International Journal of Industrial Engineering & Production Research June 2026, Vol. 37, No. 2: 123-136
DOI: 10.22068/ijiepr.37.2.2414

RESEARCH PAPER

Proposing the Pricing Model of Petrochemical Products with a Customer-Centered Approach Based on Fuzzy Delphi Evaluation

Sakineh Alizadeh Latrei[1,*], Seyed Ali Nabavi Chashmi[2], Iraj Mahdavi[3]

Received 13 May 2025; Revised 22 February 2026; Accepted 23 May 2026;
© Iran University of Science and Technology 2026

ABSTRACT
Pricing is the core of every business plan and directly affects the components and marketing strategies of industrial companies. The present study was conducted with the aim of achieving product pricing patterns in industrial markets with a customer-oriented approach based on the Fuzzy Delphi method. The method considered for conducting the present study is the qualitative method. The statistical population of the qualitative part of this study consists of experts, managers, assistants, and senior experts in the petrochemical industry. The data collection tool in the qualitative stage is in-depth and semi-structured interviews with experts, and in the quantitative part, a researcher-made questionnaire, which was used to confirm its validity by using content validity and construct validity. In order to measure the reliability of the study, Cronbach's alpha coefficient was used, the value of which was calculated to be above 0.7 for the total research variables. In the first part, using the data-based approach, the 6 main categories of the model were identified and presented in the form of a strategic pricing model for petrochemical products. The results confirm the positive and significant relationships between the research variables. Therefore, it can be stated that the relationships considered in the model are correct and logical, and the presented model is confirmed.

KEYWORDS: *Transfer pricing; Petrochemical products; Costing; Hybrid approach.*

1. Introduction

Business has long been a fundamental component of societies, generating numerous benefits for all stakeholders involved. Accounting has played a crucial role in this evolution by organizing and interpreting transactions, enabling organizations to better understand their operations and explore new alternatives for improving business performance. In recent years, rapid technological advancement has significantly transformed the business environment. Both providers and consumers are increasingly engaged in online marketplaces and business-to-consumer communication platforms, while access to vast amounts of data has enhanced the quality of business decision-making. As a result, new opportunities continue to emerge for managers and accountants, particularly in areas where technology and business practices intersect.

Pricing decisions have also evolved in parallel with changes in organizational strategies and performance objectives. Traditional pricing approaches, largely rooted in the literature of the 1950s and 1960s, have gradually given way to more flexible and data-driven methods. The expansion of the internet, the continuous development of digital commerce, simplified transactions, and improved information about consumers, suppliers, and competitors have compelled organizations to refine their pricing strategies and tactics. Numerous examples in recent decades demonstrate how e-commerce firms have implemented innovative pricing mechanisms (Streitfeld, 2016; Mohammed, 2017). Although translating complex human pricing decisions into algorithms or automated systems remains challenging for many organizations, ignoring technological advancements and the diverse pricing strategies adopted by competitors may pose an even greater risk. Moreover, emerging technologies such as negotiating agents within smart contract environments present additional opportunities for innovation in pricing practices.

Despite these developments, the specialized literature in management accounting and business management still provides limited attention to emerging pricing solutions, including dynamic pricing. Tomke (2020) explored the concept of organizational experimentation and emphasized the strategic value of business experiments in improving managerial decision-making. Similarly, Happel et al. (2020) examined the role of experimentation in identifying new ventures and market opportunities, particularly

* *Corresponding author: Sakineh Alizadeh Latrei*
Alizade.manager64@gmail.com

1. *PhD in Industrial Management, Finance, Babol Azad University*
2. *Associate Professor, Babol Azad University*
3. *Faculty member of Mazandaran University of Science and Technology*

within startup environments. These approaches are highly relevant to pricing decisions, especially in markets where products and services become increasingly commoditized and customer price sensitivity intensifies.

Pricing represents a key strategic instrument for management and is inherently linked to management accounting. At the same time, it constitutes a complex managerial challenge because pricing decisions are influenced simultaneously by cost structures and demand conditions, which often evolve independently and are difficult to coordinate effectively. Pricing systems must therefore support the strategic objectives of the organization (Laitinen, 2011). Given its importance, pricing has attracted considerable attention across multiple disciplines—including economics, accounting, business management, law, psychology, and engineering. However, perspectives across these fields are not always aligned, as illustrated by the differences between accounting and economic approaches to pricing (Lucas, 2003). Nevertheless, organizations consistently devote substantial resources to improving pricing practices to outperform competitors, satisfy customers, and enhance financial performance.

In industrial markets, pricing decisions for products such as petrochemical goods represent a central component of business planning and have a direct impact on the marketing strategies of industrial firms. According to many experts, the absence of appropriate pricing frameworks or market-oriented guidelines has led some companies to introduce products or technologies whose prices are inconsistent with market expectations. From the perspective of commercial management, price is the only element of the marketing mix that directly generates revenue and is also the most flexible component of marketing strategy. Consequently, pricing and valuation remain among the most challenging activities in the commercialization of products.

The determination of prices for goods and services in different markets is generally explained through price theory. However, prices established in real markets do not necessarily correspond to economically efficient levels that maximize societal welfare. This discrepancy highlights the importance of identifying optimal pricing mechanisms that balance economic efficiency with organizational profitability (Michael, 2013).

The petrochemical industry represents one of the most significant and influential sectors of Iran's macroeconomy. Its importance stems from its role in supporting the development of other industries, generating substantial employment, and producing strategically essential products through advanced production technologies. Furthermore, the wide variety of petrochemical products and the significant share of overhead costs in industrial production highlight the critical need for accurate, timely, and relevant information to support managerial decision-making. Such information is essential for cost control, profitability analysis, production planning, and effective product pricing.

In this context, the adoption of advanced costing systems—particularly Fuzzy Activity-Based Costing (FABC)—is of considerable importance in industries such as oil, gas, and petrochemicals. These systems provide more accurate cost information, thereby improving pricing decisions and supporting strategic management.

Accordingly, the purpose of this research is to develop an innovative pricing model for petro-chemical products in industrial markets. The proposed model aims to provide sufficient dynamism and flexibility to respond to environmental changes while enabling accurate product pricing, ensuring the profitability of industry participants, and safeguarding the interests of customers and consumers.

Based on this objective, the present study seeks to answer the following research questions:

What innovative pricing model for industrial products can be developed using an economic-factors approach based on fuzzy evaluation?

What factors and components contribute to the formation of this model?

What relationships exist among these factors and components within the context of the petrochemical industry?

2. Related Works

In this study, the research literature consists of two parts: empirical and theoretical research literature, which we will discuss below.

Empirical Research Literature:

Despite the vital role of the price of goods and services as an important variable in creating competitive advantage in today's dynamic, turbulent and competitive markets, little research has been conducted so far in the field of pricing policies and strategies, especially with a strategic approach that focuses on both marketing and financial aspects. A brief description of previous foreign and domestic research is shown in Table 1.

Tab.1. Research background

Row	Researcher	Research achievements
1	Tenants and Co-workers (2025)	In addition, regulatory constraints such as trade agreements and environmental regulations can significantly affect pricing decisions in the Iranian petrochemical industry. Overall, this paper provides a useful structural model for analyzing the effects of pricing strategies on the export of petrochemical products in Iran. The findings of this paper can help Iranian petrochemical companies make strategic pricing decisions by considering both internal and external factors to ensure their long-term success in the global market. The research variables are export market entry constraints, penetration strategy, market development strategy, and opportunity creation, all of which have an impact on product exports. Here, the following features are described: penetration strategy (importance coefficient: 0.95), market development strategy (importance coefficient: 0.94), opportunity creation (importance coefficient: 0.9), and export market entry restrictions (importance coefficient: 0.8). The Cronbach's alpha of the two questionnaires is 0.817 and 0.814, respectively, indicating adequate validity.
2	Kosasi et al. (2024)	This study used partial least squares structural equation modeling (PLS-SEM) to analyze the relationships between variables. The findings indicate that product quality significantly affects customer satisfaction and loyalty, highlighting its pivotal role in meeting customer expectations and strengthening long-term relationships. While service innovation does not directly affect immediate satisfaction, it significantly enhances customer enduring loyalty, indicating its importance for long-term engagement. Corporate image also plays an important role in fostering customer enduring loyalty, emphasizing the value of maintaining a positive reputation. The study concludes that customer satisfaction mediates the relationship between product quality and loyalty, emphasizing the cyclical nature of these constructs. This research fills a significant gap in the literature by providing a comprehensive model that integrates these variables in the context of the petrochemical industry and provides new insights into sustainable customer loyalty strategies.
3	Najafi et al. (2023)	This research focuses on the supply chain of petrochemical companies. Laboratory studies, experts, and visits to petrochemical sites were used to identify production processes and determine indicators. After that, they were evaluated with an envelope model and coefficients related to the identified petrochemical supply chain structure. The total and component efficiency of the studied units in petrochemicals was also examined from 2016 to 2019.
4	Lee et al. (2022)	The first stage proposes several price forecasting models with comprehensive information, including contract price, supply rate, demand rate, and upstream and downstream information. The second stage applies the analytic hierarchy process and reinforcement learning technique to derive an optimal purchasing decision policy and reduce the total procurement cost. An empirical study is conducted to validate the proposed framework, and the results show that the price forecasting accuracy and the raw material procurement cost are improved.
5	Carvalho (2016)	If the output of one sector is used as an input in the production of other sectors, even assuming perfect price flexibility in a sector, macro shocks can still have a delayed effect on retail prices due to interactions between sectors. In contrast, in the market for primary inputs at the sector level, the response to sector-specific shocks occurs much more quickly.
6	Daniel and Titman (2015)	In studies related to the anomalies related to the size and book-to-market ratio of capital asset pricing, they showed that the tests used were unable to examine the specific characteristics of the company, because the basis for using these tests was the classification of companies in a portfolio with similar characteristics. On this basis, they presented tests appropriate to the portfolio-based approach to pricing.
7	Pizzini (2014)	The relationship between the performance of the costing system, managers' beliefs about the relevance and usefulness of cost information, and actual financial performance was examined, and the usefulness of cost information was determined by four characteristics: the level of detail provided, the ability to provide details of cost behavior, the frequency of information collected, and the reporting of deviations. Therefore, Managers' evaluation of the usefulness of cost information is positively related to the extent to which cost information is provided in detail, better classification of costs based on behavior, and continuous reporting of cost information.

8	Passpit (2013)	In a study on small and medium-sized industrial companies in Indonesia, the researchers examined the internal and external environment and analyzed them to present their marketing and development strategies. Based on the results obtained, these companies should use product development and market penetration strategies according to the industries in which they operate.
9	Javadpour (2019)	The activity-based costing model has a long-term perspective, and since it is possible to change the factory capacity in the long term, the range of variable costs becomes wider. Therefore, in this model, all production costs, including direct material costs, direct labor, and factory overhead, as well as selling, administrative, and general expenses, are classified under the variable cost heading.
10	Master (2018)	Activity-based costing with a fuzzy approach, by considering uncertainty in cost parameters, provides a more accurate estimate of the cost of activities under conditions of uncertainty and allows costs to be calculated more accurately.
11	Pak Meram (2014)	Establishing and implementing an "Activity-Based Management and Costing" system not only improves the accuracy of product cost calculations (through the use of activity-based accounting) but also paves the way for continuous improvement of activities and processes, which is the key to successfully controlling companies' operations in today's fast-paced environment.

Theoretical literature of the research:
Price is used literally as a measurement, evaluation, and criterion. In the market, price is defined as the exchange value of goods and services in the form of a unit of currency. Accordingly, pricing means determining the price, which is a repetitive and continuous activity. This continuity is due to environmental changes and the instability of market conditions (Taybnia, 2009).
Armstrong (2003) considers price to be the amount of benefit that the customer pays for the benefits obtained from having or using the product. Price reflects the seller and customer's perception of the value of the product (Chib, 2009). Price is the most flexible element of marketing strategy, while pricing decisions can be implemented relatively faster than other elements of marketing strategy. However, among the difficult activities in the field of product commercialization are evaluation and pricing.
The prices of goods and services in different markets are determined based on price theory. However, these prices determined in all markets are not necessarily prices that are economically efficient, or in other words, provide the maximum benefits to society. Hence, determining the optimal price or the issue of pricing in these markets arises. Pricing means determining the price
For a product or service (Kotler, 2008). Pricing is an activity that must be repeated and is a continuous and ongoing process. This continuity is due to environmental changes and the instability of market conditions, which creates the need to modify and adjust the price (Shafei, 2014).

1. Pricing is one of the most important elements of the marketing mix, because it is the only element of the marketing mix that creates cash flow for the organization, while the other 3 elements of the marketing mix are the variable costs of the organization; in other words, product (costs are spent on designing and producing products); place (costs are spent on distributing products) and promotion (costs are spent on advertising products) and only price should support the other elements of the marketing mix. Therefore, the conceptual model of the present study is drawn below.

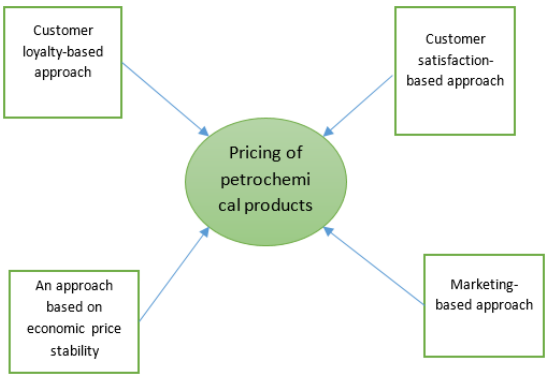

Fig.1. The conceptual model of the present study

3. Pricing Perspectives

Although pricing decisions are usually a marketing decision, making the right decision also requires understanding the customer and society's understanding of price. In some ways, pricing is the most important decision a business makes. For example, just as pricing too low can lead to lost revenue and even job losses, pricing too high can lead to poor customer response and, surprisingly, job losses due to lack

of customers. Therefore, understanding the perspectives of other stakeholders in the organization's product pricing is essential. The price category can be of great help to decision makers in the process of designing and implementing a pricing program (Cooper, 1991).

Common approaches and strategies in product pricing:

One of the major problems in the pricing literature is the identification of common pricing approaches. In this regard, many inconsistencies are evident. The three common and dominant approaches that companies take in determining product prices are:

1) Cost-based approach: In this approach, the price of goods and services is determined based on the total cost plus a reasonable profit margin (Qazizadeh, 2010). The disadvantages of this method include not considering supply and demand; not paying attention to the sensitivity of customers to price; difficulty in separating fixed and variable costs allocated to multiple products; and not considering the unique characteristics of the product and sales conditions in pricing decisions. (Shahbazi, 2015).
2) Customer-based approach (market demand): In this approach, the price is determined based on the reaction of customers to the price. This means that the price is determined based on the amount of goods or services used and the amount of customers gained or lost. In this approach, the price level is determined according to the tastes and preferences of the customer, and since customers are also outside the company, like competitors, the focus of this approach is outside the organization. (Lawrence, 1999).
3) Competition-based approach: In this approach, the price is determined to achieve the competitive situation of the market and the determining factor is the situation of competitors or the market. Accordingly, pricing is mainly based on the prices that competitors have set and not on the basis of costs and customers. The advantages of this approach include things such as simplicity and speed, and the possibility of preventing price wars (Lee, 2001).

3.1. Customer-centric pricing

Changes in the internal and external conditions of the functioning of economic enterprises and organizations, and the impact of factors such as the intensification of competition, the implementation of activity management, and the criticality of responding to customer needs through the appropriate combination of quality and expected profits have radically transformed the responsibility and role of costing systems (Kaufman, 2013).

A customer-centric approach will combat the lack of interaction in the retail electricity market by assessing consumer needs, applying behavioral psychology principles, and encouraging optimal market participation. The ideal scenario for customer-centric pricing would be for energy customers to actively seek the best energy deals from a carbon and economic perspective and to fully commit to dynamic pricing arrangements.

Tab.2. Different perspectives on product pricing

Row	Opinion	Description
1	Customers regarding pricing	The customer seeks to satisfy a need or set of needs by purchasing a specific product or set of products. As a result, the customer uses various criteria to determine how much he should pay for these needs and how much he should pay for them.
2	Society towards pricing	From this perspective, the reaction of individuals in society to the category of price and its changes follows the following two methods: 1) Rational man: the results resulting from price manipulation are predictable; 2) Irrational man: which is based on the assumption that sometimes human reactions to price changes are unpredictable.
3	The Rational Man's View of Pricing	The consumer is a rational decision maker and is quite professional. Therefore, if the price of a particular product increases and the customer is aware of all the relevant information, the demand for that product will decrease and vice versa.
4	The irrational man's (laws of freedom) view of pricing	The economic assumptions underlying the rational man model are valid, and increasing prices will reduce customers. There are many cases where people buy more when prices go up. So when prices go down, people become suspicious of prices and their assumptions and buy less.
5	Marketers on pricing	It represents marketers' assessment of the value that a customer sees in a product or service and is willing to pay for it. Therefore, the continuous introduction of new products and competitors' strategies are effective in pricing products.
Source: Gholami and Hakak (2019)		

Tab.3. Types of product pricing approaches and strategies

Approach	Pricing strategy	Description
Cost-based approach	Based on the cost-plus method	In this strategy, a standard figure is added to the cost price of the product as a fixed profit.
	Based on the experience curve	In this strategy, since it is predicted that costs will decrease in the future, the current price is based on future costs, which are lower than current costs.
	Investment rate of return	This strategy determines the price levels necessary to achieve the desired profit.
Customer-centric approach	Prestige (personal)	It is a long-term strategy that aims to use price as part of the overall product image. In general, getting a specific price for a product or service depends largely on the company's consumer and competitor strategy. That is, pricing takes into account customer preferences, a company's brand positioning, as well as current and expected competitor behavior, and has even been called a sufficient statistic for decision-making. In addition, and in general, revenue management is more likely to focus on the lower end of the demand curve because it allows for greater profits.
	Infiltrator	First, the product price is set unrealistically low to capture a larger market share. Then, after capturing an acceptable market share, the product price is slowly increased.
	Expensive (non-invasive)	When a new product is launched, this pricing method sets a high and substantial price to reflect the product's innovation or uniqueness.
	Group	Companies consider various price ranges, and customers go to specific ranges and purchase the product they want, depending on their budget.
	Valuable	It sets the price according to the value it has for the customer compared to other products.
	Collective and closed	at a price lower than the sum of their individual prices, thus increasing sales volume and sales of products that are less commonly purchased under normal circumstances .A combination of goods and services is sold
Competition-based approach	Positioning	This strategy is used to position products relative to competitors.
	Leader or cheap product to attract customers	In this strategy, companies attract customers of competing companies to their products and services by significantly lowering the price of one or more specific, best-selling products.
	Follower	Pricing is based on industry leaders' pricing.
	A drop	This strategy is used to continuously reduce prices with the aim of reaching successive layers of demand.
Source: (Gholami and Hakak, 2019)		

An improved standard of customer interaction can be achieved by using innovative methods of marketing petrochemical products. Retail product markets facilitate the efficient exchange of petroleum and petroleum products. As a result, over the past decade, most energy and petrochemical product providers have preferred to offer both products to consumers, usually through dual tariffs at a discount. In addition, petrochemical retail companies have diversified their products by “bundling” with other companies (Furszyfer Del Rio et al., 2020).

The aim of creating a fuzzy activity-based pricing (FABC) system is to develop an expert evaluation methodology based on fuzzy sets because it is able to combine knowledge related to inherently ambiguous and inaccurate information with a pricing system based on the approach and type of activity. In fact, a fuzzy activity-based costing and pricing system allows the user of the system to be able to gain knowledge about the existing ambiguities and uncertainties.

Integrate the resulting knowledge with the production and decision-making process. Therefore, this system is suitable for companies that: firstly: operate in unstable environments; secondly: do not have correct and sufficient costing information; thirdly: are not confident in the accuracy of their cost estimates (Yeganeh et al., 2012). In such circumstances, using a fuzzy activity-based costing (FABC) system has potential advantages such as: a) providing additional information to the system user in making decisions about production costs; b) empowering

the system user by providing information related to errors and ambiguities inherent in the system; c) performing sensitivity analysis of the activity-based costing system by creating an appropriate state (Gholami and Hakak, 2019). Similarly, Hinterhuber and Liozu [2] defined four pricing strategies depending on customer value as well as competitor prices:
a) low price/high value, b) low price (discounts); c) high price and low value (SKF); and finally, d) premium prices and high value (luxury). Researchers have examined that "premium pricing is a pricing strategies that result in prices that are both high relative to competitors' prices and high relative to customer value" (Hinterhuber and Liozu [2]. Kumcu and McClure [3] added that, contrary to the classical law of demand, prestige goods have a "reverse demand" as fine jewelry and luxury cars (Hawkins [4]). In the same context, Vigneron and Johnson [5] examined the relationship between exclusivity, price, and perceived prestige value. As a result, researchers identified four different customer groups that differ in their demands and perceptions of prestige.

3.2. Research questions and hypotheses

Given that the main parts of the theoretical research method arise from the collected data, therefore, in order to achieve a pricing model for industrial products with a fuzzy activity-based costing approach and a conceptual research model in the qualitative part of the research, the researcher must answer the following questions:
Research questions:
The main question of the above research is:
1. What is the pricing model for petrochemical products with a customer-oriented approach based on fuzzy Delphi?
The sub-questions of this research are:
Causal Factor Coding
1-1. What are the causal factors affecting the central phenomenon of the petrochemical product pricing model with a customer-centered pricing approach based on the fuzzy Delphi?
Contextual Factor Coding
1-2. What are the contextual factors affecting the strategies of the petrochemical product pricing model with a customer-centered approach based on the fuzzy activity?
Intervening Factor Coding
1-3. What are the intervening factors affecting the strategies of the pricing model for petrochemical products with a customer-centered approach based on the fuzzy Delphi?
Coding of strategic factors
1-4. What are the strategies for pricing petrochemical products with a customer-centered approach based on the fuzzy Delphi?
Coding of consequential factors
1-5. What are the consequences of implementing the pricing model for petrochemical products with a customer-centered approach based on the fuzzy Delphi?

4. Research Methodology

The worldview of the present study is based on the school of pragmatism or originality of action, which is often seen in mixed research. This perspective supports the purposeful use of methodological pluralism and is not committed to a prescribed framework or a single approach to understanding reality (Cresswell, 2009). The research method considered for this study is the mixed method. The mixed methodology used in the present study is of the sequential-exploratory type.

Fig.2. Exploratory research design in a mixed approach (Creswell and Plano-Clark, 2007)

As stated, the method considered for conducting the present study is a mixed method. The first phase of this research is based on a qualitative method and a data-based research strategy. Grounded theory is an inductive and exploratory research method that allows researchers in various subject areas to develop their own theory instead of relying on existing and predefined theories (Strauss and Corbin, 2011). The design used in this study is based on the systematic design developed by Strauss and Corbin. This design is based on the use of three-stage open, axial, and selective coding.

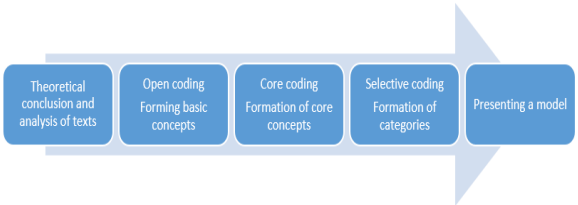

Fig.3. Stages of the systematic design of Strauss and Corbin's data-based theory (Saghfi, 2017)

The second phase of this research is based on a quantitative method and seeks to test the theory

and explain the relationships between phenomena in the proposed research model.

4.1. Statistical population of the research

The statistical population of the qualitative part of this research consists of managers, vice presidents, senior experts in the petrochemical industry, and academic experts (interviewees).

The statistical population of the quantitative part of this study consists of all personnel at the undergraduate level, department managers, division managers, unit heads, and senior managers of the petrochemical company in Tehran.

Data collection tools:

In this research, the library study method, including the use of books, articles, and the World Wide Web to collect information on the theoretical foundations of research and literature related to the research topic, as well as field methods including questionnaires, interviews, and observation to provide information for qualitative and quantitative data analysis, has been used. Accordingly, in order to collect data in the qualitative part of the research, the in-depth and semi-structured interview technique was used, and since the interview method was in-depth and semi-structured, an attempt was made to collect and extract existing facts by asking questions about events related to the research. In the quantitative part of the research, a researcher-made questionnaire was also used to collect data in the field.

5. Data Analysis

In the described Fuzzy Delphi process, while the core methodology of iterative feedback and fuzzy aggregation is outlined, the specific criteria for expert selection and the stopping rule for Delphi rounds require explicit articulation for methodological rigor. Expert selection should be based on demonstrable expertise and experience relevant to the research topic, potentially involving criteria such as years of practice, academic credentials, previous publications, or demonstrated involvement in the specific industry or problem domain. The stopping rule, conversely, dictates when the process has reached a sufficient level of consensus or stability.

Common stopping criteria include achieving a predefined level of consensus among experts (e.g., a specific degree of agreement on fuzzy ratings or a low standard deviation in crisp values after defuzzification), reaching a maximum number of predetermined rounds, or observing minimal changes in expert responses between consecutive rounds, indicating that further iterations are unlikely to yield significant shifts in the collective opinion. Clearly defining these aspects ensures the transparency, replicability, and validity of the Fuzzy Delphi study.

To the six dimensions of the "causal conditions" cycle, at the end of the first Delphi round and based on the experts' opinions, two more dimensions were added, namely "product needs assessment" and "timeliness of needs", which became eight dimensions. After conducting the Delphi qualitative technique round, it had seven dimensions, namely: Product needs assessment, Compliance with the external sample, Product physical structure, Authority, Product branding orientation, Product efficiency, Product appearance, Type of packaging, and Timeliness of needs.

To the seven dimensions of the "Contextual Conditions" cycle, at the end of the first Delphi round and based on the experts' opinions, three dimensions were added, namely "Customer loyalty to the product", "Power of creativity in product packaging", and "Mobility and market fluctuations", which became ten dimensions. Therefore, finally, the "Contextual Conditions" cycle, after carrying out the qualitative Delphi technique, has ten dimensions, namely: Supply chain, Market strategy, Market price fluctuations, Inflation rate, Transportation costs, Labor costs in chemical product production, Raw material costs, Marketing and advertising costs, Customer loyalty to products, and power of creativity in packaging.

At the end of the first Delphi round and based on the experts' opinions, two dimensions were added to the six dimensions of the cycle of intervening conditions, namely "price inflation rate" and "market intermediaries", which became eight dimensions.

Tab.4. Profile of participants in interviews in the qualitative part of the research

Number of interviews	Expert Composition (Industry Communication Method)	Education	Average activity history
15 Person	academic members of the university	PhD	17 years
	executive directors and board members of petrochemical companies	Master's degree-PhD	15 years
	activists and experts from the petrochemical industry	Master's degree-PhD	22 years

After conducting the qualitative Delphi technique, there are eight dimensions, namely: Advancement of production technology, Multiple management in pricing, Unbalanced market policy, Carbon tax, Continuous competitiveness of petrochemical products, and Uncontrolled import of similar products.

To the three dimensions of the "Strategies" cycle, at the end of the first Delphi round and based on the experts' opinions, a dimension was added, namely "Technical knowledge costs of new product production", which became 4 dimensions. Therefore, in the end, the "Strategies" cycle, after carrying out the qualitative Delphi technique, has four dimensions, namely: Technical knowledge costs of new products, Supply and demand strategy, Strategy for production of widely used products, and Future prices in the stock market.

To the four dimensions of the "Factors and Consequences" cycle, at the end of round one of Delphi, and based on the experts' opinion, a dimension called "Inflation Rate" was added, which became 5 dimensions. Therefore, in the end, the "Consequences" cycle, after performing the qualitative Delphi technique, has 5 dimensions: Market control, Elimination of intermediaries, Production of low-quality products, Customer relationship management.

Results of the Fuzzy Delphi Method for the Core Categories:

This research considers 5 main cycles: causal conditions, background conditions, intervening conditions, strategies and outcome factors as the main and effective dimensions on the pricing management of petrochemical products and conducts this study as a case study. Each of these dimensions has indicators that in this research, the goal is to investigate and discover the degree of importance of the indicators determined for each dimension.

First round-Converting verbal values into real numbers:

The initial research questionnaire was prepared verbally based on the Delphi method, with a seven-point Likert scale, taking into account the indicators of each dimension, and was provided to experts (15 people). Therefore, in the first round, we extracted the verbal expressions of the questionnaires as numbers. This can be done in two ways: extract them directly from the verbal form into fuzzy numbers, or first convert them numerically from the verbal form (according to the Likert scale) and then convert the real and correct numbers into fuzzy numbers. In this study, the second method was used to obtain the usual average of the experts' opinions. Some indicators may be very unimportant in the opinion of experts, so we can identify, separate, and even eliminate the unimportant and very unimportant indicators by having the simple Delphi numerical average from the first round, so that we do not encounter an increase in ineffective data in the following steps.

First round-Converting real numbers to triangular fuzzy/physical cycle:

In this stage, according to Table 5, all the numbers in the first round tables will be converted into fuzzy sets. It is worth noting that in this stage, the revised expert tables (to which new indicators have been added) are used. In the following, each of the real numbers in the tables corresponding to Table 5 will be converted into triangular fuzzy numbers.

First round-Fuzzy mean calculation and defuzzification:

Next, the fuzzy mean, which includes the mean of the lower bounds, the mean of the upper bounds, and the mean of the probable values, is calculated from equation (1). Then, the defuzzification operation is performed using the center mean method (equation 2).

$$F_{AVE} = \frac{\sum l}{n}, \frac{\sum m}{n}, \frac{\sum u}{n} \qquad \text{Relationship (1)}$$

$$\text{if } \tilde{F} = (L, M, U) \text{ Then } F = \frac{L+M+U}{3} \qquad \text{Relationship (2)}$$

If we use fuzzy methods to perform calculations, the defuzzified value is obtained between zero and one.

Tab.5. Triangular fuzzy numbers corresponding to verbal variables

	Corresponding real numbers	Triangular fuzzy number (1,m,u(
Too much	7	(0.9, 1, 1)
Too much	6	(0.75, 0.9, 1)
Verbal variables	5	(0.5, 0.75, 0.9)
Medium	4	(0.3, 0.5, 0.75)
Low to medium	3	(0.1, 0.3, 0.5)
Low	2	(0, 1.0, 3.0)
Very little	1	(0, 0, 0.1)
(Habibi et al., 2015)		

Normally, we consider the middle limit (i.e., 0.5) as a criterion for calculating the threshold intensity. However, since the fuzzy technique must be a little stricter, we used the value (0.7) as a decision criterion. As can be seen in Table 4-14, the physical index (6) is more than the permissible threshold intensity of this study and has been eliminated in the first round.

Significance Filtering: A threshold is used to filter out factors or conditions that have a below-average or negligible impact. By setting a threshold (e.g., 0.7), you are essentially defining a minimum level of importance. Factors whose defuzzified values exceed this threshold are considered significant and warrant further attention, while those below it are deemed less critical in the specific context of the study.

Focusing resources and attention: In practical decision-making, resources (time, money, effort) are often limited. A threshold helps in prioritizing where to focus these resources. For example, if you have multiple factors influencing pricing, a threshold allows you to concentrate on the factors that have the most substantial calculated impact.

In qualitative research, triangulation, also known as credibility checking, is a vital methodological approach employed to enhance the trustworthiness and rigor of findings. It involves using multiple data sources, methods, investigators, or theories to examine the same phenomenon. By cross-validating data obtained through different lenses, researchers can mitigate the potential biases inherent in any single method or perspective. For instance, data triangulation might involve collecting information from interviews, observations, and documents; methodological triangulation could compare findings from a qualitative study with quantitative data; investigator triangulation involves multiple researchers analyzing the same data set; and theoretical triangulation applies different theoretical frameworks to interpret the findings. The convergence of evidence across these diverse sources strengthens the validity of the conclusions, providing a more comprehensive and robust understanding of the research problem.

4-2-4-First round-Converting real numbers to triangular fuzzy numbers/Background conditions

The results derived from the fuzzy and defuzzied means analysis within the causal condition cycle reveal that indicators related to the physical and functional characteristics of the product play the most significant role in explaining the model's causal conditions. Notably, "Product Elegance" emerged as the most crucial factor, exhibiting the highest defuzzied value (1.05), underscoring experts' emphasis on the aesthetic quality and design precision of the product in establishing competitive advantage. Following closely, "Physical Structure and Form of the Product" and "Timeliness of Needs" (both at 0.98) were ranked next, indicating the simultaneous importance of manufacturing quality and temporal alignment with market demands. Furthermore, "Packaging Type" (0.96) and "Product Efficiency" (0.94) are identified as other influential factors, highlighting their significant role in enhancing product desirability and market positioning. Conversely, "Brand Authority" (0.87) and "Matching with Foreign Sample" (0.73) registered the lowest defuzzied values. This suggests that within the context of industrial products, functional and technical attributes are more paramount than branding considerations or mere similarity to foreign counterparts. Overall, the findings corroborate that in the causal condition cycle of the proposed model, competitive advantage is primarily founded upon manufacturing quality, engineering design, and product efficiency.

Raw material costs (0.97) emerge as a crucial economic factor, suggesting that managing the expense of inputs is vital for the business's success.

The cost of difficulty in producing chemical products (0.91) and the **inflation rate** (0.87) represent significant economic and operational challenges that need careful consideration.

Tab.6. Fuzzy and defuzzified mean table-causal condition cycle

Indicators	Average			Defuzzification
Matching with a foreign product	0.21	0.27	0.42	0.73
Matching with a foreign sample	0.32	0.43	0.48	0.94
Physical and form structure of the product	0.26	0.42	0.58	0.98
Authoritarianism of product branding	0.26	0.35	0.49	0.87
Product efficiency	0.32	0.43	0.48	0.94
The product's elegance	0.28	0.45	0.62	1.05
Packaging type	0.30	0.39	0.53	0.96
Timeliness of needs	0.26	0.42	0.59	0.98

Tab.7. Fuzzy and defuzzied average table of background conditions

Indicators	Average			Defuzzification
Customer loyalty to products (discounts and purchase incentives) 1	0.27	0.53	0.50	0.97
The power of creativity in packaging	0.27	0.34	0.50	0.77
Market volatility mobility	0.27	0.50	0.63	0.98
Supply chain	0.25	0.35	0.50	0.77
Target market strategy	0.31	0.47	0.64	0.99
Inflation rate	0.30	0.40	0.52	0.87
Transportation cost	0.27	0.34	0.50	0.77
The cost of difficulty in producing chemical products	0.21	0.53	0.50	0.91
Raw material costs	0.24	0.53	0.60	0.97
Marketing cost	0.22	0.33	0.48	0.71

Conditions such as **the power of creativity in packaging** (0.77), **supply chain** (0.77), and **transportation cost** (0.77) have a moderate level of impact. **Marketing cost** (0.71) shows the least influence among the analyzed background conditions, suggesting that while important, it may be less critical compared to strategic, market, cost, and loyalty factors in this specific context.

Unbalanced market policy emerges as the most impactful intervening condition, with the highest defuzzied average of 1.04, suggesting that market policy imbalances pose a significant challenge or opportunity. **Uncontrolled import of similar products** (0.96) is another critical factor, indicating that the influx of competing products significantly influences the market environment.

Conditions such as **the cost of timely technological advancement** (0.82), **continuous competitiveness** (0.82), and **sanctions and inflation rates** (0.81) hold moderate to high significance, pointing to the importance of technological adaptation, sustained competitive efforts, and navigating economic pressures.

Global price of carbon tax (0.79) and **multiple management in controlling supply and demand** (0.78) have a moderate influence, suggesting that global environmental policies and supply-demand management strategies are relevant but perhaps less immediately critical than the aforementioned factors.

6. Conclusion and Suggestions

The present study aimed to develop a strategic pricing model for industrial products using the FABC (Activity-Based Costing with a strategic focus) approach, with the steel industry—specifically Khuzestan Steel Company—as the focal case. The findings revealed that pricing decisions in large industrial sectors are shaped not merely by cost structures but by an integrated system of causal, contextual, and intervening conditions, including supply chain capabilities, distribution management practices, internal organizational structures, target-market policies, and national political-economic dynamics.

Tab.8. Fuzzy and defuzzied mean table-mental cycle

Indicators	Average			Defuzzification
The cost of timely technological advancement	0.24	0.39	0.56	0.82
Multiple management in controlling supply and demand	0.28	0.35	0.45	0.78
Unbalanced market policy	0.37	0.47	0.60	1.04
Global price of carbon tax	0.23	0.37	0.55	0.79
Continuous competitiveness	0.27	0.40	0.45	0.82
Uncontrolled import of similar products	0.27	0.51	0.54	0.96
Sanctions and inflation rates	0.19	0.32	0.48	0.81
Market intermediaries	0.17	0.31	0.49	0.75

Tab.9. Fuzzy and defuzzification mean table-intuitive (smell)

Indicators	Average			Defuzzification
Forecasting the costs of technical knowledge for new products	0.34	0.42	0.56	0.94
Market launch strategy	0.35	0.51	0.67	1.08
Production strategy for widely used products	0.20	0.35	0.56	0.74
Future prices in the world market 4	0.24	0.40	0.58	0.83

The results of the analysis of data extracted from the theoretical study and in-depth interviews with university professors and steel industry experts in the field of marketing and sales of products were collected based on the data-driven theory and were coded in three stages, and the conceptual model of the research was presented as follows:

This research offers several distinct contributions to the theoretical literature on industrial pricing:

It introduces a **comprehensive conceptual framework** that expands pricing research beyond conventional cost-based or competition-based perspectives by incorporating strategic, organizational, and macro-environmental dimensions.

The study identifies and integrates **supply chain capability** and **customer-oriented distribution management** as causal conditions that shape pricing mechanisms—a linkage that has been underexplored in prior industrial pricing literature.

By embedding **global determinants** (exchange rates, international petrochemical and steel prices, carbon taxation, and global oil price fluctuations) into a firm-level pricing model, the research connects domestic pricing strategies to international market forces, thus bridging a notable gap in existing theoretical models.

The application of the **FABC approach** within the conceptual framework provides a theoretically grounded method for identifying non-value-adding activities, refining cost structures, and enhancing the accuracy of product-level cost estimation.

Collectively, these contributions advance pricing theory from a predominantly financial–operational domain to a more strategic–systemic perspective, offering a foundation for future scholarly development in industrial marketing, strategic pricing, and managerial accounting.

- Strategies: Based on the results of qualitative data analysis, two categories of cost calculation with a customer-centric pricing approach and global factors related to the petrochemical industry are two key strategies for accurately calculating the cost of goods and at the same time, considering the specific characteristics of petrochemical products (taking into account the effects of global petrochemical prices, exchange rates, carbon taxes, global prices of oil and its products, etc.), considering global factors in determining the price of products in the market will balance the price offered for products in the market.
- Results: According to the conceptual model presented from the qualitative data analysis of the research, the implementation of the petrochemical product pricing model increases productivity and increases competitiveness, because the approach to calculating the cost of industrial products with a modern approach (FABC), in addition to accurately calculating the cost associated with each of the activities carried out in the production of products, by identifying and eliminating redundant activities and defining standards and criteria for those inefficient activities that cannot be eliminated, provides opportunities for increasing productivity for the company. On the other hand, considering the accurate allocation of costs in calculating the cost of products, it is possible for sales and marketing managers to have greater flexibility in negotiating and presenting prices to their customers, considering market conditions, supply and demand levels, and customer conditions. Also, according to the findings of the second part of the research (qualitative part), which was conducted to fit and ensure the accuracy of the proposed model, the accuracy of the research hypotheses was evaluated and tested using the structural equation model. The results confirm the fit of the theoretical model of the research.

Reduce direct governmental control over price determination in the petrochemical and steel sectors to encourage competitive price discovery through market mechanisms.

Strengthen commodity-exchange frameworks for transparent price formation based on real supply and demand.

Support vertical integration and investment in the value chain, enabling domestic firms to capture higher value-added segments instead of relying on raw-material exports.

Design tariff and taxation policies (e.g., carbon and energy taxes) that incentivize efficiency while preserving the international price competitiveness of domestic producers.

The study provides several actionable insights for practitioners in heavy industries—particularly steel, petrochemical, and similar sectors:

Implementing the FABC-based pricing model improves **cost transparency**, supports the elimination of redundant activities, and enhances overall operational productivity.

More accurate cost allocation strengthens **pricing flexibility** for sales and marketing managers,

enabling them to adjust prices in alignment with market demand, buyer characteristics, and competitive conditions.

At the policy level, the findings highlight the necessity of reducing government intervention in pricing, expanding commodity exchange mechanisms for price discovery, and promoting investment along the value chain to enhance market efficiency. Considering global economic factors in domestic pricing decisions can help firms achieve a more balanced and competitive price structure, improving both **profitability** and **market positioning** in local and international markets.

Practical suggestions:

At this stage, based on the results of testing the research hypotheses in the quantitative stage (model validation), the following suggestions are presented based on confirming the hypotheses:

- Taking into account global factors affecting the price of petrochemical products (such as economic conditions related to the petrochemical industry at the international level);
- Policy-making for the supply of all petro-chemical value chain products on the commodity exchange;
- Price discovery based on supply and demand mechanisms;
- Reducing government ownership in the pricing of petrochemical products;
- Investing in the value chain;
- Imposing tariffs on raw materials and supporting the export of their products.

References

[1]. Cahyadi, I. (2020). Developing a digital application to improve business process sustainability in an Indonesian fast-moving consumer goods company. Journal of Physics: Conference Series, 1569(3), 032023. https://Doi.org/10.1088/1742-6596/1569/3/032023.

[2]. Caliskan, A., Özkan Özen, Y. D., and Ozturkoglu, Y. (2020). Digital transformation of the traditional marketing business model in the new industry era. Journal of Enterprise Information Management, 34(4), 1273-1252. https://doi.org/10.1108/JEIM-02-2020-0084.

[3]. Calle, A. D. L., Freije, I., Ugarte, J. V., and Larrinaga, M. Á. (2020). Measuring the impact of digital capabilities on product-service innovation in Spanish industries. International Journal of Business Environment, 11(3), 254–274.

[4]. Carvalho, A., Alves, H., and Leitão, J. (2022). What research tells us about leadership styles, digital transformation and performance in state higher education? International Journal of Educational Management, 36(2), 218–232. https://doi.org/10.1108/IJEM-11-2020-0514.

[5]. Cooper, Robin; and Robert S. Kaplan (1991). Profit Priorities from Activity-Based Costing Harvard Business Review, May-June, pp. 130-135.

[6]. Cresswell, John; Plano-Clark, Vicky (2007), Mixed Research Methods, translated by Alireza Kiamanesh, Javid Sarai, Tehran: Abizh Publishing.

[7]. Feizi, Tahereh. Moghli, Alireza, Geramipour, Masoud, and Zare, Reza (2015). The relationship between administrative decentralization and public governance in government organizations of Fars province, PhD thesis at Payam Noor University.

[8]. Gholami, Mehran, and Hakak, Mohammad (2019). PhD thesis entitled "Designing a strategic pricing model for industrial products with an activity-based costing approach (case study: Khuzestan Steel Company products)", Payam Noor University.

[9]. Hassan Shahi, M., Rahimi, M., and Khalili, M. (2012). The effects of monetary and fiscal policies on employment and Added Value: A case study of the agriculture sector in IRAN. Journal of Basic and Applied Scientific Research. 2(4): 4262-4265.

[10]. Kaufmann, D., and Lein, S. M (2013), "Sticky Prices or Rational Inattention–What Can We Learn from Sectoral Price Data?", European Economic Review, Vol. 64, PP. 384-394.

[11]. Kosasih, Oos, Kadarisman Hidayat, Benny Hutahayan, and Sunarti. 2024. "Achieving Sustainable Customer Loyalty in the Petrochemical Industry: The Effect of Service Innovation, Product Quality, and Corporate Image with Customer Satisfaction as a Mediator" Sustainability 16, no. 16: 7111. https://doi.org/10.3390/su16167111.

[12]. Lawrence NW. Social research methods: qualitative and quantitative approaches. 4th ed. Allyn and Bacon Co. 1999.

[13]. Lee J. (2001) A grounded theory: Integration and internalization in ERP adoption and

use [Unpublished PhD Thesis]. Lincoln: University of Nebraska.

[14]. Lee, C. Bai-Jian Chou, Chen-Feng Huang, (2022), Data science and reinforcement learning for price forecasting and raw material procurement in the petrochemical industry, Advanced Engineering Informatics, Volume 51, 2022, 101443, https://doi.org/10.1016/j.aei.2021.101443.

[15]. Michael V. Marn, Eric V. Roegner, and Craig C. Zawada, "The Art of Pricing Your New Product", McKinsey Quarterly, 2013.

[16]. Mittlemann, J., "New Product Planning and Pricing: From Idea to Commercialization– A marketing approach", 2004.

[17]. Mostajerian, M., Daei-Karimzadeh, S., Dehghani, A., & Ghobadi, S. (2025). The constructional model of the effects of pricing strategies on the exporting of petrochemical products in Iran. International Journal of Nonlinear Analysis and Applications, 16(2), 165-176. doi: 10.22075/ijnaa.2024.32206.4783.

[18]. Shafei, Reza. Kafcheh, Parviz, and Darvand, Fateh (2014). Study of pricing strategies and their relationship with marketing capabilities in manufacturing companies, Quarterly Journal of Business Strategies, Year 21, No. 4, pages 47-53.

[19]. Shahbazi, Kiyomars, and Karimzadeh, Elham (2015). The impact of monetary and fiscal policies on the added value of the industrial sector in Iran, in line with the general policies of the industrial sector.

[20]. Strauss, Anselm and Corbin, Juliet (2011). Principles of Qualitative Research Methodology, translated by Boyuk Mohammadi, Tehran, Institute for Humanities and Cultural Studies, 25-34.

[21]. Tayebnia, Ali, and Fouladi, Masoumeh (2009). Investigating the effects of rising world prices on domestic price levels, trade balance, and exchange rates, using an interview general equilibrium model, Journal of Economic Research, No. 89, pp. 157-184.

Follow this article at the following site:

Sakineh Alizadeh Latrei, S. Ali Nabavi Chashmi, Iraj Mahdavi. "Proposing the pricing model of petrochemical products with a customer-centered approach Based on Fuzzy Delphi Evaluation" IJIEPR 2026; 37 (2): 123-136
URL: http://ijiepr.iust.ac.ir/article-1-2414-en.html