

Construction and Application of a Production-Sales Settlement Price Model for Unified-Sales Chemical Products Based on Market-Oriented Pricing and Data Fusion

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Abstract: At the critical stage of the transition from the end of the “14th Five-Year Plan” to the “15th Five-Year Plan” and the promotion of high-quality industrial development, China’s chemical industry is facing dual pressures: structural release of production capacity and intensified market competition. The traditional manual pricing model can no longer meet the needs of refined management and dynamic competition in terms of efficiency, accuracy, and market response speed. Taking the unified-sales chemical products of a large comprehensive energy company as the research object, and targeting characteristics such as complex product categories and grades and large regional differences, this paper constructs a production-sales settlement price model based on the principle of “market-based price acquisition for all grades.” The model integrates multi-source market data and establishes a standardized pricing rule system. Through data collection, weight calculation, dynamic correction, and visual analysis, it achieves precise pricing by enterprise, product, grade, and region. Practical application shows that the model compresses the pricing cycle from 5 days to 4 hours and increases price accuracy to 98%, significantly enhancing the company’s market perception ability and the scientific nature of pricing decisions. It provides a feasible path for the digital transformation of pricing systems in the chemical industry.

1. Introduction

During the “15th Five-Year Plan” period, China’s petrochemical industry is undergoing a critical stage of transition from scale expansion to high-quality development^[1]. On the one hand, state-owned backbone enterprises represented by PetroChina continue to advance refining and chemical transformation and upgrading, and new large-scale projects such as ethylene are being put into operation in an orderly manner. On the other hand, the industry as a whole faces the challenge

of a new round of concentrated capacity release^[2]. According to forecasts by the CNPC Economics and Technology Research Institute, from 2026 to 2028, newly added capacity for major chemical products such as polyolefins, synthetic rubber, and caprolactam in China will remain at a high level, the supply-demand pattern will tend to be loose, profit margins will continue to be under pressure, and market competition will enter a “red ocean” stage^{[3][4]}.

Against this background, a scientific, agile, and market-aligned internal production-sales settlement price mechanism has become a core lever for refining and chemical enterprises to optimize resource allocation, stimulate internal vitality, and safeguard the bottom line of profitability. The traditional pricing model, which relies on Excel spreadsheets, manual comparison, and offline meeting deliberation, can no longer cope with the complex coordination needs of thousands of grades, dozens of entities, and multi-regional markets^[5]. To this end, this paper focuses on the pricing practice of unified-sales chemical products of PetroChina Refining and Chemical New Materials Company, and proposes and constructs a digital price model based on market-based price acquisition for all grades, integration of multi-source data, and support for dynamic adjustment. It aims to improve pricing efficiency and decision quality through modeling and platformization, and to provide a reference digital transformation sample for the industry.

2. Analysis of Business Status and Pricing Challenges

At present, the company’s unified-sales chemical products cover six major categories: synthetic resins, synthetic rubber, synthetic fibers, organic products, inorganic products, and urea. They involve five main product lines, nearly 30 refining and chemical enterprises, and five chemical sales companies. The pricing mechanism has long followed the “market-based price acquisition for all grades” model, but in practice there are the following prominent problems:

(1) Heterogeneous and dispersed data sources: Market prices depend on several domestic third-party information agencies. Data formats are inconsistent, update frequencies differ, and there is a lack of unified standards, making integration difficult.

(2) Complex and diverse pricing logic: Pricing rules differ significantly among product categories and involve many dynamic parameters, such as distribution costs, operating costs, quality differentials, customer incentives, and market adjustment. Rules are difficult to maintain.

(3) Lagging response speed: A monthly pricing cycle makes it difficult to capture weekly or even daily price fluctuations, weakening the company’s ability to grasp short-term market opportunities.

(4) Insufficient decision support: There is a lack of systematic price backtracking and comparative analysis tools. Pricing adjustments rely on empirical judgment and are insufficient in scientificity and foresight.

The above pain points^{[6][7]} indicate that there is an urgent need to build a standardized, automated, and interpretable pricing model to achieve a fundamental shift from “experience-driven” to “data-driven.”

3. Methodology Design of the Price Model

3.1 Construction of the Pricing Rule System

The model takes “market determination as the main body and management adjustment as the supplement” as its core concept and establishes a unified calculation framework:

$$P_{\text{settlement}} = P_{\text{market_benchmark}} + \Delta_{\text{deviation}} + F_{\text{adjustment}} - C_{\text{distribution}} - C_{\text{operation}} \pm \Delta_{\text{quality}} - I_{\text{incentive}} + \Phi_{\text{policy}}$$

Where:

P_settlement: the price settled between the refining and chemical enterprise and the sales company;

P_market_benchmark: the monthly average price by enterprise, product, grade, benchmark product, and sales region, obtained through weighted calculation based on market prices provided by multiple information companies;

Δ_deviation: a parameter used to adjust the market price, dynamically adjusted according to market fluctuations and corporate strategy;

F_adjustment: a market adjustment factor set by the pricing committee according to the difference between the current month's market price and the previous month's market price;

C_distribution and C_operation: logistics transportation costs and sales operating costs, respectively;

Δ_quality: a quality price differential adjustment item, referring to price differences caused by product quality differences, such as grade, performance, indicators, purity, and processing characteristics;

I_incentive: customer or channel incentives, i.e., price discounts or rebates given by the enterprise to encourage customers to achieve specific goals, such as purchase volume, payment speed, and long-term cooperation;

Φ_policy: industry or group policy adjustment items, such as environmental production restriction subsidies, new material support funds, and regional coordinated development subsidies, which are temporary and strategic.

This formula not only ensures the objectivity of the market benchmark but also retains the flexibility of management intervention, realizing a balanced mechanism of “market determination as the main body and management adjustment as the supplement.”

3.2 Benchmark Product Selection Rules and Grade Mapping Mechanism

Because external information agencies only provide daily quotations for mainstream grades, while the company's unified-sales products involve thousands of subdivided grades, many non-mainstream or customized grades lack direct market data. Therefore, for a large number of self-produced grades without direct market quotations, a four-dimensional mapping rule of “same category—similar performance—active market—regional matching” is established to build a “self-produced grade—market benchmark” mapping library.

3.3 Multi-Source Market Data Fusion Mechanism

Based on the market-oriented prices of chemical benchmark products, two authoritative quotation agencies, A and B, are selected. The market prices of benchmark products are derived according to sales region, product category, regional market, and market weight, forming scientific and reliable buyout prices by refining and chemical enterprise, sales region, and product category. The market price calculation relationship is depicted in Figure 1.

Daily market price by information company_benchmark product_sales region = Σ (daily market price by information company_benchmark product_sales region_regional market $\times$ regional market weight);

Monthly average market price by information company_benchmark product_sales region = daily market price by information company_benchmark product_sales region $\div$ number of days in the period;

Monthly market price by benchmark product_sales region = $\sum$ (monthly average market price by information company_benchmark product_sales region_product $\times$ information company weight);



Figure 1: Market Price Calculation Relationship Diagram

4. System Implementation and Technical Architecture

The technical route of this paper is designed as four core layers that are closely connected and jointly support the construction and application of the production-sales settlement price model for chemical products^[8]. The technical route of this paper are presented in Figure 2.

Data collection layer: Based on ETL tools, a data pipeline is constructed to collect market-oriented price data from price information agencies in real time. These data directly support the model calculation layer, provide a solid data foundation for the price model, and thereby realize a market-oriented pricing strategy.

Model calculation layer: The model calculation layer is the core of the technical route. According to the standard logic of chemical product pricing, it designs and builds models separately for rubber and plastic chemicals, fiber materials, urea, and adipic acid. The models are refined to dimensions such as production enterprise, product, grade, specification, and sales region to achieve precise pricing. Through the models, the production-sales settlement prices of unified-sales chemical products can be formulated monthly, improving the accuracy of settlement prices. This directly responds to the project objectives of enhancing competitiveness and achieving precise pricing.

Result output layer: The model calculation results are summarized by product category, grade, and region to form standardized settlement price reports that are easy to review and consult. This layer ensures the transparency and traceability of pricing decisions and supports the enterprise’s internal pricing process.

Display and analysis layer: Through charts and other forms, the market-oriented prices by grade and region, model constants, and calculation results are displayed and analyzed in a pivot-style manner. This helps management intuitively grasp the price difference patterns “by grade and by region” and supports the strategy optimization of “precise pricing” in the objectives.

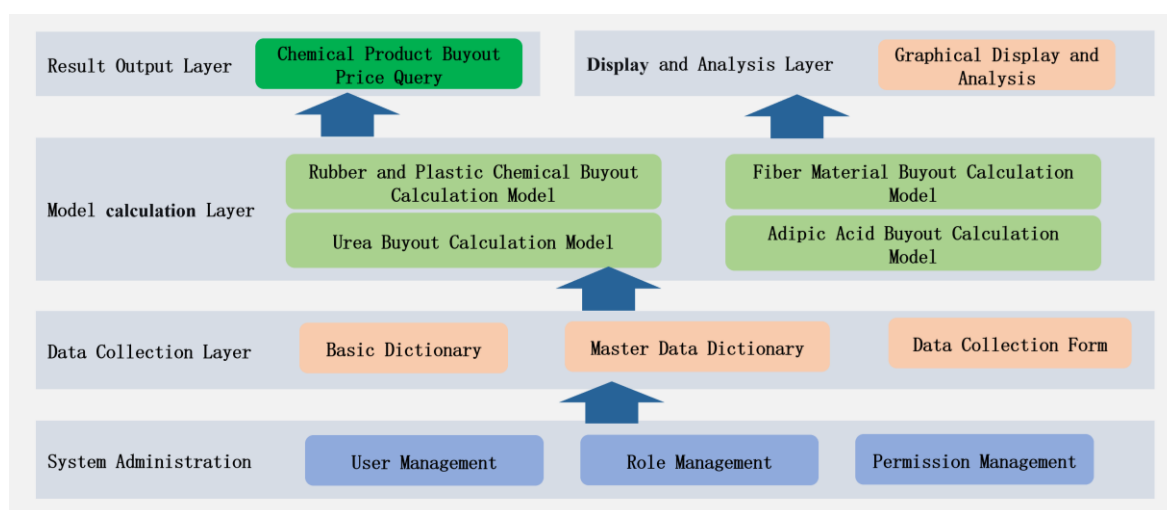


Figure 2: Technical Roadmap

5. Model Application and Empirical Analysis

Through tracking and analysis of pricing data from 2025 to date, the model application has achieved remarkable results:

(1) **Efficiency improvement:** The monthly pricing cycle was shortened from 5 days to 4 hours, and manual participation was reduced by about 70%.

(2) **Accuracy improvement:** Price accuracy increased from less than 90% to 98%, and pricing deviations continued to converge.

(3) **Decision optimization:** The price analysis platform provides data support for the pricing team, making pricing adjustments more scientific.

(4) **Management transparency:** The entire process is operated online, and data are traceable and auditable, enhancing the effectiveness of internal control.

(5) **Enhanced market response:** Through price trend early warning and backtracking mechanisms, the company can capture market opportunities more quickly.

6. Conclusion and Outlook

The production-sales settlement price model for unified-sales chemical products constructed in this study effectively solves the problems of low efficiency, large errors, and slow response in traditional pricing models through rule standardization, data fusion, and system platformization, providing a systematic solution for the digital transformation of pricing management in large chemical enterprises. In the future, it is recommended to deepen research in the following aspects:

(1) **Expand data sources and enhance real-time capability:** Introduce more market data sources and explore real-time price capture and dynamic pricing mechanisms.

(2) **Introduce forecasting and optimization algorithms:** Combine machine learning methods to build price forecasting and parameter optimization models.

(3) **Establish a pricing effectiveness evaluation system:** Continuously evaluate and iterate the pricing model from dimensions such as economy, adaptability, and robustness.

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