

ARTICLE

Research on Material Procurement Category Strategy and Application in Petrochemical Enterprises

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ABSTRACT

This study focuses on procurement category strategies and applications in petrochemical enterprises, aiming to provide theoretical support and practical guidance for optimizing procurement management. The research first analyzes the technical complexity, stringent quality requirements, supply chain risks, and refined management characteristics of material procurement in petrochemical enterprises. Subsequently, differentiated strategies are proposed for different material categories: Strategic materials ensure long-term supply stability through lifecycle cost control and deep supply chain collaboration; Bulk materials achieve cost optimization and risk management via large-scale centralized procurement and dynamic price adjustments; Bottleneck materials establish diversified supply channels and risk hedging mechanisms to ensure supply continuity; General materials enhance procurement efficiency through digital platform-driven operations and supply chain ecosystem development. This categorized procurement management approach effectively improves supply chain resilience, reduces operational costs, and provides crucial support for sustainable industry development.

Keywords: petrochemical enterprises; materials; procurement; categories

1. Introduction

As a cornerstone of the national economy, the petrochemical industry's material procurement

management directly impacts production safety, cost control, and supply chain stability. Petrochemical enterprises' material procurement is characterized by high technical barriers,

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stringent quality requirements, significant supply chain risks, and complex management. Different material categories exhibit notable variations in supply models, cost structures, and risk profiles. Based on the classification characteristics of petrochemical materials, this paper systematically explores differentiated procurement strategies and key application points for strategic materials, bulk materials, bottleneck materials, and general materials. The aim is to establish a scientific, refined, and flexible procurement management system, providing theoretical support and practical references for enhancing supply chain competitiveness in petrochemical enterprises.

2. Characteristics of Material Procurement in Petrochemical Enterprises

Petrochemical procurement exhibits distinctive industry characteristics, primarily manifested in four aspects: technical complexity, stringent quality requirements, supply chain risks, and refined management. Petrochemical production operates under extreme conditions including high temperatures, high pressures, and strong corrosive environments, demanding highly specialized materials. For instance, special valves must meet large-diameter and high-load standards, while catalysts require high-precision online analysis capabilities. Some equipment involves patented technologies, and the scarcity of qualified suppliers further complicates procurement. Quality control is exceptionally rigorous, with materials undergoing specialized equipment type testing and ISO quality management system certification. Critical equipment often requires third-party supervision and inspection to ensure compliance with safety standards. Supply chain risks are pronounced, as most petrochemical projects are located in remote areas or have multinational operations. Long-distance transportation and extended delivery cycles make them vulnerable to external factors like international politics, exchange rate fluctuations, and import/export policies. Establishing emergency

supply mechanisms is essential to address sudden disruptions^[1]. Procurement management emphasizes refinement and collaboration, utilizing bundled procurement strategies to achieve economies of scale—such as consolidating bids for similar valves and pipelines to reduce costs. Simultaneously, cross-departmental coordination is strengthened by integrating technical, production, and financial needs to develop differentiated procurement strategies. Electronic procurement systems enable end-to-end digital management, enhancing both efficiency and transparency in the process.

3. Category Strategy and Application Points of Material Procurement in Petrochemical Enterprises

3.1 Strategic Material Procurement Strategy: Full Life Cycle Cost Control and Deep Supply Chain Synergy

In the procurement systems of petrochemical enterprises, strategic materials—including core production equipment, critical process materials, and patented technology licensing supplies—play a decisive role in plant safety, operational efficiency, and long-term competitiveness due to their high value, extended service life, and strong technological dependence. For procuring such materials, it is imperative to abandon the short-sighted logic of “lowest bid wins” and adopt a procurement strategy centered on optimal Life Cycle Cost (LCC), while actively advancing supply chain collaborative innovation^[2].

Full lifecycle cost management requires procurement decisions to cover the entire process from equipment selection, procurement, installation, operation and maintenance to decommissioning. During the technical agreement signing phase, the procurement department should collaborate with design institutes, process technology teams, and suppliers to conduct multiple rounds of in-depth technical briefings. This involves precisely defining equipment performance boundaries and material corrosion resistance levels—for example, resistance

to H₂S and Cl⁻ environments—along with interface standards and process compatibility requirements. For instance, specifying intergranular corrosion sensitivity indicators for reactor lining materials can prevent unplanned shutdowns and high replacement costs caused by material failure after commissioning. For patented technology-licensed materials such as specific catalyst formulations or proprietary control systems, long-term framework agreements should be established to lock in supply prices and incorporate technical iteration clauses. These clauses require suppliers to provide version upgrades free of charge or at discounted rates during the contract period, ensuring the facility remains aligned with advanced process requirements throughout its 10-20 year lifecycle and avoiding “technology lock-in” risks ^[3].

Meanwhile, supply chain collaboration must be extended to the project’s source stage by implementing the “Early Supplier Involvement” (ESI) mechanism. During feasibility studies or basic design phases, core equipment manufacturers should be invited to participate in process route discussions. Leveraging their engineering expertise, suppliers can propose optimization suggestions: For instance, while complying with ASME standards, using finite element analysis to optimize high-pressure vessel wall thickness distribution—ensuring safety while saving hundreds of tons of special steel; or recommending modular designs to shorten on-site installation cycles. Furthermore, enterprises and leading suppliers can jointly establish collaborative laboratories to develop customized materials for extreme operating conditions (e.g., ultra-high temperatures, strong corrosion), such as novel nickel-based alloys or nano-coated seals. Such collaborations can resolve “bottleneck” challenges, establish exclusive technical parameters and supply partnerships, thereby creating competitive barriers ^[4].

3.2 Bulk Material Procurement Strategy: Bulk Procurement and Dynamic Price Regulation

Bulk commodities such as crude oil, coal, natural gas, and basic chemical feedstocks account for

over 60% of procurement costs in petrochemical enterprises. These companies must balance economies of scale with market risk management in their procurement strategies. Large-scale centralized procurement can be achieved through regional joint purchasing models, where industry leaders form procurement alliances to consolidate regional demand and leverage bulk advantages. The procurement model adopts a “framework agreement plus dynamic pricing” mechanism. The framework agreement establishes benchmark prices and adjustment formulas, with execution prices regularly adjusted based on international market indices (e.g., Brent crude oil futures, Platts coal index). This approach ensures supply stability while mitigating price volatility risks ^[5].

In inventory management, bulk material procurement should adopt a dual-tier system combining “strategic reserves” and “commercial reserves”. Strategic reserves involve enterprises either constructing their own storage facilities or leasing national warehouses to mitigate extreme supply disruptions. Commercial reserves are implemented through Vendor Managed Inventory (VMI) models, where companies sign inventory-sharing agreements with major suppliers. These agreements allow suppliers to establish forward warehouses in designated areas, with settlements based on actual consumption. This approach not only reduces capital tie-up but also enhances emergency supply capabilities by leveraging suppliers’ nationwide storage networks. Additionally, futures hedging tools can be employed to mitigate price risks, with procurement contracts including price protection clauses. If market price fluctuations exceed agreed parameters, both parties will proportionally share cost adjustments.

3.3 Bottleneck Material Procurement Strategy: Diversified Supply Channels and Risk Hedging Mechanism

Bottleneck materials—those with high market concentration, low substitutability, and critical impact on production continuity, such as specialized

catalysts, imported instruments, and equipment for extreme operating conditions—require a three-tier procurement framework: primary suppliers, backup suppliers, and contingency plans. When selecting primary suppliers, comprehensive evaluation of their technical expertise, production capacity, and emergency response speed is essential, with supply priority secured through long-term contracts. Backup suppliers must demonstrate seamless product compatibility with primary materials and maintain synchronized upgrades via regular technical collaboration.

In risk hedging strategies, the procurement of bottleneck materials requires a dual safeguard system combining “technological substitution with inventory buffer”. The technological substitution approach involves collaborating with research institutions to develop alternative materials or optimizing processes to reduce dependence on specific materials. For instance, for a particular imported catalyst, partnerships with universities could develop domestic catalysts with comparable activity while optimizing reaction conditions to expand their applicability. The inventory buffer strategy entails establishing safety stock levels based on material supply cycles. For imported materials, additional buffers should be allocated by considering shipping timelines, customs clearance periods, and geopolitical risks.

3.4 General Material Procurement Strategy: Digital Platform Driven and Supply Chain Ecosystem Construction

General supplies are characterized by high procurement frequency, low unit value, and a significant proportion of total costs, requiring procurement strategies that prioritize efficiency and cost optimization. The digital procurement platform serves as the core tool, integrating supplier management, demand aggregation, electronic bidding, and contract management to fully digitize the procurement process. The platform must feature intelligent matching capabilities, automatically recommending optimal suppliers and prices based

on historical procurement data, while supporting innovative transaction models such as reverse auctions and group purchases to further reduce procurement costs^[6].

In the construction of supply chain ecosystems, general material procurement departments should implement tiered supplier management and collaborative innovation. Dynamic evaluations should be conducted based on key metrics including delivery punctuality rates, quality compliance rates, and service response speed. A-level suppliers will receive preferential order allocations and priority payment incentives, while C-level suppliers will face mandatory rectification deadlines or elimination. Concurrently, an innovation incentive mechanism should be established to encourage suppliers to propose cost optimization solutions or process improvement suggestions. Adopted solutions should be rewarded proportionally based on cost savings achieved. For instance, when a supplier reduces transportation damage rates through optimized packaging solutions, the company may return a percentage of the resulting cost savings to the supplier, creating a shared benefit mechanism. Additionally, supply chain financial tools should support supplier development by providing SMEs with accounts receivable financing and order financing services, thereby reducing their capital costs and enhancing supply stability^[7].

From an operational perspective, general material procurement must enhance data-driven decision-making capabilities. By leveraging transaction data, supplier profiles, and market price data accumulated through procurement platforms, organizations can develop cost analysis models to identify cost fluctuation patterns and potential savings. For instance, analyzing historical procurement prices of standard components against current raw material market prices enables future price trend forecasting, allowing procurement rhythm adjustments. Furthermore, big data technology can be employed to predict demand, optimize inventory levels and replenishment strategies, and reduce risks of stockpiling and shortages. For example, by

forecasting demand for specific spare parts based on production schedules and equipment maintenance cycles, centralized procurement can be utilized to lower unit costs^[8].

4 .Conclusion

Research on procurement category strategies for petrochemical enterprises demonstrates that categorized policies are the key to enhancing procurement efficiency. Going forward, these enterprises should continuously refine their category management models, strengthen data-driven decision-making capabilities, and advance procurement management toward intelligent, green, and globalized development, thereby injecting sustained momentum into the industry's high-quality growth.

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