Role of procurement and supply chain management in construction project performance: A case on Pakiza Industrial Park

By

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Declaration

It is hereby declared that

1. The thesis submitted is my/our own original work while completing degree at Brac University.
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.
4. I have acknowledged all main sources of help.

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Approval

The thesis "Role of procurement and supply chain management in construction project performance: A case on Pakiza Industrial Park" submitted by Tushar Kanti Das, 17182010 of 7th Semester, 2019 year has been accepted as satisfactory in partial fulfillment of the requirement for the degree of Masters of Procurement & Supply Management.

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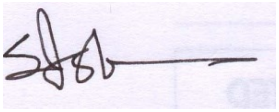

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Abstract

Construction supply chain consists of flows of information, materials, labor availability, necessary construction tools and probationary work, which are organized from several stakeholders such as contractors, suppliers, subcontractors, engineer and architects. Construction project is always unique and complex. Any shortcoming of this flow during project implementation disrupts construction progress performance. The aim of this study is to analyze the role of procurement and supply chain activities on construction project performance. To achieve the study goal, data were collected from various sources. Interviews were conducted with procurement and supply chain team and suppliers, contractors, engineers and associate stakeholders of construction project. To get first hand observation I have also visited ongoing construction site several times. It was found that problems in materials flow and layout change caused major disruption in project performance. Problems in materials flow occurred due to material unavailability. These shortage and unavailability of materials at site during construction period indicate how supply chain makes delay and what negative impact may happen in completion of project execution timely. Based on these insights, the study puts forward suggestions to overcome and generate a significant approach for successful construction project performance.

Keywords: Procurement, Supply chain, Construction, materials supply, delays.

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List of Acronyms

ADB	Asian Development Bank
BoQ	Bill of Quantities
CIPS	Chartered Institute of Purchasing & Supply
Sqft	Square feet

Chapter 1

Introduction

1.1 Background of the Study

Pakiza Group plans to construct Industrial Park at Narshingdi Bangladesh, which comprises of Pakiza Apparels Limited and Pakiza Woven Fashion Limited. The detailed construction works include two storied 96,000 square feet (sq ft) footprint per floor dyeing unit, three storied 40,000 sq ft footprint per floor warehouse, four storied 15,000 sq ft per floor utility building, three storied 35,000 sq ft yarn dyeing unit, three storied 45,000 sq ft allover printing dyeing unit, 6000 cubic meter per day disposal capacity effluent treatment plant, and internal rigid pavement road constructions. To accomplish the project the Group engaged a cross functional team for procurement of services, works and supplies. The team comprises of consultants, architects, engineers, and workers who were hired through service level agreement. A service level agreement is an agreement between two or more parties where one is the customer and other is service provider. Broadly a designated supply chain department looks after all types of supplies of construction project. This department selects suppliers to supply construction materials such as rod, cement, sand, stone chips, bricks, tiles, marbles, glass, aluminum channel, granite and plumbing, and sanitary fitting-fixings. Construction works are carried out in orderly manner, that required timely delivery of particular construction materials. The timely delivery and ensuring

quality of these items appear to be crucial factors to finish construction works within scheduled time frame. Any disruption in construction materials supply causes delay in the project, also increases the cost and hampers the quality of construction. So, the procurement of construction supplies should be managed properly to complete the Pakiza Industrial Park within stipulated timeframe. In this context, the study examines the role of procurement and supply chain management in Pakiza Industrial Park construction works.

1.2 Objectives of the study

This study aims to examine the role of procurement and supply chain management in construction project performance with particular focus for Pakiza Industrial park construction project. This goal will be obtained through the following study objectives.

- To identify types of procurement and supplies required in construction of Pakiza Industrial Park.
- To describe the management of procurement and supplies for those projects.
- To evaluate the role of procurement and supply chain management to complete construction work timely and with quality.

1.3 Methodology of the study

The study will be based on reviews of general literature on procurement and supply chain management and project documents related to Pakiza Industrial Park construction, and primary information which were collected through interviews with project officials, contractor, suppliers and supply chain management experts. Since the author is playing a key role in this construction project, his insights and observations were utilized to elaborate the

study objectives. Broad categories of respondents interviewed for this study are given in Table 1.1 and their details are provided in Annex 1.

Table 1.1: Broad categories of respondents interviewed for this study

Respondent category	Number of respondents
Respondents from procurement and supply chain	7
Respondents from engineering side	5
Respondents from contractors	2
Respondents from suppliers	3
Responded from labors side	2

1.4 Report structure

The study report is organized into six chapters. Chapter 1 presents the background, objectives and methodology of the study. Chapter 2 provides a general description of various concepts and issues of procurement and supply chain, and activities of procurement and supply chain department. Chapter 3 describes procurement and supplies of Pakiza Industrial Park and its related issues. Chapter 4 presents procurement planning, supplier selection and awarding, construction materials delivery and quality control of services, works and goods which were undertaken in management of procurement of supplies for Pakiza Industrial Park. Role of procurement and supply chain management to complete construction work timely and with quality is described in Chapter 5. Finally, Chapter 6 concludes the study with a brief summary of discussion and recommendations for procurement and supply chain department as well as recommendation for furthers research.

Chapter 2

A general description of procurement and supply chain management

2.1 Procurement and its management

Procurement is the process of acquisitions or buying services, works and goods by means of financial aspect through allocating contractual terms. Functions of procurement entails identification, sourcing, access in the market, analysis of internal and external market and assessment of business that an organization needs or may need to fulfil its strategic objectives. Procurement explores supply network and implement sourcing strategies with best possible supply outcome for an organization and its stakeholders and customers. Procurement embraces activities and events before and after signing the contract such as –

- Prior to contract in a construction project there needs forecast planning, need assessment, preparation technical specification, and sourcing.
- After contract the activities include contract management, delivery at right quantity and right quality on time and overall maintain the supply chain up to disposal.

General activities such as optimum supplier and contractor base preparation, supplier relationship development and management, risk assessment analysis and management as well as maintains all sorts of compliance according to Government or company rules and regulations.

A public or private organization procures three types of items such as, works, goods and services. A brief description of these items is given below:

- **Works:** This type of contract is made between employer and contactors generally for construction works for a short period of time. These contracts are generally complex and required sophisticated management and technical experts. Scope of works are mentioned in the contract and has a definite starting and ending date.
- **Services:** Professional and knowledge-based expertise are hired under this contract. In a construction project Architect, Engineer and Consultants are hired under service contract. Contract is made with professional personnel based on particular objectives and goals, where they support the existing structure and ready to provide services in order to satisfy the customer demands.
- **Goods:** This type of contract is made with suppliers for different types of goods. In the construction project contracts are made for supplies of cement, rod, stone chips, bricks and so on. Generally, there are two types of purchase agreements:
    i) **Local purchase:** Goods are readily available in the local market and a short-term contract duration is maintained and relationship with suppliers should have competitive approach.
    ii) **International Purchase:** Goods are strategic for the organization and brought from other countries since goods are not available in the local market. Long term contract period is maintained in this contract. Procurement personnel needs to looks cross border formalities. Procurement personnel should maintain collaborative relationship with suppliers.

2.1.1 Procurement procedure

For procuring goods, services and works an organization develops its procurement process. Common steps of any procurement are stated below:

i) Need assessment:

This is the initial step in procurement of services, works and goods. In a construction project what types of scope of works will be implemented according to proposed design and drawings need to be identified. Technical team assess the total bill of quantities and prepare quantitative and qualitative specifications.

ii) Price data base preparation:

Procurement personnel looks outward to analyze the overall market price for procurement of works, goods and services. Based on market analysis a competitive price database is prepared for individual scope of procurement. This is the key understanding of market competitiveness and overall market place and development of their internal resources.

iii) Cost analysis:

Cost analysis is an important issue to be taken prior to any strategic decision. An organization seeks value for money in procurement and looks forward to competitive advancement. In a construction project cost analysis is a prime task to make a decision.

iv) Supplier selection:

It is the first step for supplier management process within procurement cycle. Procurement department prepares optimum quantity of supplier's database for individual category of jobs. According to Carter (2012), Procurement personnel assesses the following steps for selection of potentials suppliers:

- Competency of supplier for particulars task and their previous experiences
- Capability to perform the task within specified time period
- Commitment for their duty and responsibility
- Control over their tasks
- Cash flow plan to implement the assigned task
- Cost for their materials compared to others
- Consistency analysis for their previous record in supply
- Culture for suppliers; is it matching with buyer organization?
- Cleanliness of supplier business; are they maintaining all sorts of compliance?
- Communication channel between supplier and buyer

After evaluation of all parameters, suitable suppliers or contractors are selected for continuous supply and suppliers who are underperformer are removed. In addition, based on evaluations new suppliers are enlisted to enable the supplier base.

v) Request for quotation:

The procuring entity asks for a competitive quotation from identified suitable potential suppliers or contractors. The entity mentions all contractual terms, total bill of quantities,

technical specification, general condition of contract, special condition of contract if any, relevant drawings for particular jobs during submission the quotation. Contractors or suppliers submit their rate quotation after analysis the scope of works, all contractual terms, parameter of jobs and place of jobs. Then, the procuring entity prepares the comparative statement with the submitted quotation rates by suppliers or contractors.

vi) Negotiation and contracting:

Negotiation starts from communication between buyers and suppliers to reach a mutual agreement about contract terms and financial aspects. Generally, both parties discuss quality, timing, supply quantity, price and delivery schedules. After successful negotiation, contract is made between supplier and buyer upon signing on agreement which is legally binding.

vii) Contract implementation:

This is the stage of contract management**.** Contract management is the process of managing contracts for contractor, suppliers, employees and other stakeholder who are related to this business. In this stage, contractor carries out the contract based on contractual terms. Employer and contractors sit together and prepare a road map to implement the contract according to sequence of work patterns. When any variation is found during implementation, both parties review and amend the contact. Successful contract management depends on completion of the task within time schedule at right quality, right quantity.

viii) Monitoring and evaluation:

Contract monitoring is to make sure that contractors or suppliers perform their duties adequately. On-site monitoring through inspection confirms right track and progress of the contract accomplishment. Monitoring reports on site visit give clear picture of project performance. After evaluating this performance higher authority can adopt strategic decision to accelerate progress of works upon analysis of the drawback in implementation of the contact. Based on monitoring report procurement performances and contractors' performances are evaluated as lesson learned for the future project.

2.1.2 Performance of Procurement

Procurement performance depends on mainly cost, quality and time to perform the contract. The Chartered Institute of Purchasing and Supply (2010) proposed a model of "five rights" which express the basic objectives of procurement and general criteria by which performance of procurement are measured.

i) Right quality
ii) Right quantity
iii) Right place
iv) Right time
v) Right price

Procurement performance are evaluated upon fulfillment of above mentioned five rights. The constriction project performance mainly depends on goods or services purchased at right quality, in the right quantity as per site demand and delivered at right place, at right time.

2.2 Supply chain and its management

Supply chain is a flow of supply network from supplier to supplier, manufacturing, assembly, distribution and logistics facility that perform the procurement functions of material purchase, transform these materials into intermediate and finished goods.

Supply chain in construction project is unique and time bound. Large number of contractors and suppliers are involved with different types of tasks. Since construction project is unique and different types of new materials may appear during implementation of project. Managing all these issues with cross functional team involvement is a vital matter in supply chain management. Different types of stakeholders' involvement are also different in construction project. Timely project completion mainly depends on properly flow of raw materials at site; any delay in materials supply leads to another delay which hamper the project performance and project cost may increases.

Supply Chain management is the management of supply networks and flow of goods and services together with all process of transform raw materials into finished goods. Lambert (1998) defined Supply Chain Management as "the integration of business process from customer through original supplier who supply goods, services and information that adds value for the customers." It maintains the supply streamlining activities to maximize the customer's value and obtain a competitive advantage in the market place. Supply chain management epitomize goodwill of business reputation through efficient and effective supply network development for the organization. Supply chain covers everything from production to product development upon market analysis.

The chartered Institute of purchasing and supply (2010) stated important aspect in supply chain management is to locate value chain and segment value individually from whole supply networks. It identifies all value added and non-value-added activities from the whole supply chain and removing the non-value-added activities from supply chain. This is the diagnostics process to diagnose each segment of supply chain so that organization can improve through enhancing particular value segment in supply networks.

2.2.1 Function of supply chain management in an organization

Supply chain management carries out a strategic role within the organization. The key function of supply chain management is to make strategic alignment with project activities which starts from design stage to complete the works. It makes bridge among purchasers, suppliers and end customer's requirement that deliver goods and services to meet customers' demands. It removes all non-value-added cost, increases quality and ensures ethical, environmental and corporate social responsibility. Supply chain management involves sharing of risk with suppliers that can be managed by suppliers easily to reduce the risk for the organization. The supply management can decentralize the risk through taking strategic decision of risk management. Every organization has an own policy to evaluate risk level and convert it into a financial cost internally and establish a right approach. Supply chain management also shares benefits with suppliers.

2.2.2 Function of supply chain management in Construction

Vrijhoef and Koskela (2000) presented four roles of supply chain management in construction, which are not mutually exclusive but often used jointly. Firstly, they shown the impact of supply chain on site activities to reduce the costs and duration of site activities. They indicate the

dependable materials and labor flow to the site to avoid interruption to the workflow. This can be achieved simply relationship between site and suppliers. Secondly, they focus to reduce the costs from supply chain logistics, lead-time and inventory. Materials and component suppliers may also adopt this focus. Thirdly, they focus on transferring activities or information from the site at the earlier stages of supply chain. Supply chain procedurally can avoid any inferior items or can achieve wider currency between activities, which is not responsible with site construction and it may be technical dependencies, which may reduce the total cost and duration. Fourthly, they emphasis on integrated project management and improvement of the supply chain as well as production at site.

2.2.3 Logistic support in construction project

Silva and Cardoso (1999) explain the role of logistic in construction project and involvement in multidisciplinary process of goods supply, warehousing, processing, transporting, inventory, scheduling and manpower supply, management of materials flow, necessary services and related information. All of these activities are executed prior to start and during implementation the construction works. Supply logistics are resource planning of people, materials, cash flow, and necessary equipment, acquisition, transport, warehousing, and inventory control. Logistic support at site are more important which are associated with corporal planning, organizing, directing, supervision and monitoring on site activities.

Vrijhoef and Koskela (1999), Hong-Minh et. Al., (2000) Akintove et. al., (2000), O'Brien, (1999), Ofori, (2000) argue that supply chain in the construction project likely fall in interruption and most

of the complications are not created in the change process but exist in the different interface of the supply chain. Following deficiencies have been chalked out in execution of construction project:

- Lack of communication, cooperation and commitment between suppliers, contractors and employer within the supply chain.
- Architectural and structural design change during implementation which may occur inconsistent in materials flow and interruption of work progress
- Insufficient materials delivery as per demand and poor quality of materials
- Deficient communication and information transfer
- Lack of proper performance measuring of suppliers within the supply chain
- Lack of trust between suppliers and employer within the supply chain

For mitigating above mentioned deficiencies, employer can get competitive advantages to run the construction project through value addition, cost reduction and integrating all stakeholders connecting with this project that interfere in project management and construction process satisfying both internal and external stakeholders.

Chapter 3

Procurement and supplies of Pakiza Industrial Park

Pakiza Industrial Park is a construction project. Procurement in this project include design services, construction works, goods and materials and so on. An engineering team are responsible to make technical specification of quantity, quality and procedure. The team prepared estimation against construction of individual project. Based on design, specification and estimation, procurement team proceed to purchase different category of goods and services as per specific schedules.

3.1 Procurement of design services

Design services are creative activities performed by in-house or hired architects and engineers. Construction works are executed based on different types of approved architectural drawings, structural design and technical specifications. To accomplish construction design and drawings qualified architectural and skilled structural consultants were hired under procurement of design services. Table 3.1 describes design services under Pakiza Industrial Park.

Table 3.1: List of architectural and structural design services

Sl. no.	Description of Project	Footprint area (square feet)
1	Pakiza Apparels Ltd	
i	3-storied all over printing unit	51980
ii	3- storied warehouse building	80000
iii	3- storied utility building	41964
iv	2- storied Knit Dyeing unit	103904
v	Effluent treatment Plant (ETP)	30000
vi	Internal pavement road	25000
2	Pakiza woven Fashion Ltd	
i	3-storied Yarn Dyeing Unit	63350

Source: Engineering Department, Pakiza Industrial Park

Architectural consultants play an imperative role in planning phase of project and they are responsible for all matters relating to the planning intervention with engineers, technical specialists and other stakeholders who are directly involved with operational activities. Civil engineers work as structural designer who play vital role in planning, designing, supervising and monitoring the quality and progress the works. The team are responsible in checking the feasibility, economic level, strength, and integrity of the structure based on design analysis. They maintain a proper communication channel with procurement and supply chain department including internal and external stakeholders. A successful project construction management depends on proper resource planning and stakeholder mapping at the location of project.

3.2 Procurement of supplies

Procurement and supply chain departments are responsible to procure different types of supplies associated with construction works at site. Pakiza engineering department raised requisition for delivery materials at site mentioning the level of quality, quantity and arrival time of supplies. Procurement department go forward to sourcing, identifying, selecting materials based on technical specifications and obtaining all materials for the construction process. Major items of construction materials are cement, sand, stone chips, bricks, mild steel, prefabricated steel joist, ready mix concrete, admixtures of concrete strengthening, tiles, aluminum and glass that are used below mentioned construction projects. Project wise quantity of supplied materials are listed Table 3.2.

Table 3.2: List of construction major supplies used for the projects

Source: Procurement and Supply chain Department, Pakiza

Sl	Name of Project	Supply materials									
		Cement (bag)	Sand (cft)	Stone chips (cft)	Bricks (no)	M.S Rod (ton)	Bonding agent (litre)	Steel Joist (ton)	Ready Mix Concrete (cft)	Tiles (sft)	Glass (sft)
1	All over printing building	27750	51500	70000	451300	310	500	125	-	18105	8420
2	Warehouse building	55870	115500	180320	115300	1150	320	-	-	5968	1350
3	Utility building	33100	58195	62980	520250	254	300	-	-	9659	4937
4	Knit Dyeing building	27900	58150	77350	320000	640	-	560	90105	16050	2980
5	Effluent treatment Plant	36330	80560	88767	52582	388	8150	-	-	2588	600
6	Internal pavement road	660	1260	1260		3.2					

7	Yarn Dyeing building	25250	66120	63354	405022	254	361	323	-	8505	10610
Total		206860	431285	544031	1864454	3000.2	9631	1008	90105	60875	28897

3.3 Procurement of works

As stated above, construction of Pakiza Industrial Park includes Pakiza Apparels Ltd. and Pakiza Woven Fashion Ltd. which is my study field. There are several units under Pakiza Apparels Ltd. such as all over printing unit, utility support unit, dyeing and printing unit, and warehouse. Construction of all-over printing unit, dyeing & printing unit, yarn dyeing unit are constructed with prefabricated steel and reinforced cement concrete composite structure. For this purpose, two categories procurements were conducted: (i) contract agreement for prefabricated steel structure and (ii) contract agreement for reinforced cement concrete (RCC). These contracts were made between Pakiza and contractor under competitive price rate quotation. Construction of utility unit and warehouse were made only with RCC frame structure and works of both units are carried out by qualified contractors under procurement method of competitive price rate quotation. For different types of finishing work like glass, tiles, paintings, separate contractors were hired with unit rate quotation under frame work agreement intervention with known skilled contractors. All plumbing and sanitary works were installed through in-house plumbers. Quantity of all types of civil construction works under the procurement are presented in Table 3.3.

Table 3.3: Quantity of construction works procured for Pakiza Industrial Park

Name of Project	Particulars of works						Type of contract
	Pre-fabricated steel Structure (SFT)	RCC structure (SFT)	Tiles work (SFT)	Glazing work (SFT)	Plumbing and Sanitary work (RFT)	Painting work (SFT)	
All over Printing Unit	37500	114480	14480	6500	5000	70000	Competitive price quotation, Frame work agreement, In-house

Utility Building	-	41964	30660	4800	2000	46560	Competitive price quotation, Frame work agreement, In-house
Dyeing and Printing Unit	103904	103904	18000	21000	6000	66000	Competitive price quotation, Frame work agreement, In-house
Warehouse	-	80000	10000	5600	2500	110000	Competitive price quotation, Frame work agreement, In-house
Yarn Dyeing Unit	63350	63350	6300	4500	1600	31600	Competitive price quotation, Frame work agreement, In-house
Internal Road	-	2500	-	-	-	-	Competitive price quotation

Source: Procurement and supply chain department, Pakiza

3.4 Quality assurance of construction materials

Pakiza procurement department assured the quality of purchased materials based on specification prepared by engineering department. Procurement department sends samples of construction materials to engineering department to check the quality of materials prior to purchase. Engineering department performed different types of test to assess the quality standard. Engineering department prepared all test reports of materials and recommended to procurement department if found the quality as per requirement of parameter of works. Purchase department, then, proceeded to place partly purchase order after ensuring quality of materials.

Checking and inspection of incoming construction materials are carried out against different benchmarks to achieve the desired level of quality as follows:

i) Received materials as per actual technical specifications

ii) Identify the capacity and capability of suppliers before issue the purchase order

iii) Materials testing and inspecting as per approved interval

iv) Request proper certification from suppliers prior to receiving goods

v) Maintain proper packaging and transportation facility to avoid deterioration or damage during storage.

vi) Proper storage, sorting and inventory to avoid adulteration and damage the goods at warehouse

i) Keeping record properly of goods receiving note at the time of materials received from suppliers.

Primarily Pakiza always tried to ensure the best quality construction materials to get the quality infrastructure.

Chapter 4

Management of procurement of supplies for Pakiza Industrial Park

Pakiza generally maintains a centralized procurement strategy for construction materials purchase based on requirement from construction site. Since a huge volume of materials are required for construction sites, centralized procurement is more suitable in terms of economies of scale by sum of requirements, optimum use of expertise, efficient storage and distribution arrangement as well as lower administrative cost. Procurement department of Pakiza performs overall responsibility in purchasing and supplying the materials to construction sites. Management of Pakiza procurement and supplies are described in the following sections.

4.1 Planning of procurement

An effective planning of construction materials leads to project successful. Pakiza engineering department prepares a material requirement plan and specification according to construction phases. Pakiza procurement department procures all kinds of construction materials as per requisition raised by engineering department. Procurement planning process of Pakiza are as follows:

Assessment of construction materials by engineering team

Pakiza engineering department is responsible to check the structural integrity and all sorts of compliance according to Bangladesh National Building Code to achieve the quality standard. Engineering team prepare technical specifications and bill of quantities for each individual

project and assess the grade of materials for construction. It was observed that during construction, structural design and drawings got changed on multiple occasions due to changing the process flow of machine layout. To minimize these challenges the team need to give more concentration and extra care in early stage of design phase and during construction.

Preparation of construction materials price database

A list of construction material is required before staring any construction project. Pakiza procurement department collect all materials lists from engineering project team. Construction materials are different in size and grades of quality and brands, which are used for different purposes in construction based on functionality and strength. Procurement department survey the market for availability of required materials and of its prices. Based on market analysis procurement department prepared a preliminary materials price database.

Sourcing of material suppliers

Pakiza generally relies on multiple sourcing to make themselves free from lock in situation since single sourcing may dominant the purchaser. In single sourcing procurement approach supplier has more power than that of buyer at the time of large capacities supplier relative to small quantity of demand. In multiple procurement sourcing approach buyer has a more power because of having

alternative options for sourcing the materials and buyer can get competitive cost advantages and reliability on suppliers with minimum order quantity of supply.

4.2 Identify the needed materials for construction

As stated in Chapter 3, all construction materials were estimated in quantity. Technical specification was prepared with bill of quantities of materials for supplies and work. Based on the phase of construction work a material requirement plan is prepared for individual project.

4.3 Development of contractual terms

Pakiza procurement department develop contractual terms depending on the context of procurement categories such as works, goods and services. These are the written terms of suppliers or contractors and buyer's duties and responsibilities based on agreement between buyer and suppliers. The written terms govern the part of contract which is legally enforceable because it meets the requirements and approval of the law. The contract agreement categorically involves procured items, rates, payment schedules and other important elements. In the event of breach of contract, the law allows the injured party to have access to legal remedies such as damages and cancellation of contract.

4.4 Selection of suppliers

Pakiza procurement department give more attention to selection of right suppliers. Project performance mostly depends on right suppliers and they play important roles in completion of project timely through supplying the goods at right quality on right time. Selection of right supplier

is very much critical in competitive market. Pakiza always tries to select primarily multiple potential suppliers for each category of materials intervention with different criteria.

4.4.1 Selection criteria followed in Pakiza

Criteria for selection of potential suppliers in Pakiza included quality, price, value for money, reliability, flexibility, and responsiveness.

Quality control of materials

Quality is a standard of works, goods and services which is set forth in the specification in terms of structural design strength, architectural appearances, compliances and durability of building infrastructures. In the construction project of Pakiza all categories of procurements are completed according to technical specifications. Engineering team collect sample of construction materials from multiple sources to conduct test; if the test report meets the design requirement and then sources are considered as responsive. Pakiza procures all types of goods, services and work from the responsive sources and procurement department issued purchase order for responsive suppliers after recommendation of quality that fit for use. Pakiza engineering team ensure the quality of construction materials through field test and lab test from recognized institute. The objectives of desired strength and overall compliances can be achieved through continuous quality control in all stages of project works.

Price of materials

Pakiza procurement department developed primary tentative price data base through market analysis. Pakiza generally asked price quotation on specific quality of goods, services and works from multiple suppliers and prepared a comparative statement by their submitted price quotations. Procurement department analyses all quotations and compare with the internal developed price database. Pakiza gives emphasize on getting right quality at right time delivery rather than price. They have focus on sustainability and total cost of ownership through considering the cost of operating, storing, environmental impacts, transportation and the cost of disposal.

Value for money

Pakiza analyses the purpose and functionality and based on its importance procures goods, services and works as well as selects suppliers and contractors. Use of cheap materials in construction is not always economical considering whole project life costs. Cheap suppliers or contractors may not represent best value; instead, higher prices of materials may give good result in infrastructure and sustain long time which represent economical for the infrastructure. Pakiza analyzed the consistency and previous proven track records of supplier and its materials quality and capacity of delivery at right quantity on time.

Reliability

Pakiza assesses reliable suppliers who are able to supply goods or services consistently at required level of quantity at right quality on right time to minimize the risk flow of materials. Continuous materials flow is the prime issue to complete the construction at right time with effective price.

Flexibility

Pakiza always seeks flexible suppliers and they maintains a long-term relationship with suppliers. Flexible suppliers generally respond quickly to satisfy the customer requirements even also in changing customer demands.

Responsiveness

Procurement Department analyzed all suppliers and contractors' data to determine who are fit for specific purpose. If they are eligible as per Bangladesh Government rules and regulations, Pakiza considered them as a responsive supplier and contractor.

4.4.2 Selection process in Pakiza

Request for quotation

Pakiza invites responsive suppliers and contractors to submit rate quotation for different category of goods, works and services. Request for quotation involves quality and quantity dimensions, time period as well as terms of contract.

Shortlisting potential suppliers

Pakiza procurement department analyze all quotations and select the best three to five potential suppliers. To begin shortlisting Pakiza looks supplies level of quality, stock requirements, delivery time and finally price. Moreover, Pakiza ensures the following criteria from suppliers:

- Suppliers are capable to deliver when required
- Are the suppliers or contractors financially secure?

- How long are they doing similar business?
- What are the recommendations about them?
- Are they have necessary approved licenses as per Bangladesh Government rules and regulations?

Shortlisted suppliers are checked whether they are interested in forming a business agreement. It provides a clear brief, summarizing what are requirements of Pakiza and how a potential supplier can fulfill the requirement for construction.

Negotiation best value

Pakiza analyzed technical and financial proposals of shortlisted suppliers and contractors. If the bidders become responsive technically in terms of right quality, at right quantity delivery schedule at right time, Pakiza proceeds for financial negotiation with them. In most cases, Pakiza prefers suppliers and contractors those who worked with Pakiza in the past and had good track record. Pakiza does not always seek low price rather than emphasizes best promising and supporting suppliers and contractors.

4.5 Awarding the contract

Contracts are awarded to the responsive suppliers or contractors through evaluation of their technical and financial proposals where technical proposal govern the best value than that of financial. Technical proposal represents the necessary expertise to perform the objectives, previous track record in execution of similar tasks, necessary tools and machineries and available human resources and overall period of implementation. Financial proposal represents the supplier or

contractor's financial health and capability as well as best value for the Pakiza. Pakiza made contract with eligible contractor or suppliers considering best value for money.

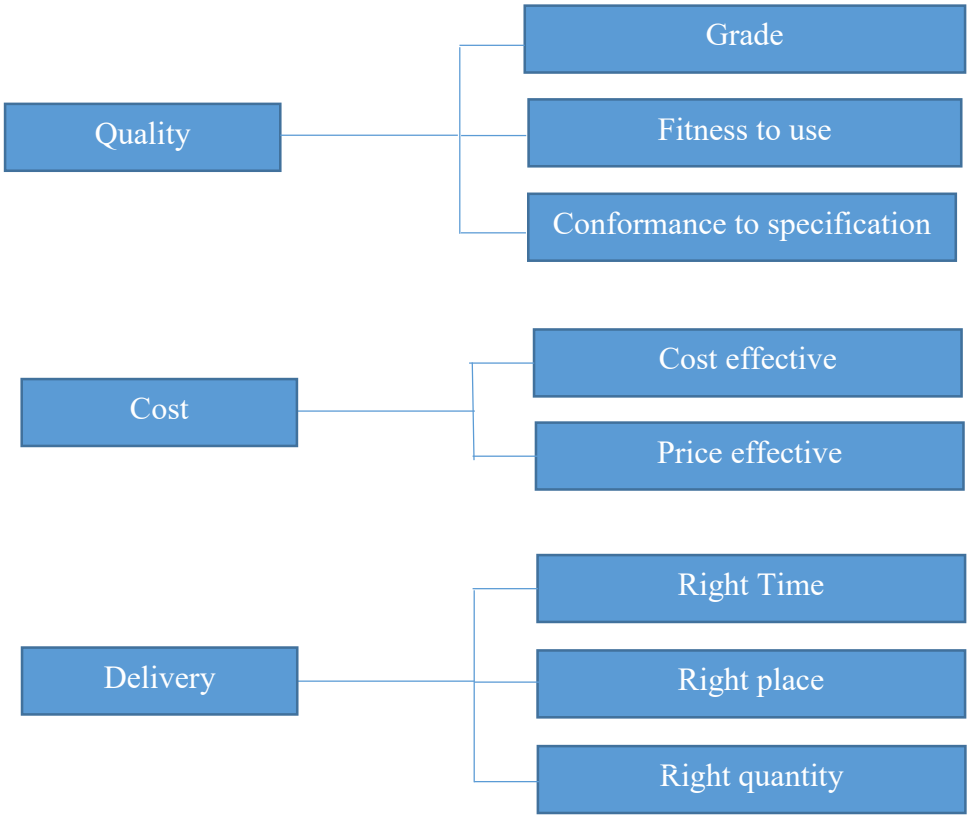
4.6 Monitoring and evaluation

Supplier's performance is measured against certain indicators such as right time delivery, right quantity, right quality, right price, technical services, and total quality of management. a standard evaluation procedure is maintained to assign the grade rank all new and existing suppliers or contractors. Evaluated grade for contractors or suppliers helps to setup a benchmark and corrective action plan for the next. Pakiza gives incentive or reward for excellence performance and de-listing contractor or suppliers if their performance is below satisfactory level.

Overall, procurement of required supplies is guided by a general framework consisting of quality, cost and on time delivery (Figure 4.1). Quality of materials should meet the requirement of grade and fit for use confirming the specification. Initial cost is not the main criteria in supplier evaluation process. Total cost of ownership is the key factor in evaluation process of potential suppliers. Total cost of ownership includes unit price of goods, services and works, mode of payment, lead time of material delivery, cash discount, carrying and transport cost, logistics and maintenance cost, and so on. Pakiza ensures effective price through cost effective strategy of procurement. Value addition further depends on delivery when required. A potential supplier responds the queries of customers about information or warranty services and on time delivery can reduce the wastes in case of purchasing raw materials like inventory, storage cost, goods transferring and carrying cost. Supplier that performs the excellence delivery ability can offer

additional value for the organization by reducing the risk of materials running short, saving on unnecessary transport costs, reducing the storage and inventory related cost.

Figure 4.1: Flow chart of material's quality, price and delivery check list by Pakiza



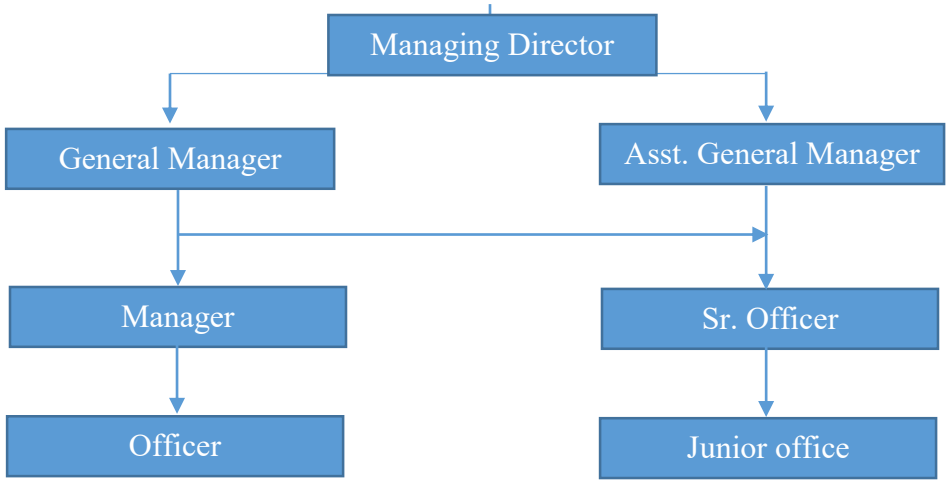
Source: Pakiza Procurement and supply chain Department

Chapter 5

Role of procurement and supply chain management in execution of construction works timely and with quality

Pakiza has a dedicated department of procurement and supply chain management to complete the construction works for Pakiza Industrial Park (Figure 5.1). This department always tried to maintain all sorts of requirements for construction materials in terms of right quality, right quantity and delivery at right place through cost effective approaches. They engaged several types of suppliers for supply of construction materials including stone chips, cement, sand, rod, bricks, tiles and so on. In implementation the procurement activities the department faced different types of challenges and tried to mitigate those challenges.

Figure 5.1: Organogram of Pakiza Procurement and supply chain department



5.1 Strategy development for purchasing

Pakiza procurement department is responsible for sourcing all kinds of materials and procurement strategies also differ based on availability of these materials locally or abroad. The department lay the strategy in the four quadrants that are

i) Non-critical items which are available in the local market; short duration of procurement and transactional relationship are maintained with suppliers.
ii) Leverage items where multiple local suppliers are deployed and contain low supply risk, thereby the company achieves competitive advantages.
iii) Strategic items where Pakiza maintains collaborative long-term relationship with suppliers; materials generally are sourced from abroad, required frequent analysis and planning supply risk and special attention for maintaining the relationship.
iv) Bottleneck items, materials scarcity in the market and also required quantity is small but it is very urgent where Pakiza maintains long term collaborative relationship with suppliers.

5.2 Analysis of needs and suppliers

In case of purchasing strategic items, Pakiza had to benchmark how the suppliers performing their duties in supply the materials at site. Procurement department analyses the needs based on requirements for the projects. At the same time, suppliers' market was analyzed to examine are they deploying right suppliers at right price to meet the needs. Procurement department enlisted potential suppliers' data base through evaluation of their capabilities for individual procurement of goods, works and services. The procurement department fixed the organization's objectives to

complete the project timely and come up with a plan to supply materials according to time schedule.

5.3 Potential supplier's selection and relationship development

Pakiza procurement department select multiple potential suppliers to supply necessary goods, services and works. They maintain relationship with suppliers based on procurement focus. Pakiza generally maintain collaborative long-term relationship in purchasing. Relationship development is the key point in dealing the business that ensures the right quality, right quantity on time delivery at right place.

5.4 Preparation of contract documents and awarding contracts

Pakiza procurement department prepared documents for scope of works, contract data sheet, instruction to suppliers, specifications, general condition of contract, special condition of contract if any for individual project. Procurement department scrutinized the supplier capacity, are they meet conditions according to objectives for the construction project. Pakiza generally asked quotations from responsive suppliers and best value suppliers got the award.

5.5 Ordering and inventory control

At the operational level ensuring availability of right quantity of raw materials at right place on time delivery is essential. The procurement department made inventory regularly to avoid overstocking and running out the stock. Overstocking cement may result in damage of the properties after certain period of times and increase the storage cost. Contrary, under-stocking materials at site leads to delay the construction works and workers remained idle due to materials

shortage at site. Optimum level-stocked warehouse is generated, and the procurement department check items and statements for accuracy and coordination with construction site. Generally, procurement department has a system in place which triggers a stock order whenever a certain quantity of inventory is reached.

5.6 Compliance and Quality Control

Procurement department sources goods, service and works from compliance suppliers and contractors who maintained all sorts of rules and regulations. Quality is a relative measurement against standardization and it is the main focus for the procurement process. The department regularly monitors the quality, performance and reliability of the suppliers to confirm there was no laps into complacency. Procurement department measured suppliers' performance against the following indicators:

- Percentage of materials delivered on time
- Lead time to deliver supplies at site
- Percentage of defect materials

The department assess how potential suppliers fulfilled requirements and how promptly they responded on the basis of emergency. It visits the sourcing point frequently and makes strategic plan and adjustment as necessary.

5.7 Management of construction materials

Procurement of materials and its management are crucial tasks in construction works. Pakiza conducted materials management upon needs assessment, panning purchasing strategy, sourcing, purchasing, transporting, sorting and warehousing, controlling, reducing wastage and optimizing

the profitability by proper materials management. Materials management ensure project performance through proper resource planning. Material management include the following components:

- Materials estimation, budgeting and planning
- Scheduling and purchasing
- Checking and receiving
- Warehousing and inventory
- Materials handling and transporting
- Waste management

Step-by-step material management is illustrated in Figure 5.2.

Figure 5.2: Flow diagram of materials management of Pakiza Industrials Park

5.8 Challenges of procurement

During project implementation, supply chain faced several types of challenges in material management. It was observed that some of supplies were not clearly identified with requirement of appropriate level of quantity and quality and milestones. Lack of communication between suppliers and procurement department was found in material supply, sometimes supplier made delay or earlier to supply materials at site. Though some of materials had not been required to supply that time and some of materials were very urgent to deliver at site but it had been made delay. Pakiza did change the machine layout several times and consequently floor layout plan had been changed. Because of these changes, procurement department had fallen in problems in materials planning, budgeting, rescheduling and material delivery at site. It also delayed the construction project. Technical specification is a vital issue in maintaining the level of quality of supplies or works as per requirement of structure. It was observed Pakiza engineering team prepared all technical specification, mentioning the dimension of quality and quantity as well as procurement department ensured the quality of construction materials purchase accordingly.

Development of procurement strategies and planning can ensure the purchasing goods, services and works with best value for money. In the construction project huge material required within short period of time and in this case similar types of goods like tiles and marble become scarcity compared to the requirement for the project. Brick is one of the major items of construction. It is observed that brick production becomes absent during rain seasons and production continued in the winter-season. Procurement faced problem in procuring bricks in the rain seasons and that time available quantity and quality of brick become shortage in the market. On the other hand, if procurement department procures bricks in advance then there is probability of more wastage and

investment becomes idle for a certain period of time and also increase the inventory cost. It was observed that most quantity of stone chips come from India and Pakiza generally used Pakur Indian stone chips for their construction. But India as and when stopped the export and abruptly hiked the price in that case suppliers made interruption to deliver stone supply at site. Procurement department had to revise the rate time to time based on market price. Immediately after declaration budget for the fiscal year 2018-2019 organization postponed procurement of construction materials cement and rod due to abrupt price hike which hampered project progress (Table 5.1). Procurement department took initiative to sit with all suppliers and managed them amicably through consultation and reschedule the materials delivery at site. By monitoring the stock, internal and external supply markets, procurement department prevents shortages of materials, over-purchasing and waste. Procurement team helped the Pakiza avoid operational shutdowns by creating contingency plans that account for supply shortages and complete the construction works at right time.

During implementation of contract different types of dispute arisen between contractors and Pakiza. Changes of layout during construction work resulting work pattern and scope automatically differ from agreement. Contractor tried to revise delivery schedule and increased the rate of works. Pakiza procurement department sat with supplier and contractors and listened to their speech carefully and resolved their disagreements upon consultation.

Table 5.1: Project wise delay in Pakiza Industrial Park Construction

Name of Project (Duration)	Layout change		Delay (days) due to				Total Delays (Days)
	Time	Delay (days)	Materials Supply	Material Scarcity	Decision Pending from Higher authority	Natural calamity	
All over printing unit (01.06. 2015-15.08 2018)	3	90	30	0	15	20	155
Yarn Dyeing Building (15.03.2016-11.06.2018)	2	50	20	0	60	15	145
Utility Building (01.10.2016-10.04.2018)	1	25	20	0	20	20	85
Dyeing and Printing Building (01.05.2017- 15.07.2019)	1	25	30	30	0	15	100
Warehouse Building (10.04.2017-01.10.2019)	0	0	90	20	10	30	150
ETP (01.05.2015-15.07.2018)	2	60	45	0	10	40	155
Total Delays of all projects		250	235	50	115	140	790
% of Delays, Category wise		31.64	29.74	6.33	14.56	17.73	100

Chapter 6

Conclusion and recommendations

This chapter concludes the study by summarizing the foregoing discussions and presents some recommendations for procurement and supply chain management for further research.

6.1 Conclusion

Pakiza Industrials Park consists of two export-oriented manufacturing organization. It was crucial issue to complete the project within targeted timeline; in failure to do so machinery installment and commissioning will not be performed and investment become idle. During implementation of construction, operational layout drawings were changed with the change of machine configuration and process flow on several occasions. These modifications caused changes in specifications of works and project timeline. Engineering department had revised the process layout and structural designs as well as BoQs with technical specifications which interrupted all process of planning of procurement, material flow management and smooth progress of works. As a result, most of the projects of Pakiza Industrial Park had needed extra time to accomplish the tasks. Process layout change is a common phenomenon of manufacturing organization in Bangladesh and most of the construction project fail to complete within specific time schedule.

Construction material flow to the site was a critical issue for successful completion of the project. Pakiza procurement and supply chain department always tried to ensure delivery of materials at right time; however, due to some unavoidable circumstances such as road strike and shortage of materials at source, suppliers could not supply materials timely. For instance, blue glass became unavailable in the market and supplier had to wait two months to supply as per requirement of project. Abruptly price hike for cement, rod and stone chips was a great interruption of material flow management which leads to delay in completion of works.

As Table 5.1 reveals 31.64% delay due to layout changes, 29.74% delay due to materials supply, 6.33% delay due to materials unavailability in the local market, 14.56% delay due to decision pending from higher authority and 17.73% delay due to natural calamity.

Higher authority of Pakiza was found concern about quality. Particularly, procurement department procured construction materials and prior to procurement they conducted necessary test and examined quality parameters in collaboration with engineering department. Test of concrete and construction materials were performed during implementation of project and test reports were found more adequate.

6.2 Recommendations

Pakiza is a production-oriented textile composite manufacturing organization. One of its goals is to secure the business investment through maintaining all sorts of compliance and structural integrity in their construction. During implementation of project, layout changes led to delay in project completion and hence increased the project cost. Setting up the layout for a manufacturing

floor required a strategic decision because each of floor contained different types of machinery, equipment, service facility and storage space and process flow are also unique. Configuration of machine for same product varied from principal to principal or brand and its operation process flow also varied. When machine brand or types were changed and then floor layout required redesign due to process flow and dimension of machineries. New layout also required revising architectural, utility and structural design and that time work had to keep suspended which incurred project cost and performance. A good floor layout is a composite plan of operation, ease process flow and service facility give efficient rate of productions and minimize the production cost. To handle these issues, procurement department should involve skilled cross-functional team and make suppliers aware of these changes. Since prime issue to arrange the machine on the floor, floors are constructed to install machine or equipment for productions. In this case, strategic decision needs to be taken to finalize the machine or equipment layout and its process flow layout from principal of machine or equipment suppliers, after that should confirm the architectural and structural design.

Construction material flow management is a vital issue to perform the project successfully because construction of infrastructure consists of mainly cement, sand, stone chips and reinforcement bar, glass, aluminum, and tiles; and their prices very rapidly fluctuate in the market. Suppliers made delay to supply the materials due to price hike and inflation. Procurement department should need to conduct market analysis more frequently and need to prepare a price data base and introduce a price escalation approach in the contract based on latest market analyzed base price.

Price adjustment formulae comprise fixed or nonadjustable and adjustable cost components. Each cost component has a coefficient or weight that is calculated based on its proportional value to the total contract amount as per the engineer's estimate. A price escalation index ADB 2018. *User's guide to procurement of plant Design, Supply and Installation: Standard Bidding Document.* Manila. Section 9, Appendix 2, Engineering Advancement Association of Japan, is to be used to estimate the periodical adjustment of unit price of each cost component included in the formula:

$$P_1 = P_0 \times (a + b\, L_1/L_0 + c\, M_1/M_0) - P_0$$

Where,

P_1 is adjustable amount payable to supplier

$P_{0\ is}$ contract price (base price)

a is percentage of fixed element in the contact price

b is percentage of labor component in the contract price

c is percentage of material and equipment component in contract price

L_1/L_0 is labor index at the date of adjustment and at the date of base respectively

M_1/M_0 is materials index at the date of adjustment and at the date of base respectively

Price adjustment is a modification made to the overall price of a contract to take account of appropriate changes in the costs of performing it. Price adjustment provisions include formulas designed to protect both Pakiza and suppliers from price fluctuations. Price adjustment formulae allow contractors or suppliers to offer more realistic prices at the time of quotation and materials flow will be stable as well as there will be smooth performance construction work progress.

6.3 Recommendations for further research

i) It has been recognized that early involvement of machine supplier at the layout design phase, supplier could be given constructive process layout plan about necessary space and its functional requirement. After finalized the process layout plan of a particular machine floor layout plan and design may be embraced concerning reduce the delay of procurement rout. The current research provides future support for this procurement options by identifying and quantifying sourcing of materials as the main cause of delay in materials supply

ii) The project faced delay in completion through interruption of material flow, late delivery and insufficient quantity of materials and several time layout changes. The impact of delay in this research was measured in term of times only due to limited available data. Further research may be performed what total cost incur in a manufacturing company due to delay of construction, delay in staring production and Bank interest, invested capital blockage and what investment could return if production had been launched in due times.

iii) Procurement and Supply chain delays were assumed to be independent. In practical, however, there are delays which are dependent, meaning that one delay can lead to another delay. Future study shall be dream what total delay may occur and what types of impact may be fallen on a manufacturing organization due to delay completion the project.

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Annex 1: List of respondents interviewed for this study

Respondents from procurement and supply chain

1. Mr. Mazibur Rahman, AGM, Procurement and Supply Chain Department, SQUARE Pharmaceuticals Ltd
2. Mr. Mahbub, Sr. Executive, Procurement and Supply Chain Department, Pakiza
3. Mr. Rohan, AGM, Procurement and Supply Chain Department, Pakiza.
4. Mr. Humayun Kabir, GM, Procurement and Supply Chain Department, Pakiza
5. Mr. Anamul, Asst. Manager, Procurement & Supply Chain Department, ACI Pharmaceuticals Ltd.
6. Mr. Pikasu, DGM, Procurement and Supply chain Department, ACI Pharmaceuticals Ltd
7. Mr. Sohag, Sr. Executive, Procurement and Supply Chain Department, SQUARE Pharmaceuticals Ltd.

Respondents from engineering side

1. Mr. Shahriar, Sr. Executive, Technical Service Department, SQUARE Pharmaceuticals Ltd.
2. Engr. Arif Hossain, Project Manager, Engineering Department, Pakiza
3. Engr. Eshan Undin, Site Enginner, Engineering Deptment, Pakiza
4. Engr. Khalilur Rahman, Manager, Engineering Department, Pakiza
5. Engr. Towhidul Islam, Sr. Executive, Engineering Department, SQUARE Pharmaceuticals Ltd.

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, Sagor Enterprise, Road 3/F, Sector 9, Uttara, Dhaka-1230
2. Mr. Shamin, Abdul Aziz & Co. Danga Bazar polash Narshingdi
3. Mr. Azad, Azad Enterprise, 96 Nizamudding Road, Dhaka

Responded from labors side

1. Mr. Mohan, Forman, Aziz Construction
2. Mr. Babul, Forman, Aziz Construction