

Supply Chain Cost Management in the Automotive Components Industry: A Case Study of Fuyao Glass

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Abstract:

The current electrification and smart transformation of the automotive industry has had a long-term negative effect on procurement prices, as well as increasing upstream cost volatility, which has created a profit squeeze that is forcing component suppliers to fundamentally rethink their cost management architectures. In the case of manufacturers of automotive parts, the erosion of margins has been compounded by the combination of escalating costs of raw materials, escalating logistics costs, and more complex multi-level supply chains. As a result, the ability to control the supply chain costs has become a key factor in determining the continuity of operations and competitive advantage. Nonetheless, existing industrial practices remain beset with poor supply chain coordination, ineffective inventory allocation, crude methods of allocating costs, and a lack of resilience to external shocks- making traditional managerial strategies ill-suited to meet the demands of rapid technological and structural change. This study examines Fuyao Glass, a leading supplier of automotive glazing, using a case study approach triangulated with a systematic literature review to identify current gaps in its supply chain cost regime and develop specific remedial measures. The resulting optimization framework will provide Fuyao with practical avenues of cost mitigation and provide the wider automotive components industry with an example to follow in enhancing supply chain strength in the face of mounting global competition.

Keywords: Automotive Components; Supply Chain Cost Management; Fuyao Glass; Digital Transformation; Cross-Border Collaboration

1. Introduction

1.1 Problem Statement

The global automotive industry is undergoing a structural shift that is redefining competition along the value chain, as the electrification of power trains, autonomous driving systems, and connected-vehicle ecosystems transforms the industry. Original equipment manufacturers (OEMs) have been under increasing price pressure in final markets, which has led to systematic cost pressure transfer upstream via repeated procurement price cuts. To component suppliers, this top-down cost squeeze comes at the same time as unfavorable changes in the input factor markets: fluctuating commodity prices, rising energy prices, chronic labor inflation, and broken logistics chains have all played their part in a prolonged squeeze on operating margins. In this hostile environment, supply chain cost management has shifted to become more of a strategic necessity than a routine operational issue on which the viability of enterprises now hinges.

However, despite its utmost importance, the industry has widespread inadequacy in supply chain cost governance. Lack of coordination mechanisms at tiers, outdated methods of inventory planning, excessively simplistic cost accounting systems, and insufficient hedging against demand and supply fluctuations all conspire to frustrate attempts at attaining cost transparency and control. Such constraints are especially acute in the case of globally integrated manufacturers, where geographical dispersion increases informational and logistical frictions. The traditional cost reduction heuristics that were narrowly oriented towards internal production efficiency have not been effective in negotiating the complexities of modern automotive supply networks.

This paper fills this gap by discussing Fuyao Glass Industry Group, a leading player in the automotive glazing industry with an estimated 37 percent of the global market share, as an instrumental case. The study aims to: identify the root causes of cost inefficiency throughout the supply chain of Fuyao in a systematic manner; suggest theoretically sound and practically viable optimization measures; and generate practical insights that can be applied to the broader automotive components industry. The results add to the academic knowledge on supply chain cost dynamics in high-variety manufacturing settings and practitioner initiatives to improve operational resilience.

1.2 Literature Review

Over the past years, there has been a significant development in the academic community in terms of supply chain digitalization, smart inventory management, and joint procurement. Researchers such as Turcic have pointed out that the automotive procurement processes entail

several stakeholders, many variables, and complicated decision-making frameworks with information asymmetry being one of the most notable issues [1]. Clottey and Benton suggested that it was possible to create a digital information-sharing mechanism that would integrate component procurement planning, thus minimizing emergency logistics expenditures and rework losses [2]. According to Cui et al., digital technologies such as blockchain can be used to eliminate information barriers between stages of the supply chain, increase transparency in supply-demand information, reduce the inaccuracies of demand forecasts, and eventually reduce the overall cost of operations [3]. Qi et al. created an inventory model based on deep learning that could effectively determine the demand features of various SKUs, thus lowering the cost of warehousing [4]. Vorwerk and Trojahn showed that proactive digital allocation strategies can greatly decrease cross-regional transportation expenses, using a digital multi-warehouse scheduling system at an automobile manufacturer as an example [5]. There is also a specific study by domestic researchers on Fuyao Glass; Zhou Qi examined the working capital management of the company through the lens of supply chain digitalization [6]. Nonetheless, the majority of the above studies concentrate on single technologies or particular processes e. g. blockchain to provide information transparency, deep learning to forecast demand, and operations optimization to allocate warehouse but seldom combines the three dimensions of procurement fragmentation, multi-SKU inventory imbalance and cross-border information silos into a single cost analysis framework. The cost pressures experienced by global component manufacturers such as Fuyao are often multidimensional, but there is no systematic way of dealing with such complex problems in the literature. This is the gap that this paper will fill.

1.3 Research Framework

To begin with, this paper will set the basic theories of supply chain cost management and digital tools to develop a systematic framework that can be analyzed later. Second, based on the annual report data of Fuyao Glass in 2023 2025, this paper has determined three major cost pain points and how they interrelate to cause overall cost increases. Third, based on technologies like blockchain and smart demand forecasting, the paper came up with specific optimization plans in terms of procurement procedures, inventory control, and cross-border information coordination to incorporate them into an overall improvement framework of automotive glass manufacturers. Lastly, this paper will conclude with a summary of research findings, discuss the practicality of these strategies both operationally and industry-wide, and point out limitations and possible directions of future research. In general, the purpose of this study is to offer component suppliers globally

competitive solutions integrating focused strategies with practical cost control methods.

1.4 Innovation points

Most of the existing literature on supply chain cost management focuses on the application of a single technology, the optimization of specific functions, or isolated financial performance evaluation. On the contrary, this paper adopts a broader perspective and systematically explores procurement governance, inventory operation, cross-border collaboration and management mechanisms. This study reveals the multi-dimensional nature of cost issues throughout the supply chain - involving procurement, inventory, cross-border and management - thereby overcoming the limitations of previous studies that often presented one-dimensional and fragmented characteristics. In this way, this study provides a richer and more comprehensive perspective for supply chain cost management. Based on the above foundation, this paper integrates the following elements into a unified optimization scheme: VMI optimization under the supply function competition framework, dynamic inventory control driven by the primal-dual algorithm and deep learning, a cross-border collaboration platform based on blockchain, and an extended performance evaluation combined with cross-functional governance. This integration scheme has achieved the collaborative cooperation among various theoretical tools.

2. Industry Context and Corporate Profile

The global automotive glass industry operates with high entry barriers, substantial scale economies, and a notably concentrated competitive structure. By 2025, the worldwide market is essentially divided among four key suppliers: Fuyao Glass out of China, Japan's AGC and NSG, and France's Saint-Gobain. Fuyao, in particular, has cemented its lead—its global share now stands at roughly 37%, having edged up from about 34% in previous years. The company's grip on its home market is even tighter, with Chinese share estimated between 68% and 70%. The other three major players, by contrast, each account for only about 14% to 16% of the market, a gap that speaks to the formidable obstacles facing any would-be entrant in

this industry's upper echelon.

Fuyao Glass Industry Group Co., Ltd. is a key player in the automotive glass manufacturing industry, and its supply chain network spans several domestic and foreign markets. As of 2025, the group had set up production bases in 18 provinces in China and 13 countries abroad, with more than 60 major international automotive manufacturers as its customers. It has a domestic market share of about 70 percent and a global market share of 37 percent, making it the number one in the industry year after year. Table 1 shows the main operational indicators of the company in 2023–2025.

Fuyao has a vertically integrated supply chain structure, has built its own float glass production lines, and adopted collaborative management systems (SRM and ERP) in order to take advantage of economies of scale to offset the cost challenges caused by variations in raw material prices. The company operates its own float glass production lines—float glass being the fundamental raw material for automotive glass—which gives it a substantial measure of control over upstream costs. In addition to its vertical integration in materials, Fuyao has made substantial investments in information infrastructure. The firm runs Oracle's ERP system, complemented by SRM (Supplier Relationship Management) and other digital platforms, to knit together operations across its far-flung manufacturing footprint. More recently, the company kicked off an upgrade to its SRM platform—designated SRM 2.0—in collaboration with Yonyou Network Co., Ltd., a move intended to sharpen supplier collaboration and improve supply chain responsiveness.

Nevertheless, it is worth noting that the company has long been focused on internal manufacturing processes with inadequate coordination between upstream suppliers and downstream customers. Although the presence in the global market reduces risks associated with regional markets, the challenges are still high: poor supplier cooperation, slow inventory turnover, large differences in cross-border logistics costs, and continued volatility in the price of raw materials, ultimately resulting in increasing operating costs and squeezed profit margins. In this light, systematic optimization of the system of supply chain cost management has become a necessity for the company.

Table 1. Fuyao Glass: Key Supply Chain Cost Metrics (2023–2025)

Metric	2023	2025	Implication
Operating costs (RMB bn)	21.42	28.72	Surging expenses
Raw material share (%)	—	64%	High supply risk
Inventory (RMB bn)	5.14	6.80	Capital tie-up
Avg. inventory turnover (days)	89	81	Sluggish liquidity
Logistics and storage fees (RMB bn)	1.20	1.59	logistics inefficiency

3. Root-Cause Analysis of Cost Inefficiencies

This paper uses a mix of case study and literature review to determine four main drivers of the high total costs in

Fuyao Glass supply chain: procurement control, inventory turnover, cross-border collaboration, and end-to-end supply chain management (Figure 1). These dimensions do not exist in isolation but are related, and together they form systemic barriers that increase costs.

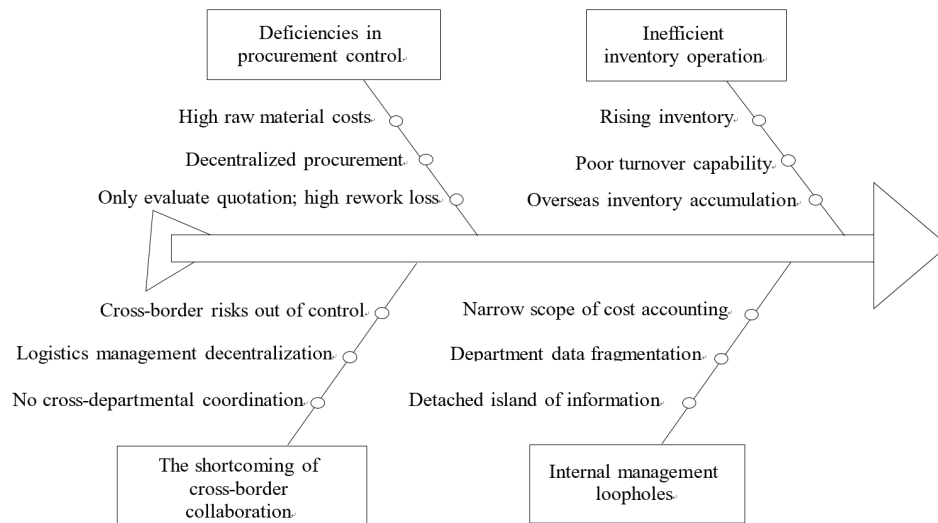


Fig. 1 Conceptual Framework of Supply Chain Cost Drivers at Fuyao Glass

3.1 Deficiencies in Procurement Governance

3.1.1 Fragmented procurement and erosion of scale economies

The basic raw materials and other auxiliary materials like soda ash and silica sand constitute more than 60 percent of the annual production costs, and their prices directly affect corporate profitability. Over the past few years, increasing costs of bulk commodities, energy, and labor have resulted in steadily rising procurement costs; nevertheless, Fuyao has not entered into two- to three-year framework contracts with key suppliers to fix price ranges. More importantly, even though it is expanding globally, domestic and foreign factories continue to be under separate procurement systems without a centralized coordination body at the group level for pricing negotiations. This piecemeal strategy has led to unit procurement costs not only not decreasing with scale expansion but also being above the industry average.

3.1.2 Oversimplified supplier evaluation mechanisms

The dominant supplier evaluation model overemphasizes quoted prices at the expense of supply stability and quality stability. Internal data show that there is significant variation in material quality between suppliers, which translates into high rework rates and scrap costs that are not reflected in procurement line items but significantly impact production efficiency [7]. This myopic view of supplier selection illustrates a suboptimal approach to cost reduction: the quest for the lowest price results in down-

stream quality costs that exceed any gains, highlighting the need for a total-cost-of-ownership (TCO) perspective in procurement decisions.

3.2 Inefficient Inventory Turnover and Structural Imbalances

3.2.1 Structural overstocking and prolonged turnover Cycles

In 2023-2025, the inventory balance of Fuyao increased by RMB 5.14 billion to RMB 6.80 billion, and the turnover days were prolonged to 81 days, much higher than the industry standards of high-volume automotive suppliers. This slow velocity means that there is a lot of working capital tied up in goods in warehouses, with direct carrying costs as well as opportunity costs of not being able to deploy it elsewhere. Moreover, long holding periods increase the risk of obsolescence, especially in an industry where models change quickly and technical specifications are changing.

3.2.2 Inventory misallocation and rising disposal costs

Fuyao has set up several production bases across the globe, and each model of vehicle is associated with a high number of dedicated SKUs, which means that there is low product interoperability. The company needs to have sufficient safety buffer stocks in regional warehouses to guarantee continuity of supply in foreign markets, further increasing the overall turnover cycles. This puts standard glass products in a predicament of experiencing harsh

stock backlogs, and customized materials often experience shortages. Also, warehouse information systems are not integrated with a common dispatch system; when there is an emergency shortage in one region, it is hard to replenish quickly with the neighboring warehouses, and one must resort to emergency procurement or expedited shipping - more expenses that eventually increase the overall logistics costs.

3.3 Cross-Border Collaboration Fragmentation

3.3.1 Information silos and the bullwhip effect

The information systems between the upstream and downstream segments have not been well integrated, which poses a challenge to real-time information sharing, adversely affecting the demand forecasting process. Information asymmetry flows up the supply chain, compounding over time and eventually forcing companies to hold more safety stock at each level to reduce uncertainties. In addition, overseas factories are independent with separate freight forwarding agencies without an integrated logistics management system. In 2025, logistics and warehousing expenses amounted to RMB 1.591 billion, representing 4.5% of the company's total costs; in terms of cost structure, there is significant potential for improvement.

3.3.2 Delayed risk warning for exchange rate and tariff fluctuations

On the financial front, Fuyao has been slow to respond to changes in the global monetary system. In 2024, exchange losses were RMB 24.28 million, and total tax and tariff liabilities in 2025 amounted to RMB 4.6 billion. The lack of active hedging strategies and early-warning systems for currency and trade policy adjustments has exposed the company to exogenous shocks, directly impacting the profitability of its international business [6].

3.4 Absence of Integrated Supply Chain Management

3.4.1 Narrow scope of cost accounting

The current cost accounting systems mainly emphasize the shop-floor indicators, such as material yield losses and direct labor hours, but systematically omit other categories of costs, including procurement premiums, logistics spending, and exchange-rate effects [8]. This small opening distorts the actual overall cost of supply chain activities, and this prevents management from recognizing high-leverage intervention points.

3.4.2 Departmental silos and suboptimal collaboration

The functions of procurement, warehousing, and finance are relatively isolated and are driven by performance indicators that reward local optimization at the cost of

global efficiency [8]. Procurement can, e. g., obtain quantity discounts that strain warehouse capacity and increase holding costs, whereas warehousing can focus on space usage rather than responsive replenishment. These misalignments are continued by the lack of a cross-functional coordinating body, which instills inefficiencies into the operational fabric.

4. Optimization Strategies and Theoretical Framework

To address the identified gaps, this paper suggests a multidimensional optimization framework that combines modern theoretical developments with operational changes. The strategies are structured around four pillars - procurement, inventory, cross-border collaboration, and management mechanisms - and should be seen as part of an integrated system rather than standalone measures.

4.1 Procurement Governance Optimization

4.1.1 Centralized group-level procurement and long-term contract mechanisms

All production bases' procurement requirements are centralized at the group level, where a single pricing negotiation center is involved in negotiating with upstream suppliers to increase bargaining power in procurement. Based on this, core suppliers enter into medium-to long-term procurement contracts of 2-3 years to secure price ranges of major raw and auxiliary materials like soda ash and silica sand, thus minimizing uncertainty due to market price fluctuations in the short term [7]. The cost stability of the raw materials is likely to be greatly improved by integrating bulk procurement with strategic inventory management.

4.1.2 VMI implementation based on marginal contribution analysis

Based on the supply function competition model, as a buyer, Fuyao can take into account the overall profitability of the supply chain in its decision-making process by distributing procurement shares and benefits according to the marginal contribution of each supplier to the supply chain [9]. In this context, the Vendor Managed Inventory (VMI) model can be further improved by creating an information system that integrates upstream and downstream partners so that suppliers can access real-time data on inventory levels and plan replenishment accordingly. This will not only help Fuyao save on the capital tie-up of its own inventory but also broaden the supplier evaluation system beyond a simplistic bid comparison to include other metrics such as quality compliance rate, on-time delivery rate, and speed of response after sales.

4.2 Inventory Optimization via Intelligent Algorithms

4.2.1 Dynamic inventory control using primal-dual algorithm

The original dual algorithm is used to constantly monitor the changes in market demand and dynamically change the inventory decision parameters, and the optimization goal is to minimize the total expected cost [10]. This algorithm will be able to detect specific patterns of demand fluctuations among various regions and product categories and adjust inventory levels between warehouses to alleviate the presence of structural overstocking and local shortages.

4.2.2 End-to-end deep learning replenishment model

The paper supports an end-to-end deep learning replenishment model, which produces suggested order quantities based on the input features, such as historical sales, promotional calendars, and macroeconomic indicators [4]. The model can optimize decision-making by following the best dynamic programming solutions based on past data and enhance responsiveness to changes in demand.

4.2.3 Active transshipment strategy based on operations research

This paper presents an active transshipment planning model that combines demand forecasting and optimization to pre-position inventory throughout the warehouse network [5]. The model minimizes the expected transportation and holding costs, with constraints on the capacity of warehouses and service-level requirements, thus decreasing the use of expensive emergency shipments.

4.3 Cross-Border Collaboration Enhancement

4.3.1 Supplier data sharing and synchronization mechanisms

It is possible to promote coordination by encouraging suppliers to provide production schedules and shipment timelines, which will help minimize idle waiting costs [2]. The real-time exchange of data allows a more accurate matching of the delivery of components with the production schedule, shortening cycle times and minimizing work-in-progress inventories.

4.3.2 Blockchain-based digital collaboration platform

This paper suggests the implementation of a blockchain-based collaboration platform that attains vertical cost transparency by using immutable, shared ledgers [3]. Smart contracts are able to automatically initiate transactions when certain conditions are met, e. g., confirmation of customs clearance or exchange rates, thus decreasing the overheads associated with manual verification, speed-

ing up the settlement process, and minimizing transaction costs associated with trust. The platform combines logistics, information, and financial flows, which improve cross-border efficiency in operations and risk management.

4.4 Management Mechanism Improvement

4.4.1 Expanded performance evaluation coverage across the process chain

Beyond production-based measures, this paper suggests adding the costs of warehousing, cross-border logistics, and the effects of foreign exchange to business unit performance scorecards [8]. A Balanced Scorecard system can shift focus to overall supply chain cost reduction and promote cross-functional thinking about downstream and upstream impacts.

4.4.2 Cross-functional task force for supply chain cost reduction

A cross-departmental task force that involves the senior management and is led by procurement, logistics, finance, and operations can be established to offer the governance framework required in integrated decision-making [8]. The task force meets regularly to review supply chain performance, address interdepartmental conflicts, and align incentives so that optimization measures are put in place coherently and over time.

5. Conclusion

This study, based on a case analysis of Fuyao Glass informed by annual report data (2023/2025) and supplemented with a systematic literature review, results in an overall diagnosis of supply chain cost drivers and an associated optimization framework. Root-cause analysis reveals four clusters of deficiencies that are interconnected: (i) fragmented procurement governance that loses scale economies and fails to consider hidden costs related to quality; (ii) structurally imbalanced inventory with long turnover cycles and misallocated safety stocks; (iii) cross-border collaboration gaps in the form of information silos, increased bullwhip effects, and unhedged forex/tariff exposures; (iv) management system reaction, this paper suggests a comprehensive package of optimization solutions: (a) centralized group procurement and multidimensional supplier evaluation, including VMI arrangements under competition of supply functions; (b) algorithmic inventory control with primal-dual dynamic policies, deep learning replenishment models, and proactive MILP-based transshipment; (c) blockchain-enabled cross-border collaboration platforms with smart contract automation; and (d) management reforms including extended performance measurement and cross-functional governance.

In terms of enterprise practice, the research offers Fuyao Glass practical avenues of cost reduction, which can help it to maximize its use of inventory capital and minimize financial losses due to its cross-border business operations. In the wider automotive components industry, firms are currently under triple pressures: competition on vehicle prices, escalating raw material prices, and higher cross-border spending; at the same time, domestic supporting businesses tend to have similar weaknesses, including poor cooperation and simplistic accounting methods. The overall optimization framework that was created in this paper may be a useful source of information among colleagues in the industry in a number of important aspects with considerable implications to their risk resilience and global competitiveness- perfectly consistent with the previous evaluation that the cost pressures are increasing steadily.

It is necessary to note that this research is mainly based on secondary data sources like annual reports and publicly available literature to analyze the cases, without gathering primary operational data by conducting field interviews or corporate questionnaires; therefore, evidence at the micro-level is inadequate. The proposed future study may entail a field study of frontline staff in procurement, warehousing, and cross-border management positions to confirm the practical usefulness of optimization strategies with raw data. Instead, quantitative models might be used to measure cost savings of various approaches, or a larger sample might be increased to conduct comparative studies across several enterprises, in order to come up with cost control solutions that have a wider industry-wide applicability.

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