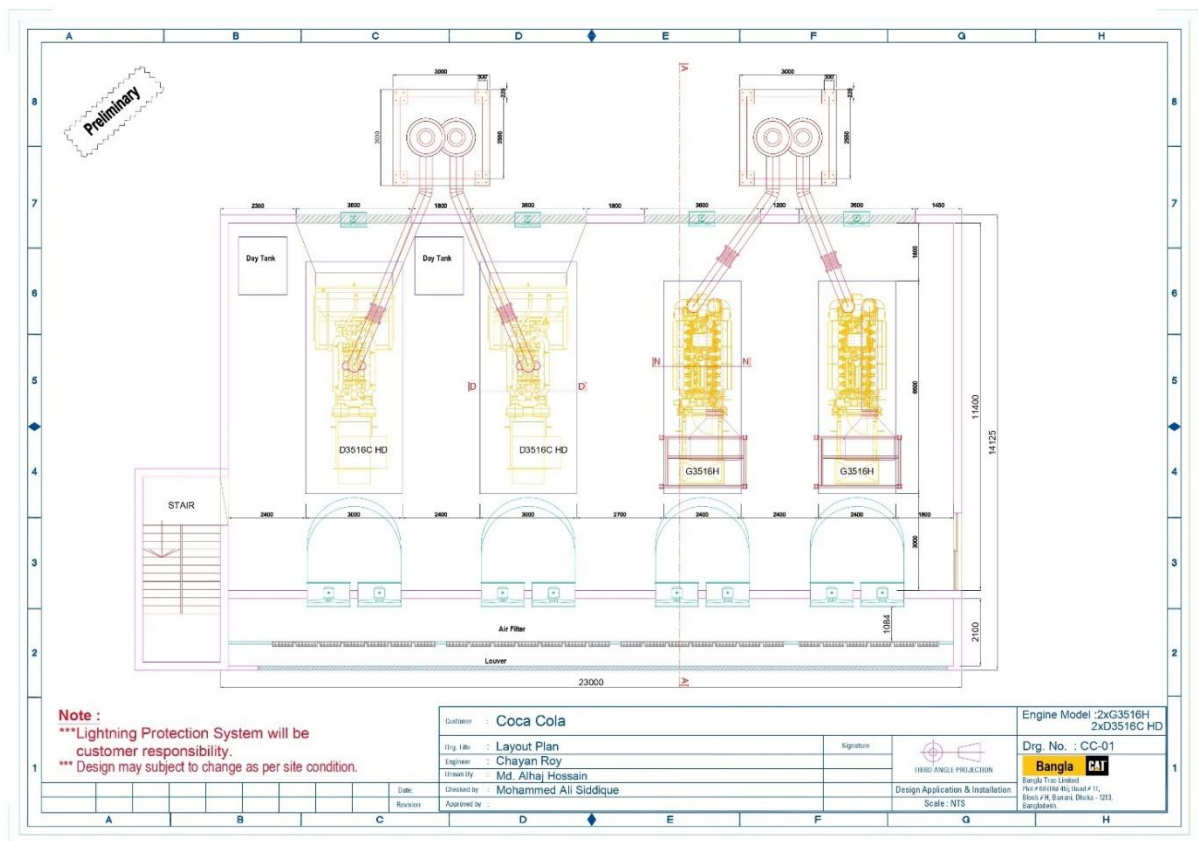


Figure 3.1: Approved design layout for 4MW diesel power plant for Coca-Cola Bangladesh Beverages Ltd.

Table 3.1: List of services for design

Sl. no.	Description of the Project
Coca-Cola Bangladesh Beverages Ltd.	
1.	2-unit 2000 MW Diesel Generator; Model: 3516C-HD
2.	2-unit Synchronization Panel
3.	1 unit Master Control Panel
4.	Switchgear panel
5.	Exhaust Structure
6.	Hot air ducting
7.	Earthing
8.	Jacketing

Source: Engineering Department, BanglaCAT

Design consultants are vital in the planning phase of a project. They coordinate with engineers, technical experts, and other key stakeholders involved in operations. Engineers, specifically, are crucial for planning, designing, supervising, and monitoring work quality and progress. The team evaluates the feasibility, economic viability, strength, and integrity of the project based on design analysis. They also facilitate communication with both the procurement and supply chain departments, as well as other internal and external stakeholders. Successful construction management depends on proper resource planning and stakeholder coordination at the project site.

3.2 Procurement of Materials and Supplies

The procurement and supply chain departments are responsible for sourcing and acquiring various supplies needed for construction work at the site. The engineering department at BanglaCAT generates requisitions for materials, specifying the required quality, quantity, and delivery schedule. The procurement department then moves forward with sourcing, identifying, and selecting materials according to the technical specifications, ensuring all necessary materials are obtained for the construction process. Major construction materials include Diesel Generators, Switchgear, Synchronization Panels, and Master Control Panels. Local construction work includes tasks such as building exhaust lines with exhaust structures, hot air ducting, jacketing, earthing, and others. The quantities of materials supplied for the project are listed in Table 3.2.

Table 3.2: List of Major Construction Supplies Used in the Project

Sr. No.	Bill of Quantities	Quantity	Unit
A.1	DG SYSTEM		
1	Supply, installation, testing & commissioning of 11KV, 2500 KVA DG set with all the standard accessories, 990L Fuel Tank, Cooling system Incoming Fan Ducting, Radiator Ducting, Air Filter Chamber System works	2	Set
	Loading & unloading, transportation, Container to base	2	Set
	2500Liter Fuel Tank, it will make by SWG-4mm MS Sheet	1	Set
	Radiator Hot air Ducting and Infornt of Ducting Lover	2	set
	Cool air Incoming Ducting from Blower Fan	2	Set
3	Supply, Loading & unloading, transportation, installation, testing & commissioning 11KV Power, Control, signaling cables, cable trays, cable tray supports & required installation accessories between DG set to Synchronising Panel for 2 nos 11KV DG (6feet wide x 70feet long and 3feet wide 60feet Long Ladder, Electrical Installation works Cable laying works) and 01-unit Master Control Panel	1	Lot
	Cable Ladder 72inch Wide	70	RFT
	Cable Ladder 36inch Wide	60	RFT
	Controll Cable Tray 6inch Wide	200	RFT
	Cable laying works with Cable Accessories Lux, Tie, Tape, (Without Any Cable)	1	Lot
4	Supply, Loading & unloading, transportation, installation, testing & commissioning earthing system (earth pit & earthing cable) for 2 nos 11KV DG (11sets Earthig Boring, Boring Depth 150RFT, Cooper Wire 12.7mm, GI Pipe, Earthing Pid etc.)	1	Lot
	Earthing Boring 150RFT	11	Set
	Earthing Cooper Wire 12.7mm per boring 150RFT	11	Set
	38mm dia GI Pipe Per Boring 150RFT	11	Set
	Earthing Cooper lead 25mm dia x 600mm long per boring 1pcs	11	Set
	Earting Bus bar with Insulator and Connecting Facility. Bus bar size- 200mm x 50mm x 12mm for earthing pit use	11	Set
	Earting Bus bar with Insulator and Connecting Facility. Bus bar size- 600mm x 50mm x 12mm	4	Set
	Earting Bus bar with Insulator and Connecting Facility. Bus bar size- 1200mm x 50mm x 12mm	1	Set
	Earthing Pid	11	Set
	Earthing Cable laying work from Earting pid to Generator Room	11	Set

5	Supply, installation, testing & commissioning of Fittings, accessories for 2 No 2500KVA DG set : Exhaust Piping including all required bend & accessories with required Rock wool Insulation /Cladding &30 Meters peak Chimney stack support fabricated from Various M.S. Section with 2 coat of Red oxide and 2 coat of finished Primer ,Lightning protection with Cu spike duly with Cu earthing cable connected along with Chimney to Earth Pit (All necessary accessories which required to complete the work.) (16inch pipe 240RFT, Chimney Stack support pipe 6inch dia 800RFT, MS Chanel, MS Angle etc.)	1	Set
	16Inch dia MS pipe 20Scheduel	240	RFT
	16inch Dia SS Flexible pipe	4	Pcs
	16inch dia MS Elbow	4	Pcs
	16inch dia MS Flange	12	Pcs
	Galied Gasket, Nut, Bolt, Washer, Welding Rod, Cutting Disk, Grinding Disk, Paint, Thinner, Brush, Roller etc.	2	Job
	50mm Rock Wool	100	Rolls
	SWG-24Aluminum Sheet	600	RFT
	SWG-18 GI Wire	30	KG
	Pop Rivit	6	Box
	6inch dia MS pipe for Stack Macking and pipe Support	860	RFT
	4x 2inch x 6mm U Channel 6M Length	30	Pcs
	2"x2"x 4mm MS Angle 6M Length	50	Pcs
	Square Plate 12" x12" x 12mm	12	Pcs
6	Supply, installation, testing & commissioning of fuel (desiel) piping for 2 No 2500KVA DG set, Fuel Reserver to Day Tank, Day Tank to 2sets Engine pipe line 1set Gear Pump. And Fittings	1	Lot
	Gear Pump	1	Set
	Pump Fitting, Foot Valve, Suction pipe, Delivery pipe, Y-Strainer, None Return Valve, Butter Fly Valve etc.	1	Job
	50mm dia MS Pipe, Elbow, Shocket, Ball Valve, Reserve Tank to Day Tank and Day tank to Generator Room Header.	390	Feet
	25mm dia MS Pipe, Elbow, Shocket, Ball Valve, Fuel line Room Header to Engine and Engine to day tank over load line	150	Feet
	Fuel Filter, Fuel Water Separator	2	Job
7	Room canopy (Lxwxh) 85x45x18 ft 75dB @1 mtr (Wall and Roof Acoustic panel Thickness 2inch Corek sheet and 2inch Rock wool= 4inch) 2pcs Outgoing lover box, 4pcs air incoming box, 6pcs Fan sound proof box, Wall and Roof Sound proof 8800SFT, 4pcs Residential type Silencer, Sound Proof and Fire Proof Door 2pcs,	1	Lot

Source: Procurement and Supply chain Department, BanglaCAT

3.3 Procurement of Works

As mentioned, my study focuses on the Design, Supply, Installation, and Commissioning of the 4MW Power Plant for Coca-Cola Bangladesh Beverages Ltd. For this purpose, two types of procurement were carried out: (i) contract agreements for internationally sourced items and (ii) contract agreements for locally sourced items. These contracts were established between BanglaCAT and the contractor based on competitive price quotations. A key component of the power plant, the 2 MW Diesel Generator, was sourced from Caterpillar Inc., and it will be imported from the USA within a specified timeline. The diesel generator is an in-house product for BanglaCAT, as they are the exclusive dealer of Caterpillar Inc. Other auxiliary imported products, such as the synchronization panel, switchgear panel, and master control panel, were sourced from the Netherlands and Turkey, and were supplied by qualified contractors through a competitive price quotation process. For various local construction tasks such as building the exhaust structure, hot air ducting, jacketing, earthing, cable ladder installation, fuel piping, and more, separate contractors were hired under a framework agreement. These contractors provided unit rate quotations, and all work was carried out by skilled contractors. The quantities for all types of installation works included in the procurement process are presented in Table 3.3.

Table 3.3(a): Quantity of Foreign procured Product for Cocacola Project

Sr. No.	Bill of Quantities	Quantity	Unit	COO	Type Of Contract
A.1	DG SYSTEM				
1	Supply, installation, testing & commissioning of 11KV, 2500 KVA DG set with all the standard accessories,	2	Set	USA	In House
2	Supply, Loading & unloading, transportation, installation, testing commissioning 11KV Power, Synchronizing Panel for 2 nos 11KV DG (6feet wide x 70feet long and 3feet wide 60feet Long Ladder, Electrical Installation works Cable laying works) and 01-unit Master Control Panel	1	Lot	Netherland	In House
3	MV Switchgear configuration (Synchronizing panel)	1	Lot	Turkey	Competitive price quotation (Third party Vendor)

Table 3.3(b): Quantity of Local procured Product for Cocacola Project

Sr. No.	Bill of Quantities	Quantity	Unit	Type Of Contract
A.1	DG SYSTEM			
1	Supply, installation, testing & commissioning of standard accessories, 990L Fuel Tank, Cooling system Incoming Fan Ducting, Radiator Ducting, Air Filter Chamber System works	2	Set	Competitive price quotation (Third party Vendor)
	Loading & unloading, transportation, Container to base	2	Set	Competitive price quotation (Third party Vendor)
	2500Liter Fuel Tank, it will make by SWG-4mm MS Sheet	1	Set	Competitive price quotation (Third party Vendor)
	Radiator Hot air Ducting and Infront of Ducting Lover	2	set	Competitive price quotation (Third party Vendor)
	Cool air Incoming Ducting from Blower Fan	2	Set	Competitive price quotation (Third party Vendor)
3	Supply, Loading & unloading, transportation, installation, testing & commissioning 11KV Power, Control, signaling cables, cable trays, cable tray supports & required installation accessories between DG set to Synchronizing Panel for 2 nos 11KV DG (6feet wide x 70feet long and 3feet wide 60feet Long Ladder, Electrical Installation works Cable laying works) and 01 unit Master Control Panel	1	Lot	Competitive price quotation (Third party Vendor)
	Cable Ladder 72inch Wide	70	RFT	Competitive price quotation (Third party Vendor)
	Cable Ladder 36inch Wide	60	RFT	Competitive price quotation (Third party Vendor)
	Controll Cable Tray 6inch Wide	200	RFT	Competitive price quotation (Third party Vendor)
	Cable laying works with Cable Accessories Lux, Tie, Tape, (Without Any Cable)	1	Lot	Competitive price quotation (Third party Vendor)
4	Supply, Loading & unloading, transportation, installation, testing & commissioning earthing system (earth pit & earthing cable) for 2 nos 11KV DG (11sets Earthig Boring, Boring Depth 150RFT, Cooper Wire 12.7mm, GI Pipe, Earthing Pid etc.)	1	Lot	Competitive price quotation (Third party Vendor)

	Earthing Boring 150RFT	11	Set	Competitive price quotation (Third party Vendor)
	Earthing Cooper Wire 12.7mm per boring 150RFT	11	Set	Competitive price quotation (Third party Vendor)
	38mm dia GI Pipe Per Boring 150RFT	11	Set	Competitive price quotation (Third party Vendor)
	Earthing Cooper lead 25mm dia x 600mm long per boring 1pcs	11	Set	Competitive price quotation (Third party Vendor)
	Earthing Bus bar with Insulator and Connecting Facility. Bus bar size- 200mm x 50mm x 12mm for earthing pit use	11	Set	Competitive price quotation (Third party Vendor)
	Earthing Bus bar with Insulator and Connecting Facility. Bus bar size- 600mm x 50mm x 12mm	4	Set	Competitive price quotation (Third party Vendor)
	Earthing Bus bar with Insulator and Connecting Facility. Bus bar size- 1200mm x 50mm x 12mm	1	Set	Competitive price quotation (Third party Vendor)
	Earthing Pid	11	Set	Competitive price quotation (Third party Vendor)
	Earthing Cable laying work from Earthing pid to Generator Room	11	Set	Competitive price quotation (Third party Vendor)
5	Supply, installation, testing & commissioning of Fittings, accessories for 2 No 2500KVA DG set : Exhaust Piping including all required bend & accessories with required Rock wool Insulation /Cladding & 30 Meters peak Chimney stack support fabricated from Various M.S. Section with 2 coat of Red oxide and 2 coat of finished Primer ,Lightning protection with Cu spike duly with Cu earthing cable connected along with Chimney to Earth Pit (All necessary accessories which required to complete the work.) (16inch pipe 240RFT, Chimney Stack support pipe 6inch dia 800RFT, MS Chanel, MS Angle etc.)	1	Set	Competitive price quotation (Third party Vendor)
	16Inch dia MS pipe 20Scheduel	240	RFT	Competitive price quotation (Third party Vendor)
	16inch Dia SS Flexible pipe	4	Pcs	Competitive price quotation (Third party Vendor)
	16inch dia MS Elbow	4	Pcs	Competitive price quotation (Third party Vendor)

	16inch dia MS Flange	12	Pcs	Competitive price quotation (Third party Vendor)
	Galied Gasket, Nut, Bolt, Washer, Welding Rod, Cutting Disk, Grinding Disk, Paint, Thinner, Brush, Roller etc.	2	Job	Competitive price quotation (Third party Vendor)
	50mm Rock Wool	100	Rolls	Competitive price quotation (Third party Vendor)
	SWG-24Aluminum Sheet	600	RFT	Competitive price quotation (Third party Vendor)
	SWG-18 GI Wire	30	KG	Competitive price quotation (Third party Vendor)
	Pop Rivit	6	Box	Competitive price quotation (Third party Vendor)
	6inch dia MS pipe for Stack Macking and pipe Support	860	RFT	Competitive price quotation (Third party Vendor)
	4x 2inch x 6mm U Channel 6M Length	30	Pcs	Competitive price quotation (Third party Vendor)
	2"x2"x 4mm MS Angle 6M Length	50	Pcs	Competitive price quotation (Third party Vendor)
	Square Plate 12" x12" x 12mm	12	Pcs	Competitive price quotation (Third party Vendor)
6	Supply, installation, testing & commissioning of fuel (desiel) piping for 2 No 2500KVA DG set, Fuel Reserver to Day Tank, Day Tank to 2sets Engine pipe line 1set Gear Pump. And Fittings	1	Lot	Competitive price quotation (Third party Vendor)
	Gear Pump	1	Set	Competitive price quotation (Third party Vendor)
	Pump Fitting, Foot Valve, Suction pipe, Delivery pipe, Y-Strainer, None Return Valve, Butter Fly Valve etc.	1	Job	Competitive price quotation (Third party Vendor)
	50mm dia MS Pipe, Elbow, Shocket, Ball Valve, Reserve Tank to Day Tank and Day tank to Generator Room Header.	390	Feet	Competitive price quotation (Third party Vendor)
	25mm dia MS Pipe, Elbow, Shocket, Ball Valve, Fuel line Room Header to Engine and Engine to day tank over load line	150	Feet	Competitive price quotation (Third party Vendor)
	Fuel Filter, Fuel Water Separator	2	Job	Competitive price quotation (Third party Vendor)

7	Room canopy (Lxwxh) 85x45x18 ft 75dB @1 mtr (Wall and Roof Acoustic panel Thickness 2inch Corck sheet and 2inch Rock wool= 4inch) 2pcs Outgoing lover box, 4pcs air incoming box, 6pcs Fan sound proof box, Wall and Roof Sound proof 8800SFT, 4pcs Residential type Silencer, Sound Proof and Fire Proof Door 2pcs,	1	Lot	Competitive price quotation (Third party Vendor)
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Source: Procurement and supply chain department, BanglaCAT

3.4 Quality Assurance of Installation Materials

The procurement department at BanglaCAT guarantees the quality of purchased materials according to the specifications provided by the engineering department. Before proceeding with any purchase, the procurement team sends construction material samples to the engineering department for quality testing. The engineering department conducts various tests to evaluate whether the materials meet the required quality standards. Once the materials pass the quality checks, the engineering department prepares test reports and recommends them to the procurement department if the materials meet the necessary specifications. The procurement department then proceeds with placing the purchase orders for the materials.

To ensure the desired level of quality, incoming construction materials are checked and inspected against several benchmarks, including:

- I. Ensuring that the received materials align with the specified technical requirements.
- II. Evaluating the capacity and reliability of suppliers before placing purchase orders.
- III. Performing material testing and inspections at designated intervals.
- IV. Obtaining necessary certifications from suppliers prior to accepting goods.
- V. Ensuring that materials are properly packaged and transported to prevent damage or deterioration during shipping.
- VI. Keeping accurate records of goods receipt notes when materials are delivered by suppliers.

At BanglaCAT, the primary focus is on ensuring that only the highest quality construction materials are used to meet the project's desired standards.

Chapter Four:

Management of procurement of supplies for Coca-Cola Project

BanglaCAT typically follows a centralized procurement strategy for purchasing installation services based on the requirements of customer sites. Given the large volume of installation materials needed for customer sites, a centralized approach is more effective in achieving economies of scale by consolidating requirements. This strategy optimizes the use of expertise, ensures efficient storage and distribution, and reduces administrative costs. The procurement department at BanglaCAT holds overall responsibility for purchasing and supplying materials to project sites. The management of BanglaCAT's procurement and supply processes is detailed in the following sections.

4.1 Planning of Procurement

Effective planning of construction materials is key to the success of a project. The engineering department at BanglaCAT prepares a service material requirement plan and specifications based on customer needs. The procurement department at BanglaCAT then procures all installation materials as per the requisition raised by the engineering department, aligned with customer requirements. The procurement planning process at BanglaCAT is outlined as follows:

Evaluation of Construction Materials by the Engineering Team

The engineering department at BanglaCAT is responsible for ensuring the quality and compliance of materials according to the customer's quality standards. The engineering team prepares technical specifications and a bill of quantities for each project, assessing the material grades needed for construction. During the project implementation phase, structural designs and drawings are often revised due to changes in the production machine layout, which affects the process flow. To minimize these challenges, the team must focus more on the early stages of the design and implementation phases.

Preparation of Project Materials Price Database:

Before starting any project, a list of required materials is prepared. The procurement department collects this list from the engineering project team. The materials vary in size, quality grades, and brands, depending on their intended function and strength. The procurement team conducts market surveys to check the availability and pricing of the materials. Based on this market analysis, the procurement department compiles a preliminary materials price database.

Sourcing of Material Suppliers:

BanglaCAT typically adopts a multiple sourcing strategy to avoid being locked into a single supplier. In single sourcing, the supplier holds more power, especially when they provide large quantities compared to the buyer's smaller demand. In contrast, the multiple sourcing strategy gives the buyer more leverage, offering alternative options for sourcing materials. This approach ensures competitive pricing, increased reliability, and flexibility in order quantities.

4.2 Identifying the Needed Materials for Project Implementation

As outlined in Chapter 3, the quantities for all construction materials were estimated. Technical specifications were created, along with a bill of quantities for the materials and work required. A material requirement plan is then developed for each project, based on its specific construction phase.

4.3 Development of Contractual Terms

The procurement department at BanglaCAT creates contract terms depending on the type of procurement, whether it's works, goods, or services, and whether it's a local or international procurement. These written terms define the responsibilities and duties of both the supplier or contractor and the buyer, forming the core of the agreement. The contract terms are legally binding and ensure that all legal requirements are met. The agreement specifies the procured items, rates, payment schedules, and other key details. For international procurements, transactions are managed through foreign banks. If the contract is breached, the law provides

the affected party with the right to seek legal remedies, such as compensation or contract termination.

4.4 Selection of Suppliers

The procurement department at BanglaCAT places significant emphasis on selecting the right suppliers. The performance of the project heavily depends on having the right suppliers, as they play a crucial role in delivering materials on time and maintaining quality. Choosing the right supplier is particularly critical in a competitive market. BanglaCAT typically selects multiple potential suppliers for each category of materials, using various criteria to ensure that the best suppliers are chosen for each procurement need.

4.4.1 Selection Criteria Followed in BanglaCAT

The selection criteria for potential suppliers at BanglaCAT include factors such as quality, price, value for money, reliability, flexibility, and responsiveness.

4.4.1.1 Quality Control of Materials: Quality refers to the standard of works, goods, and services set in the technical specifications, covering aspects like design strength, product quality, compliance, and durability of the power generation system. In BanglaCAT projects, all procurements are completed according to technical specifications. The Engineering Team ensures the quality of foreign engineering materials through Factory Acceptance Testing (FAT) and Site Acceptance Testing (SAT). For locally sourced products, engineers review test reports and conduct SAT. BanglaCAT procures all goods, services, and works from responsive sources. The procurement department issues purchase orders for locally sourced items and sends the Proforma Invoice (PI) to open a Letter of Credit (LC) for foreign items. Continuous quality control at all project stages ensures the desired strength and compliance.

4.4.1.2 Price of Materials: The procurement department at BanglaCAT creates a preliminary price database through market analysis. Price quotations are requested from multiple suppliers for specific goods, services, and works, and a comparative statement is prepared based on these quotations. The procurement team analyzes all quotations and compares them with the internally developed price database. BanglaCAT emphasizes obtaining the right quality and timely delivery rather than focusing solely on price. Their approach includes considering the

total cost of ownership, which encompasses operating, storing, environmental impacts, transportation, and disposal costs.

4.4.1.3 Value for Money: BanglaCAT assesses the purpose and functionality of the goods, services, and works to determine value for money. They avoid using cheap materials in power systems, as the lower initial cost does not always lead to long-term savings. Instead, investing in higher-priced materials can result in more durable infrastructure. BanglaCAT evaluates the supplier's proven track record, material quality, and ability to deliver the right quantity on time.

4.4.1.4 Reliability: BanglaCAT prioritizes reliable suppliers who can consistently deliver goods or services at the required quantity, quality, and time. Reliable suppliers help minimize the risk of material shortages, ensuring that the construction work progresses on schedule and at the right price.

4.4.1.5 Flexibility: BanglaCAT seeks flexible suppliers with whom they maintain long-term relationships. Flexible suppliers can quickly adapt to changing customer demands, helping to meet evolving project requirements.

4.4.1.6 Responsiveness: The procurement department at BanglaCAT evaluates potential suppliers and contractors to ensure they meet the eligibility criteria set by Bangladesh Government regulations. Those who comply are considered responsive suppliers and contractors, able to fulfill specific project needs effectively.

4.4.2 Selection Process in BanglaCAT

Request for Quotation: BanglaCAT invites responsive suppliers and contractors to submit rate quotations for various categories of goods, works, and services. The request for quotation outlines key details such as quality and quantity specifications, project timelines, and contract terms.

Shortlisting Potential Suppliers: The procurement department at BanglaCAT reviews all submitted quotations and selects the top three to five potential suppliers. The shortlisting

process involves assessing the quality of the supplies, stock availability, delivery timelines, and price. Additionally, BanglaCAT ensures the following criteria are met by the suppliers:

- Capability to deliver as required.
- Financial stability of the supplier or contractor.
- Length of experience in similar business activities.
- Recommendations and references from previous clients.
- Compliance with necessary licenses and regulations as per Bangladesh Government rules.

Once potential suppliers are shortlisted, BanglaCAT checks their interest in forming a business agreement. This stage provides a clear summary of BanglaCAT's requirements and outlines how the selected supplier can meet those needs for the construction project.

Negotiating the Best Value: BanglaCAT evaluates both the technical and financial proposals from the shortlisted suppliers and contractors. If the bidders meet the technical requirements—delivering the right quality and quantity within the specified timeline—BanglaCAT moves forward with financial negotiations. In most cases, BanglaCAT favors suppliers and contractors with whom they have had previous successful collaborations. Rather than focusing solely on price, BanglaCAT prioritizes finding suppliers and contractors who offer the best overall value and support for the project.

4.5 Awarding the Contract

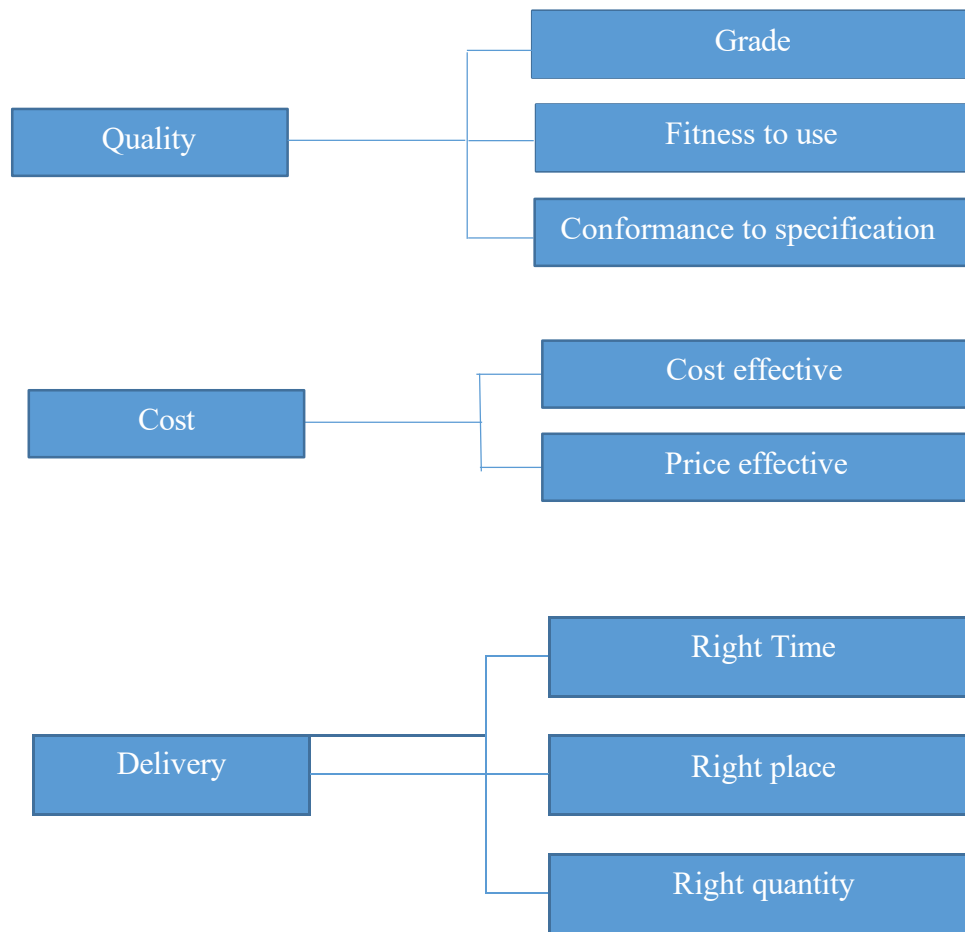
Contracts are awarded to qualified suppliers or contractors after evaluating their technical and financial proposals, with a primary focus on the technical proposal as the key factor in determining the best value. The technical proposal outlines the necessary expertise to meet the project's objectives, the contractor's past experience with similar projects, the available tools and equipment, human resources, and the proposed timeline. The financial proposal, meanwhile, reflects the supplier's or contractor's financial stability and capacity to offer the best value for BanglaCAT. The contract is granted to the supplier or contractor who offers the most comprehensive value for money.

4.6 Monitoring and Evaluation

Supplier performance is assessed based on indicators such as timely delivery, accurate quantity, correct quality, competitive pricing, technical services, and overall quality management. BanglaCAT follows a standard evaluation procedure to assign grades to new and existing suppliers or contractors. The evaluation grades serve as benchmarks and help formulate corrective action plans for future performance. BanglaCAT offers incentives or rewards for excellent performance and may de-list suppliers or contractors whose performance falls below acceptable standards.

Overall, the procurement of necessary supplies follows a framework focused on quality, cost, and on-time delivery (see **Figure 4.1**). The quality of materials should meet the required grade and be fit for use according to specifications. Initial cost is not the primary criterion in the supplier evaluation process; rather, the total cost of ownership is the key factor. This total cost includes the unit price of goods, services, and works, payment terms, lead time, cash discounts, transportation costs, logistics, and maintenance costs. BanglaCAT ensures cost-effective procurement strategies to achieve effective pricing. Value is also determined by the supplier's ability to deliver on time, as this reduces waste associated with raw materials, inventory, storage, and transport costs. Suppliers who consistently deliver on time can provide additional value by minimizing the risk of material shortages, cutting unnecessary transport expenses, and lowering inventory and storage costs.

Figure 4.1: Flowchart for Material Quality, Price, and Delivery Checklist by BanglaCAT



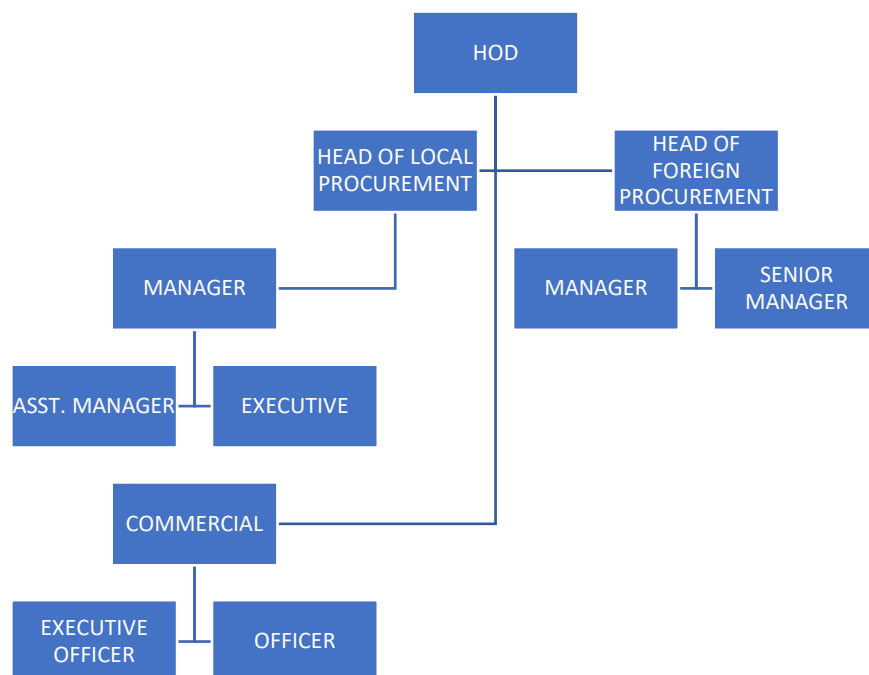
Source: BanglaCAT Procurement and supply chain Department

Chapter Five:

Role of Procurement and Supply Chain Management in Timely and Quality Coca-Cola Project Implementation

BanglaCAT has a dedicated procurement and supply chain management department responsible for completing the Power Plant Project for Coca-Cola Bangladesh Beverages Ltd. This department focuses on ensuring that all required materials are supplied in the right quality, quantity, and delivered to the right place, using cost-effective strategies. They work with a variety of suppliers for materials, including nuts, bolts, MS sheets, and more. During the implementation of the procurement activities, the department encountered various challenges but worked to mitigate these issues effectively.

Figure 5.1: Organogram of BanglaCAT Procurement and supply chain department



5.1 Purchasing Strategy Development

The procurement department at BanglaCAT is responsible for sourcing all materials, with strategies that differ depending on whether the materials are sourced locally or internationally. The materials are categorized into four groups:

1. **Non-Critical Items:** These materials are easily available in the local market, require short procurement timelines, and involve transactional relationships with suppliers.
2. **Leverage Items:** These are sourced from multiple local suppliers, carry low supply risks, and provide BanglaCAT with competitive advantages.
3. **Strategic Items:** For these, BanglaCAT maintains long-term, collaborative relationships with suppliers, often sourcing materials from abroad. Frequent analysis and risk management are necessary to maintain these relationships.
4. **Bottleneck Items:** These materials are scarce in the market, have small quantities, but are urgently needed. BanglaCAT maintains long-term relationships with suppliers to ensure timely delivery.

5.2 Evaluation of Needs and Supplier Capabilities

When purchasing strategic items, BanglaCAT benchmarks supplier performance to assess their ability to meet project requirements. The procurement department evaluates the project's needs and analyzes the supplier market to ensure the right suppliers are selected at competitive prices. A database of potential suppliers is maintained, with their capabilities assessed for each procurement category. The department then sets objectives for timely project completion and creates a plan to supply materials according to the schedule.

5.3 Selection of Potential Suppliers and Building Relationships

BanglaCAT's procurement department selects multiple potential suppliers for necessary goods, services, and works. They maintain long-term, collaborative relationships with suppliers based on procurement needs. Relationship development is essential for ensuring that suppliers deliver the right quality, quantity, and on-time deliveries.

5.4 Preparing Contract Documents and Awarding Contracts

The procurement department at BanglaCAT drafts the required contract documents, such as the scope of work, contract data sheet, supplier instructions, specifications, and both general and special conditions. The department assesses the suppliers' ability to meet the project requirements. Quotations are obtained from qualified suppliers, and the supplier offering the best value is awarded the contract.

5.5 Ordering

At the operational level, ensuring the availability of the main project component, the Diesel Generator, is crucial. Once the Letter of Credit (LC) from the customer is received, BanglaCAT proceeds with ordering the Diesel Generator from Caterpillar as per the customer's specifications, aiming to meet the delivery schedule. Additionally, the procurement department orders all foreign auxiliary products and ensures that they arrive at Chittagong port simultaneously. For local work, BanglaCAT selects the most feasible suppliers and issues purchase orders to maintain the project timeline.

5.6 Compliance and Quality Assurance

The procurement department ensures that all goods, services, and works are sourced from suppliers and contractors who comply with relevant regulations and standards. Maintaining quality is a critical aspect of the procurement process. The department continuously monitors supplier performance to prevent any lapse in quality. Supplier performance is assessed using indicators such as:

- On-time delivery rate of materials
- Lead time for delivery to the site
- Rate of defective materials

The department also assesses how promptly suppliers respond to emergencies and frequently visits sourcing points to make strategic adjustments. For foreign products, a Factory Acceptance Test (FAT) is scheduled at the manufacturing plant to ensure quality, while Site Acceptance Tests (SAT) are conducted for locally sourced products.

5.7 Material Management

Effective material procurement and management are vital for construction success. BanglaCAT oversees materials through a detailed process that includes assessing needs, planning, sourcing, purchasing, transporting, sorting, controlling, and minimizing waste to enhance profitability. Proper material management ensures optimal project performance through careful resource planning, incorporating the following key activities:

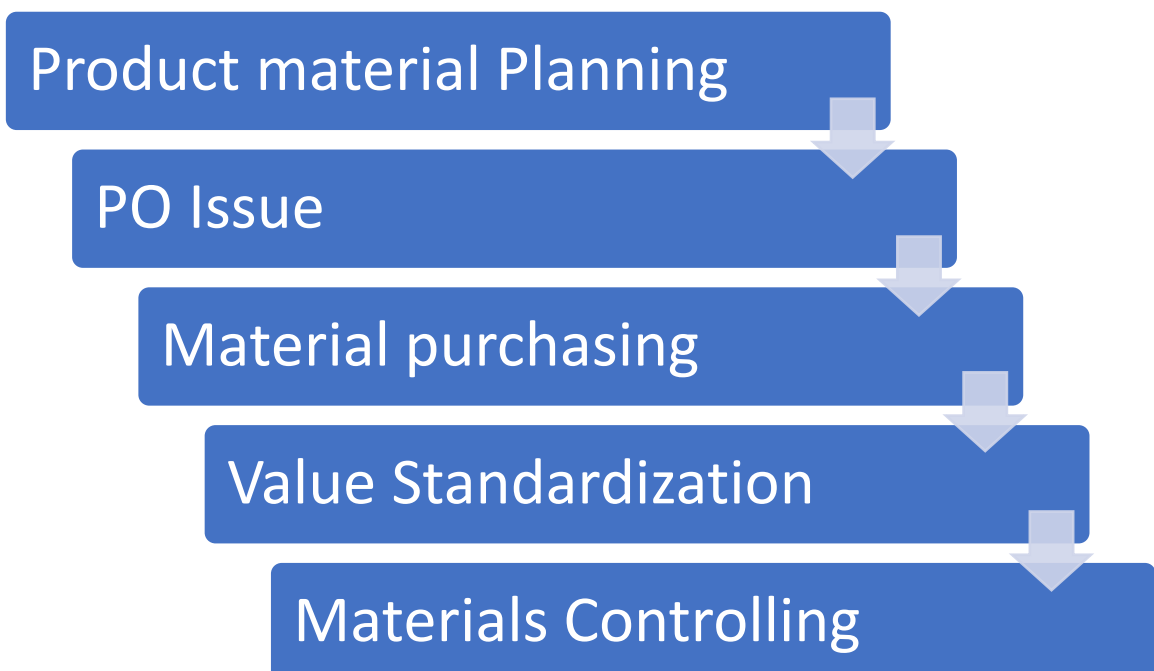
- Estimating, budgeting, and planning materials
- Scheduling and purchasing
- Inspecting and receiving materials
- Warehousing and inventory control
- Handling and transporting materials
- Managing waste

A detailed step-by-step material management process is shown in Figure 5.2.

Figure 5.2 (a): Flow diagram of Foreign product management of BanglaCAT



Figure 5.2 (b): Flow diagram of Local product management of BanglaCAT



5.8 Procurement Challenges

Throughout the project implementation, the supply chain encountered multiple challenges related to managing materials.

Delays: One of the main challenges encountered was delays in shipping. For internationally sourced materials, the shipment times were initially long, and after placing the orders, shipments were delayed for over two months due to material shortages. The situation worsened due to the Russia-Ukraine war, which disrupted supply chains. After the products were completed, there was an additional delay of over a month in scheduling the vessels for shipment. For locally sourced parts, delays occurred because local vendors faced difficulties collecting materials from the port due to lengthy procedures at Chittagong port. Additionally, some supplies were not clearly identified with the appropriate levels of quantity, quality, and milestones, which caused further delays.

Lack of Communication: There were communication issues between the suppliers and the procurement department, resulting in delays in material supply. Some materials were supplied either too early or too late, causing misalignments with project timelines. Some materials were not needed immediately, while others were urgently required but delayed.

Change in Design: Several changes were made to the machine layout and, subsequently, the power plant layout. These changes created significant challenges in planning, budgeting, rescheduling, and coordinating material deliveries to the site.

Change in Technical Specifications: Maintaining the required quality level for supplies or works based on customer specifications is critical. The engineering team at BanglaCAT prepared technical specifications that included the dimensions and quality required for materials. However, due to the unavailability of certain products in the market, the engineers had to revise technical specifications and source alternative products.

Wastage: Wastage occurred due to repeated changes in the layout. For example, additional cables were needed, leading to excess waste, idle investments, and increased project costs.

FX Rate Fluctuations: The procurement department had to frequently adjust the cost estimates due to fluctuating market prices. In 2022, the exchange rate increased significantly, which affected the cost of internationally sourced products, as well as local products. To manage this, the procurement department worked closely with suppliers to discuss price adjustments and reschedule material deliveries.

To prevent material shortages, over-purchasing, and waste, the procurement team closely monitored shipping times and external supply markets. By creating contingency plans to address potential supply shortages, the team helped avoid operational shutdowns and ensured that the project was completed on time.

Table 5.1(a): Product wise delay in Coca-Cola Projects (Foreign Sourced)

Sr. No.	Bill of Quantities		Delays Due To				
A.1	DG SYSTEM	Technical specification related delays	Product ion Delays	Material Scarcity	Vessel Schedule Delays	Port Delays	Total Delays (Days)
1	Supply, installation, testing & commissioning of 11KV , 2500 KVA DG set with all the standard accessories,	90	20	30	07	20	167
2	Supply, Loading & unloading, transportation, installation, testing commissioning 11KV Power, Synchronizing Panel for 2 nos 11KV DG (6feet wide x 70feet long and 3feet wide 60feet Long Ladder, Electrical Installation works Cable laying works) and 01 unit Master Control Panel	90	10	10	15	20	145
3	MV Switchgear configuration (Synchronizing panel)	90	15	30	10	10	155
	Total Delays Category wise	270	45	70	32	50	467
	% Delays Category wise	57.81%	9.63%	14.9%	6.85%	10.7%	100%

Table 5.1(b): Product wise delay in Coca-Cola Projects (Locally Sourced) as per annex-II

Sr. No.	Bill of Quantities	Delays Due to					Total Delays
		Technical Delays	Production Delays	Material Scarcity	Decision Pending	Natural Calamity	
A.1	DG SYSTEM						
1	Supply, installation, testing & commissioning of standard accessories, 990L Fuel Tank, Cooling system Incoming Fan Ducting, Radiator Ducting, Air Filter Chamber System works	10	20	0	5	3	38
2	Supply, Loading & unloading, transportation, installation, testing & commissioning 11KV Power, Control, signaling cables, cable trays, cable tray supports & required installation accessories between DG set to Synchronising Panel for 2 nos 11KV DG (6feet wide x 70feet long and 3feet wide 60feet Long Ladder, Electrical Installation works Cable laying works) and 01-unit Master Control Panel	15	15	0	5	3	38
3	Supply, Loading & unloading, transportation, installation, testing & commissioning earthing system (earth pit & earthing cable) for 2 nos 11KV DG (11sets Earthing Boring, Boring Depth 150RFT, Cooper Wire 12.7mm, GI Pipe, Earthing Pid etc.)	12	42	0	5	3	62
4	Supply, Installation, Testing, and Commissioning of Fittings and Accessories for Two 2500KVA DG Sets: This includes exhaust piping (16-inch, 240 feet), chimney stack support (6-inch, 800 feet), rock wool insulation/cladding, and a	4	10	30	5	3	52

	30-meter peak chimney stack fabricated from M.S. sections with red oxide and primer coatings. Lightning protection with copper spike and earthing cable connected to the chimney and earth pit. The work also covers all required accessories such as M.S. channels and angles.						
5	Supply, installation, testing & commissioning of fuel (desiel) piping for 2 No 2500KVA DG set, Fuel Reserver to Day Tank, Day Tank to 2sets Engine pipe line 1set Gear Pump. And Fittings	0	5	10	5	3	23
6	Room canopy (Lxwxh) 85x45x18 ft 75dB @1 mtr (Wall and Roof Acustic panel Thickness 2inch Corck sheet and 2inch Rock wool= 4inch) 2pcs Out going lover box, 4pcs air incoming box, 6pcs Fan sound proof box, Wall and Roof Sound proof 8800SFT, 4pcs Residential type Silencer, Sound Proof and Fire Proof Door 2pcs,	10	12	24	5	3	54

Chapter Six:

Conclusion and recommendations

6.1 Conclusion

BanglaCAT, as an import-oriented organization, faced challenges in completing the Coca-Cola Bangladesh Beverages Ltd. power plant project on time. Changes in the operational layout, design, and technical specifications caused delays in procurement and material flow management. Despite efforts to ensure timely delivery, material shortages, road strikes, and price hikes led to significant delays. International purchases faced delays mainly due to technical issues, production delays, and material unavailability, while local purchases were delayed due to technical problems, production issues, and external factors such as natural calamities. BanglaCAT's procurement department worked closely with suppliers and conducted extensive quality checks, including FAT at Caterpillar's USA factory and SAT during implementation, ensuring the quality of the materials and systems. Although the project faced delays, the team's proactive approach to managing the supply chain and quality helped mitigate risks and ensure the successful completion of the project.

6.3 Recommendations for Further Research

1. Involving machine suppliers early in the design phase could help reduce procurement delays. Future research should focus on sourcing materials as a key cause of delays.
2. Future studies should assess the total costs incurred by delays, including construction, production start, and investment returns if production had started on time.
3. Future research should explore the interdependence of delays in procurement and supply chains, examining the cascading effects of one delay on others.

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Annex I: List of respondents interviewed for this study

Respondents from procurement and supply chain

1. Mr. Tipu Sultan, AGM, Procurement and Supply Chain Department, CCBBL
2. Mr. Imran Hossain, Head of Department, Procurement and Supply Chain Department, BanglaCAT
3. Mr. Saddam Khan, AGM, Procurement and Supply Chain Department, BanglaCAT.
4. Mr. Humayun Kabir, GM, Procurement and Supply Chain Department, BanglaCAT
5. Mr. Ashis Kumar, Asst. Manager, Procurement & Supply Chain Department, Healthcare Pharmaceuticals Ltd.

Respondents from engineering side

1. Mr. Mamun, Head of Engineering, Technical Service Department, CCBBL
2. Engr. Siddique, Head of Design , Engineering Department, BanglaCAT
3. Engr. Atiqur Rahman, Head of Commissioning, Engineering Deptment, BanglaCAT
4. Engr. Hannan, Manager, Engineering Department, BanglaCAT
5. Engr. Towhidul Islam, Sr. Executive, Engineering Department, BanglaCA

Respondents from contractors

1. Mr. Ruhul Majid, Chairman of Rayes Ltd. and Director of Bangladesh Building System Ltd. and BBS Cable
2. Mr. Sentu, Aziz Construction, Founder Chairman

Respondents from suppliers

1. Mr. Mintu, Quality Product Ltd.,
2. Mr. Shamin, MJ Engineering Ltd.

Responded from labors side

1. Mr. Mohan, Forman, Quality Product Ltd
2. Mr. Babul, Forman, MJ Engineering Ltd

Annex II: Table 5.1(b): Product wise delay in Coca-Cola Projects (Locally Sourced)

Sr. No.	Bill of Quantities	Delays Due to					Total Delays
		Technical Delays	Production Delays	Material Scarcity	Decision Pending	Natural Calamity	
A.1	DG SYSTEM						
1	Supply, installation, testing & commissioning of standard accessories, 990L Fuel Tank, Cooling system Incoming Fan Ducting, Radiator Ducting, Air Filter Chamber System works	10	20	0	5	3	38
	Loading & unloading, transportation, Containeer to base	0	60	0	5	3	68
	2500Liter Fuel Tank, It will make by SWG-4mm MS Sheet	10	0	0	5	3	18
	Radiator Hot air Ducting and Infornt of Ducting Lover	5	0	0	5	3	13
	Cool air Incoming Ducting from Blower Fan	12	0	0	5	3	20
3	Supply, Loading & unloading, transportation, installation, testing & commissioning 11KV Power, Control, Signaling cables, cable trays, cable tray supports & required installation accessories between DG set to Synchronising Panel for 2 nos 11KV DG (6feet wide x 70feet long and 3feet wide 60feet Long Ladder, Electrical Installation works Cable laying works) and 01 unit Master Control Panel	15	15	0	5	3	38
	Cable Ladder 72inch Wide	3	0	0	5	3	11

	Cable Ladder 36inch Wide	4	0	0	5	3	12
	Controll Cable Tray 6inch Wide	0	0	0	5	3	8
	Cable laying works with Cable Accessories Lux, Tie, Tape, (Without Any Cable)	12	0	0	5	3	20
4	Supply, Loading & unloading, transportation, installation, testing & commissioning earthing system (earth pit & earthing cable) for 2 nos 11KV DG (11sets Earthing Boring, Boring Depth 150RFT, Cooper Wire 12.7mm, GI Pipe, Earthing Pid etc.)	12	42	0	5	3	62
	Earthing Boring 150RFT	2	4	0	5	3	14
	Earthing Cooper Wire 12.7mm per boring 150RFT	23	0	0	5	3	31
	38mm dia GI Pipe Per Boring 150RFT	3	0	0	5	3	11
	Earthing Cooper lead 25mm dia x 600mm long per boring 1pcs	3	0	0	5	3	11
	Earting Bus bar with Insulator and Connecting Facility. Bus bar size- 200mm x 50mm x 12mm for earthing pit use	5	0	0	5	3	13
	Earting Bus bar with Insulator and Connecting Facility. Bus bar size- 600mm x 50mm x 12mm	6	0	0	5	3	14
	Earting Bus bar with Insulator and Connecting Facility. Bus bar size- 1200mm x 50mm x 12mm	7	0	0	5	3	15
	Earthing Pid	2	8	0	5	3	18
	Earthing Cable laying work from Earting pid to Generator Room	6	7	0	5	3	21

5	Supply, Installation, Testing, and Commissioning of Fittings and Accessories for Two 2500KVA DG Sets: This includes exhaust piping (16-inch, 240 feet), chimney stack support (6-inch, 800 feet), rock wool insulation/cladding, and a 30-meter peak chimney stack fabricated from M.S. sections with red oxide and primer coatings. Lightning protection with copper spike and earthing cable connected to the chimney and earth pit. The work also covers all required accessories such as M.S. channels and angles.	4	10	30	5	3	52
	16Inch dia MS pipe 20Scheduel	4	0	0	5	3	12
	16inch Dia SS Flexible pipe	5	0	0	5	3	13
	16inch dia MS Elbow	6	0	0	5	3	14
	16inch dia MS Flange	1	0	0	5	3	9
	Galied Gasket, Nut, Bolt, Washer, Welding Rod, Cutting Disk, Grinding Disk, Paint, Thinner, Brush, Roller etc.	3	0	0	5	3	11
	50mm Rock Wool	7	0	0	5	3	15
	SWG-24Aluminum Sheet	4	0	0	5	3	12
	SWG-18 GI Wire	3	0	0	5	3	11
	Pop Rivit	0	0	0	5	3	8
	6inch dia MS pipe for Stack Macking and pipe Support	0	0	0	5	3	8
	4x 2inch x 6mm U Channel 6M Length	0	0	0	5	3	8
	2"x2"x 4mm MS Angle 6M Length	0	0	0	5	3	8
	Square Plate 12" x12" x 12mm	0	0	0	5	3	8

6	Supply, installation, testing & commissioning of fuel (desiel) piping for 2 No 2500KVA DG set, Fuel Reserver to Day Tank, Day Tank to 2sets Engine pipe line 1set Gear Pump. And Fittings	0	5	10	5	3	23
	Gear Pump	6	0	0	5	3	14
	Pump Fitting, Foot Valve, Suction pipe, Delivery pipe, Y-Strainer, None Return Valve, Butter Fly Valve etc.	0	0	0	5	3	8
	50mm dia MS Pipe, Elbow, Shocket, Ball Valve, Reserve Tank to Day Tank and Day tank to Generator Room Header.	0	0	0	5	3	8
	25mm dia MS Pipe, Elbow, Shocket, Ball Valve, Fuel line Room Header to Engine and Engine to day tank over load line	0	0	0	5	3	8
	Fuel Filter, Fuel Water Separator	0	0	0	5	3	8
7	Room canopy (Lxwxh) 85x45x18 ft 75dB @1 mtr (Wall and Roof Acoustic panel Thickness 2inch Corck sheet and 2inch Rock wool= 4inch) 2pcs Out going lover box, 4pcs air incoming box, 6pcs Fan sound proof box, Wall and Roof Sound proof 8800SFT, 4pcs Residential type Silencer, Sound Proof and Fire Proof Door 2pcs,	10	12	24	5	3	54
	Total Delays Category wise	193	183	64	205	123	768
	% Delays Category wise	25.1302083%	23.828125%	8.333333333%	26.69271%	16.01563%	100%