

# Category Home Online Custom One-click Quotation System and Method

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## Abstract

Aiming at the problems of low quotation efficiency, poor real-time price, isolated front-end and back-end data, high artificial dependence, and non-standard pricing in traditional online customization of home furnishings, this paper proposes an online customization one-click quotation system and implementation method based on product configuration theory, multi-dimensional linkage constraint model, real-time intelligent pricing model, and ERP order state machine model. The system consists of four modules : commodity price basic database, quotation front-end page, one-click quotation operation module and ERP order processing module. Through parameter standardization, configuration linkage, pricing formulation and order integration, the user-side one-click real-time quotation and enterprise-side order automatic transfer production are realized. The simulation results show that the average quotation time of the system is reduced from 145 s to less than 1.5 s, the quotation accuracy rate is more than 99.3 %, and the order review and production scheduling efficiency are improved by 82 %. It effectively solves the problem of online quotation and offline production coordination in door industry customization, significantly improves user experience and enterprise operation efficiency, and provides technical reference for mass customization in home building materials industry.

## Keywords

Category Home; Online Customization; One-click Quotation; Product Configuration Theory; ERP Integration.

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## 1. Introduction

Category home ( wooden door, glass door, aluminum alloy door, window cover, door cover, etc. ) is the core part of home decoration. With the upgrading of consumption and the growth of personalized demand, customization has become the mainstream trend of the industry [1]. The Internet and digital technology have promoted the transformation of the door industry from offline manual scale, manual quotation, and store order to online self-customization, real-time quotation, online payment, and offline performance. However, due to the influence of complex product structure, multiple configuration options, high non-standard ratio, and scattered price rules, the existing online customization system generally has problems such as lagging quotation, inaccurate accounting, and separation of front-end malls and back-end ERP [2, 3]. It is difficult to achieve efficient and accurate online closed-loop transactions. Therefore, in view of the above problems, this paper introduces product configuration theory, multi-dimensional data linkage model, real-time price calculation model and order state machine circulation model, and designs a set of standardized, intelligent and integrated one-click quotation system and method for online customization of home furnishing [4, 5], which realizes parameter pre-definition, front-end linkage selection, one-click real-time pricing, order direct production, and provides landing technical solutions for digital customization of door industry [6, 7].

## 2. System Composition and Theoretical Basis

### 2.1 Core Theoretical Model

#### (1) Product configuration theory

Product is represented as a four-tuple of configurable items, constraints, property values, and price rules :

$$Model = \{C, R, V, P\} \quad (1)$$

Where :  $C$  is the set of configuration items ( size, process, hardware, etc. ) ;  $R$  is a constraint relation ;  $V$  is the attribute value domain ;  $P$  is the set of price rules.

#### (2) Multidimensional linkage constraint model

The main dimension ( classification-name-type ) drives the sub-dimension ( color-process-line-metal-hole position ) to meet :

$$\forall c_i \in C_{main}, \exists C_{sub}(c_i) \subseteq C_{sub} \quad (2)$$

Realize the automatic constraint of option legitimacy and display state.

#### (3) Real-time intelligent pricing model

The price is composed of base price, configuration price, non-standard mark-up price and accessory price :

$$Price = f(P_{base}, P_{config}, P_{extra}, P_{part}) \quad (3)$$

#### (4) ERP order state machine model

Order status according to : quote  $\rightarrow$  payment  $\rightarrow$  confirmation  $\rightarrow$  audit  $\rightarrow$  purchase  $\rightarrow$  production migration :

$$S_{n+1} = \delta(S_n, Event) \quad (4)$$

### 2.2 System Composition

The system consists of four modules, as shown in Figure 1 :

(1) Commodity price basic database : store standardized parameters, configuration rules, price lists, calculation formulas ;

(2) Front-end page of commodity quotation : Provide a customized interactive interface to display parameters and price results ;

(3) One-click quotation operation module : data query and price intelligent calculation ;

ERP system order processing module : order business and production information processing.

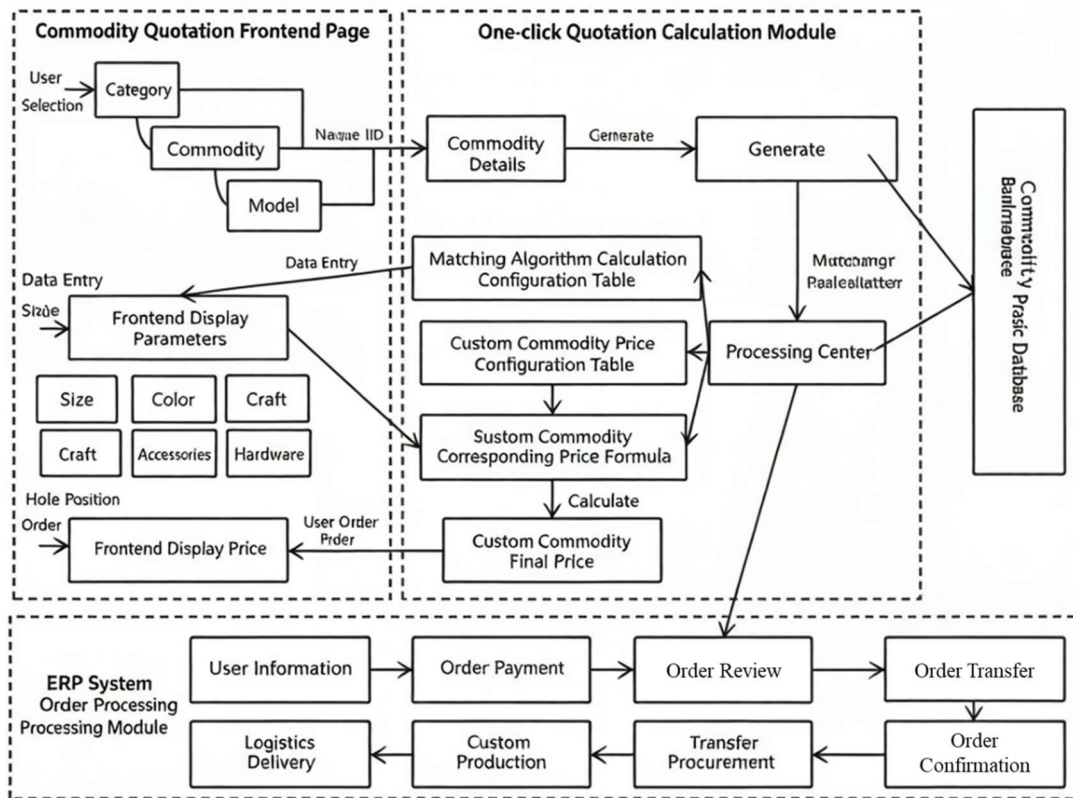


Figure 1. System composition structure of the one-click quotation system

### 3. Working Principle and Technical Implementation

#### 3.1 Overall Process

The system execution process is divided into four steps, A : establish a standardized price base database ; b : Front-end multi-dimensional linkage parameter display ; c : One key trigger real-time price calculation ; d : Order information throws ERP and enters production, as shown in Figure 2.

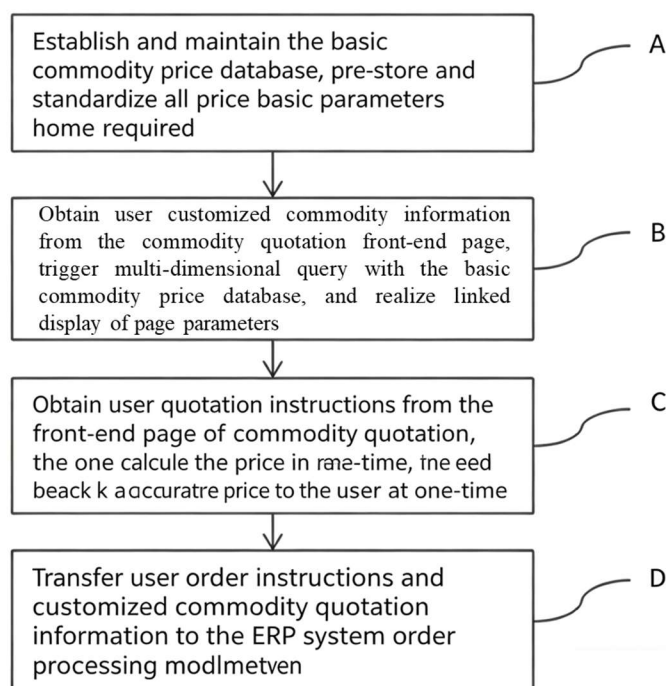
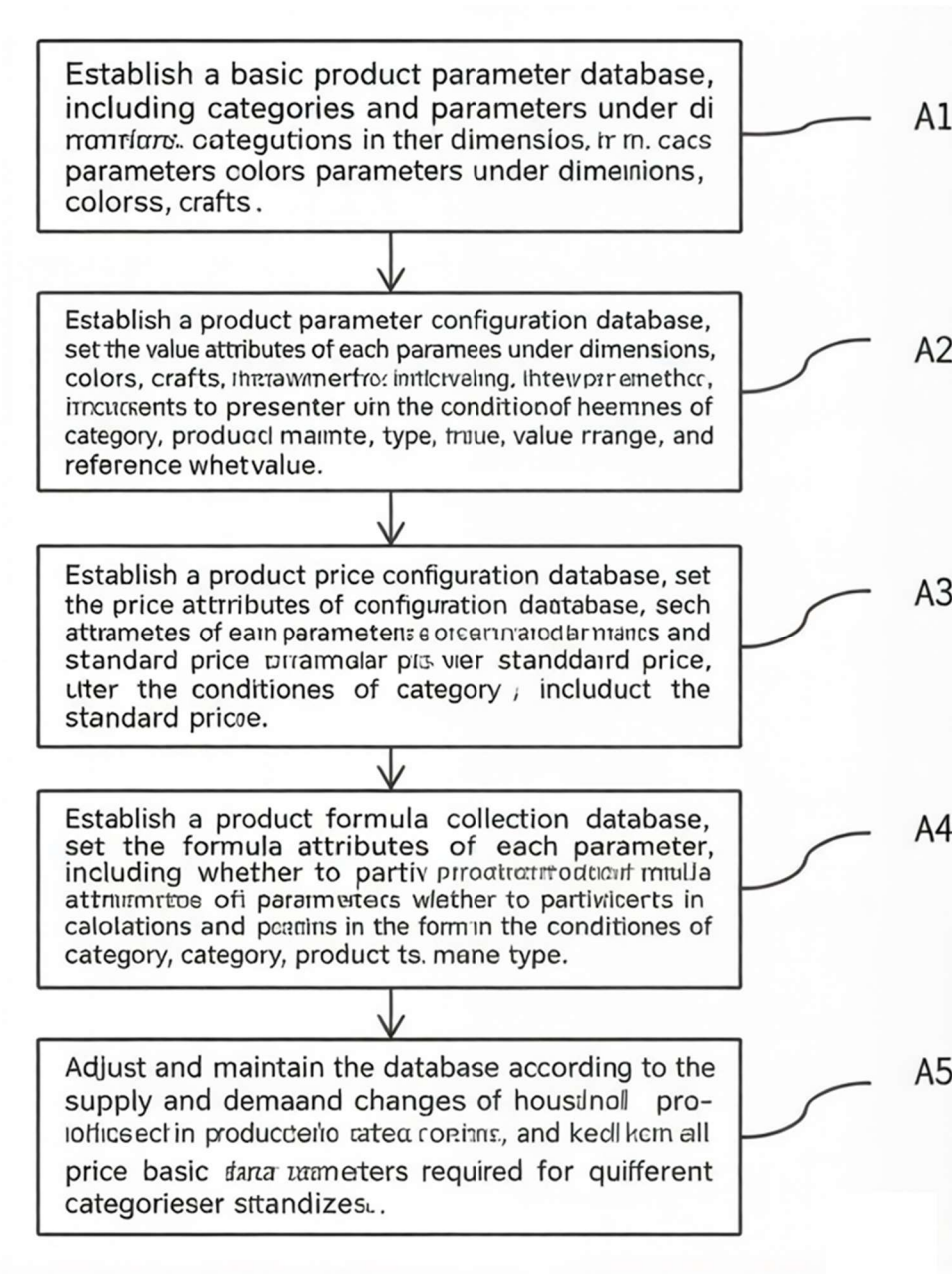


Figure 2. Overall working flow of the one-click quotation system

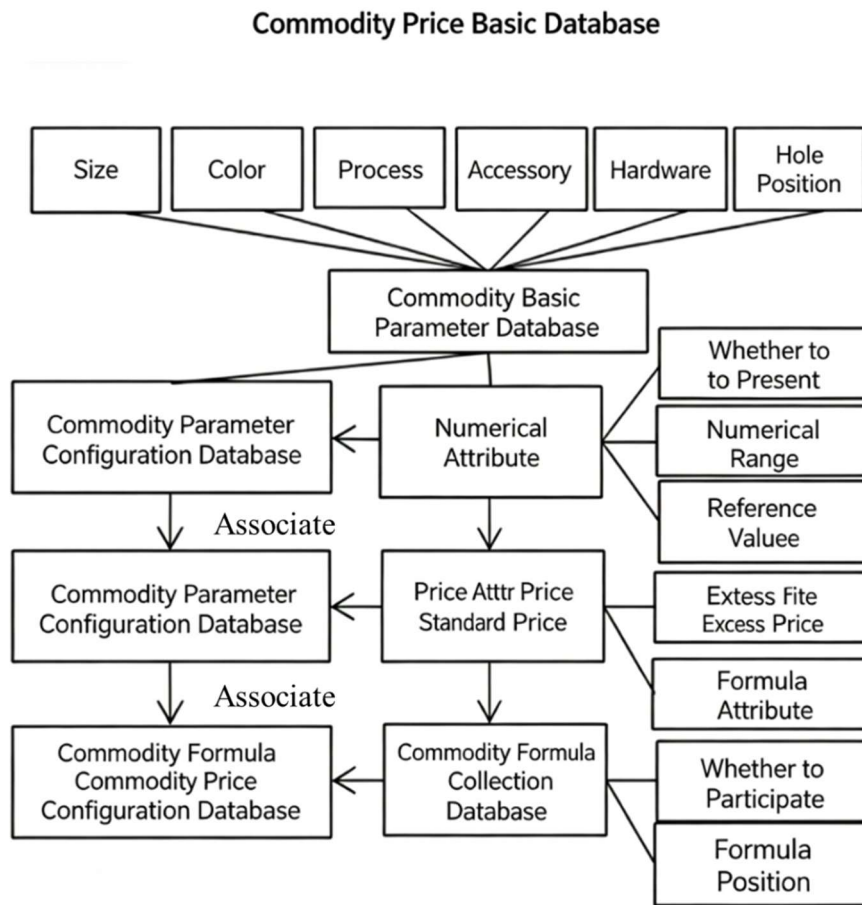
### 3.2 Step A Price Base Database Construction

Based on the theory of product configuration, a four-database integrated database is constructed. The specific implementation process includes : A1 commodity basic parameter library ; a2 parameter configuration library ; a3 price configuration library ; a4 formula set library ; a5 dynamic maintenance, its process structure is shown in Figure 3.



**Figure 3.** Construction flow of commodity price basic database

A1 : The basic parameters include size, color, process, sleeve, hardware, hole position category and parameters under the category, as shown in Figure 4.



**Figure 4.** Structure of commodity basic parameter library

Standard price formula :

$$P_{stand} = P_{unit} \cdot H \cdot W \cdot T \cdot N \cdot \lambda_{type} \quad (5)$$

Over-price formula :

$$P_{extra} = (\Delta W \cdot u_W + \Delta H \cdot u_H + \Delta T \cdot u_T) \cdot \lambda_{extra} \quad (6)$$

Where,  $H$  is the height of the box,  $W$  is the width of the box,  $T$  is the thickness of the wall,  $N$  is the number of doors,  $\lambda_{type}$  is the coefficient of door type,  $\Delta$  is the exceeding standard,  $u$  is the non-standard unit price,  $\lambda_{extra}$  is the exceeding standard coefficient.

### 3.3 Step B Multidimensional linkage display

Based on the multi-dimensional linkage constraint model and the unique ID mapping mechanism of the product, the real-time linkage and automatic constraints of user selection and front-end parameter display are realized to ensure that the user can only select the legal configuration items that conform to the production process and price rules. The specific implementation process includes : B1 is to obtain classification / product name / type ; b2 is to generate a unique ID ; b3 is multidimensional query initialization ; b4 is parameter display and acquisition, and its process structure is shown in Figure 5.

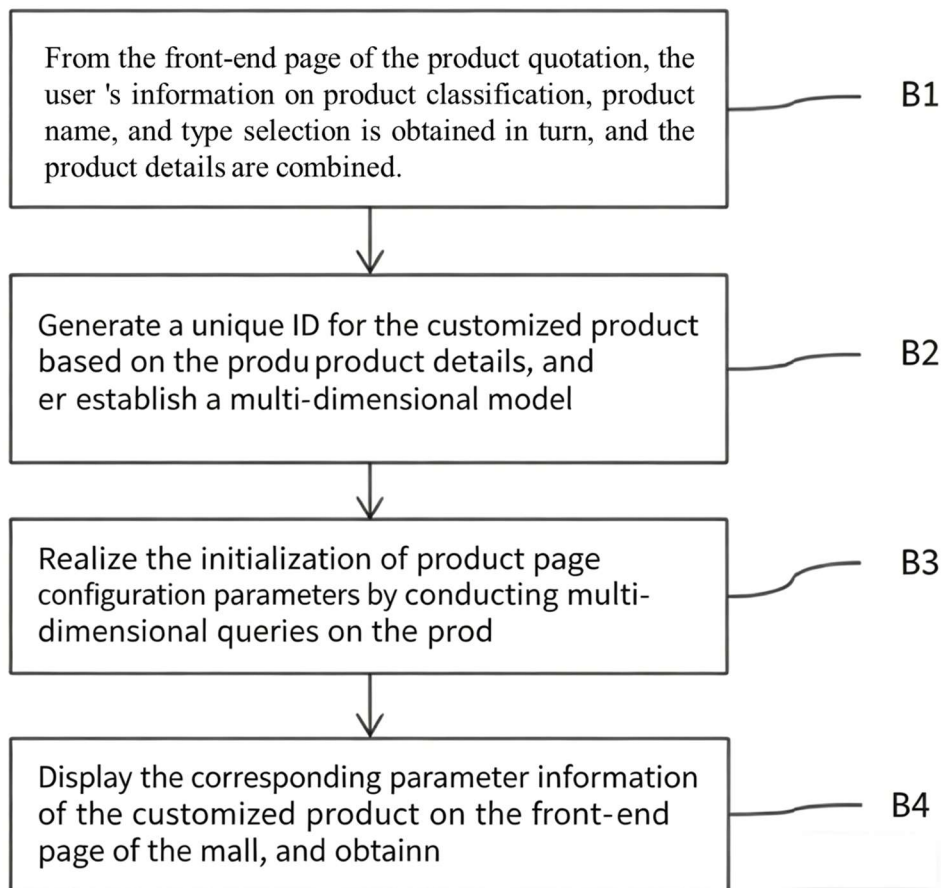


Figure 5. Front-end parameter linkage display flow

B1 Get Categories / Names / Types

From the front-end page of commodity quotation, the user's choice of commodity classification, product name and door type is obtained in turn. The three together constitute the only combination of commodity main dimension features, which is the basis for subsequent parameter linkage. Among them, the commodity classification includes paint-free, baking paint, etc. ; names include wooden doors, glass doors, aluminum alloy doors, etc. ; types include single-open doors, double-open doors, child-mother doors, invisible doors, single-shift doors, double-shift doors, three-shift doors, and four-shift doors.

Combine the above information into structured product details :

$$Detail = \{Class, Name, Type\} \tag{7}$$

Where : *Class* is the classification of goods, *Name* is the name of goods, *Type* is the type of door.

B2 Generates a unique ID

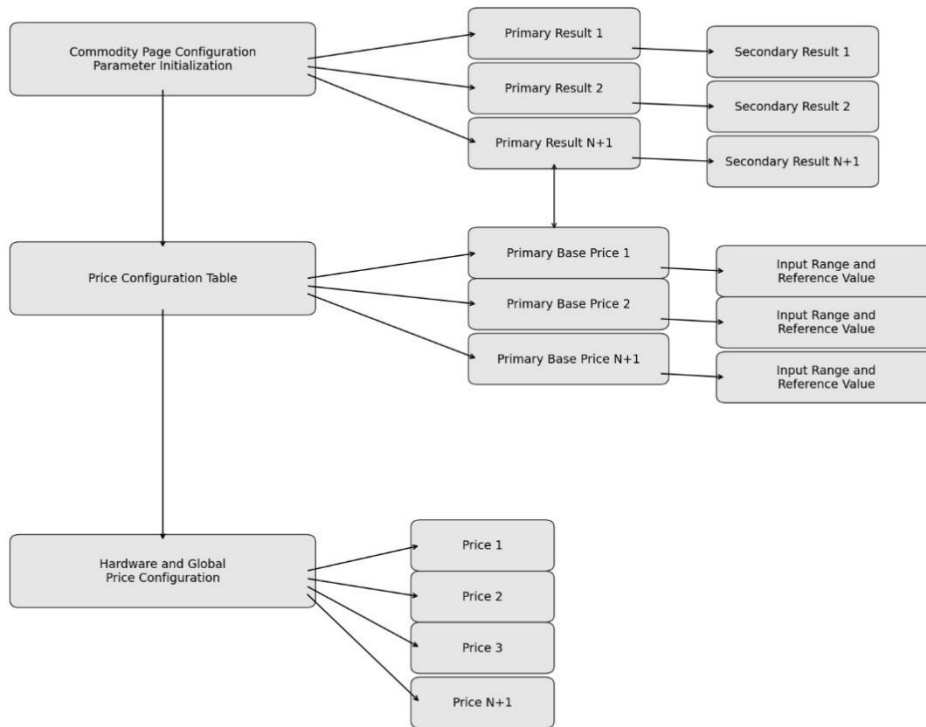
According to the above product details, the unique ID of customized products is generated by hash mapping, which is used to uniquely identify the current customized combination and accurately bind to the parameter configuration, price rules and calculation formulas in the database :

$$ID = Hash(Class, Name, Type) \tag{8}$$

As a unique identifier that runs through parameter linkage, price calculation, and order circulation, the *ID* ensures data consistency and traceability.

### B3 Multidimensional Query Initialization

With the unique ID as the index, the multi-matrix queue multi-dimensional query is performed on the commodity price basic database to complete the automatic initialization and linkage constraints of the front-end parameters. The parameter initialization process is shown in Figure 6.



**Figure 6.** Commodity page configuration parameter initialization process

#### B3.1 Configuration parameter linkage query

The system takes ID as the key, according to the classification-product name-type vertical classification, reads the first-level linkage results ( color, process ) from the commodity parameter configuration library, and then horizontally associates the second-level linkage results ( set line, hardware, hole position ) to form a complete configurable parameter set :

$$C_{sub} = Query_{DB}(ID, C_{main}) \tag{9}$$

Where,  $C_{main}$  is the main dimension,  $C_{sub}$  is the set of linkage sub-dimensions.

Through this constraint, the main option is changed to the sub-option to automatically refresh, preventing incompatible, unproductive, and unpriced parameter combinations.

#### B3.2 Price parameter linkage initialization

The system establishes a price configuration table bound to ID, and matches the basic price, size range, and reference value according to classification, product name, and type. The synchronous linkage front end can be input into the numerical interval to avoid over-range input leading to pricing errors :

$$\{H_{range}, W_{range}, T_{range}, K_{ref}\} = PriceQuery(ID) \quad (10)$$

Where :  $H_{range}$  is the frame height range,  $W_{range}$  is the frame width range,  $T_{range}$  is the wall thickness range,  $K_{ref}$  is the standard reference value.

### B3.3 Hardware and hole position linkage matching

According to the door type, the hardware, hole type and price are automatically matched to form an independent price unit set to realize the strong correlation between the accessory parameters and the main door type :

$$\{P_{hardware}, P_{hole}\} = UnitPriceQuery(ID) \quad (11)$$

So far, the integrated linkage between the database and the front-end page has been completed, and the parameters can be selected, visible, calculated and produced.

### B4 front-end page parameter display and data acquisition

According to the above linkage results, the front-end page only shows the parameters and numerical ranges that the current gate type allows to select, and automatically hides irrelevant options. The user only needs to select or input within the constraint range : color, process, and nesting style ; hardware accessories, hole type ; frame height, width, wall thickness and other dimensions.

The whole process does not require manual intervention. The system automatically completes option filtering, scope limitation, and rule verification. It ensures that the custom parameters are legal from the source, the price calculation is accurate, and the order can be directly produced.

## 3.4 Step C one-click Quote Operation

Based on the real-time intelligent pricing model, the one-click pricing is realized, and the specific implementation process is shown in Figure 7:

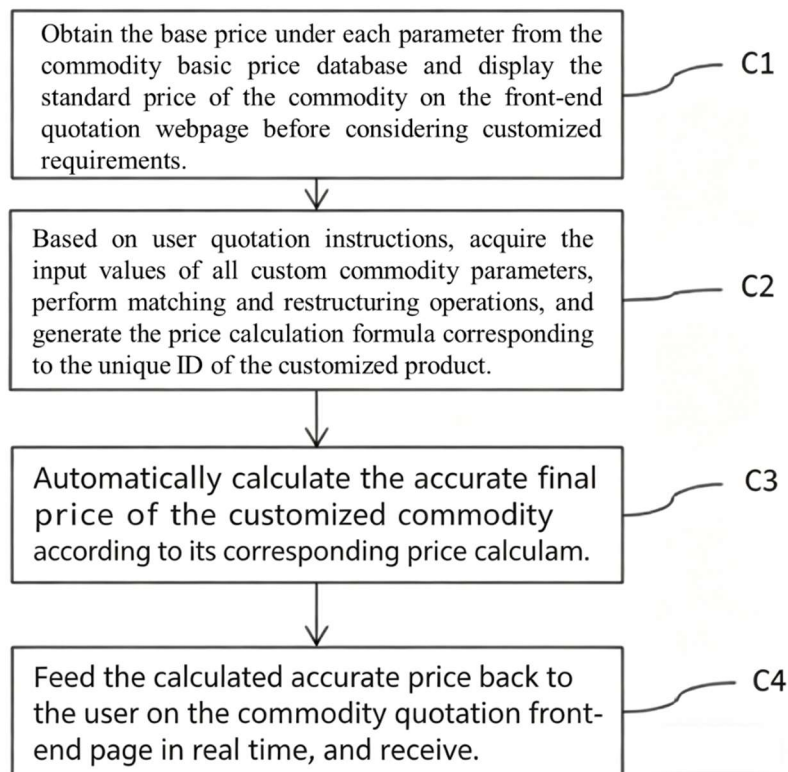


Figure 7. One-click quotation calculation flow

C1 loading base price ; c2 dynamic generation formula ; c3 automatic calculation of the total price ; c4 front-end returns the price in real time. The specific implementation process of C2 is shown in Figure 8:

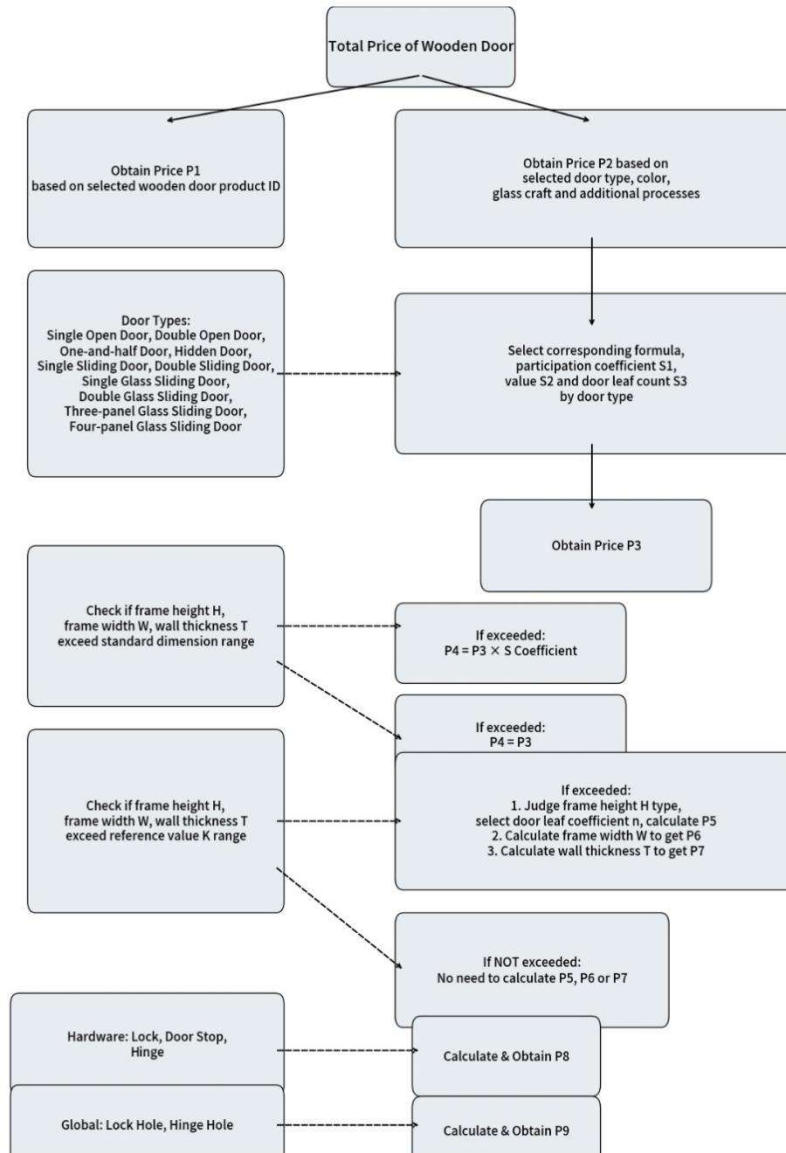


Figure 8. Price formula generation and matching flow

Typical total price formula :

(1) Single door / child door / double door :

$$TotalPrice = [(P_1 + P_2) \cdot S_1] \cdot S_{12} + P_5 + P_6 + P_7 + P_8 + P_9 \quad (12)$$

Where,  $P_3 = (P_1 + P_2) \cdot S_1$ ,  $S_1$  is the unfixed coefficient.

(2) Invisible door / single-shift door :

$$TotalPrice = [(P_1 + P_2) + S_2] \cdot S_{12} + P_5 + P_6 + P_7 + P_8 + P_9 \quad (13)$$

Where,  $P_3 = (P_1 + P_2) + S_2$ ,  $S_2$  is the unfixed coefficient.

(3) Double-shift door :

$$TotalPrice = [(P_1 + P_2) \cdot S_3 + S_4] \cdot S_{12} + P_5 + P_6 + P_7 + P_8 + P_9 \quad (14)$$

Where,  $P_3 = (P_1 + P_2) \cdot S_3 + S_4$ ,  $S_3$  is a fixed coefficient,  $S_4$  is an unfixed coefficient.

(4) Single-shift glass door :

$$TotalPrice = [(P_1 + P_2) + S_5 + S_6 \cdot S_7] \cdot S_{12} + P_5 + P_6 + P_7 + P_8 + P_9 \quad (15)$$

Where,  $P_3 = (P_1 + P_2) + S_5 + S_6 \cdot S_7$ ,  $S_5$  is a fixed coefficient,  $S_6$  is a fixed coefficient,  $S_7$  is an unfixed coefficient.

(5) Double-shift / three-shift / four-shift glass doors :

$$TotalPrice = [(P_1 + P_2) \cdot S_8 + S_9 + S_{10} \cdot S_{11}] \cdot S_{12} + P_5 + P_6 + P_7 + P_8 + P_9 \quad (16)$$

Where,  $P_3 = (P_1 + P_2) \cdot S_8 + S_9 + S_{10} \cdot S_{11}$ ,  $S_8$  is a fixed coefficient,  $S_9$  is a fixed value,  $S_{10}$  is a fixed value, and  $S_{11}$  is a variable coefficient.

Where,  $P_3 = (P_1 + P_2) \cdot S_8 + S_9 + S_{10} \cdot S_{11}$ ,  $S_8$  is a fixed coefficient,  $S_9$  is a fixed coefficient,  $S_{10}$  is a fixed coefficient,  $S_{11}$  is an unfixed coefficient.

According to the type selected by the front-end page of the commodity quotation, the reference value  $K$  of the frame height, frame width and wall thickness and the input frame height  $H$ , frame width  $W$  and wall thickness  $T$  are obtained. Among them, if the input size is greater than the standard reference value  $K$ , it is necessary to calculate the non-standard price  $P_5$ ,  $P_6$  and  $P_7$  of the frame height  $H$ , the frame width  $W$  and the wall thickness  $T$  :

$$P_5 = \frac{H-K_H}{10} \cdot u_1 \cdot N \quad (17)$$

$$P_6 = \frac{W-K_W}{10} \cdot u_2 \quad (18)$$

$$P_7 = \frac{2H+W}{1000} \cdot \frac{T-K_T}{10} \cdot u_3 \quad (19)$$

Where,  $K_H$ ,  $K_W$ ,  $K_T$  are the standard reference values of frame height, frame width and wall thickness respectively.

In the above price calculation formula, determine the category of household goods selected by the front page of the commodity quotation, and obtain the basic price  $P_1$  of the commodity from the commodity value allocation library ; according to the parameters corresponding to the front page of the commodity quotation, the type, color, process and accessories of the commodity are confirmed, and the commodity price configuration table is matched to obtain the partial price  $P_2$ , and the preliminary total price  $P_3$  is calculated according to the type.  $P_4$  non-standard total base price ; according to the parameters corresponding to the front page of the commodity quotation, the hardware price attribute configuration table and the hole price configuration table are matched, and the hardware price  $P_8$  and the hole price  $P_9$  are obtained.

### 3.5 Steps D ERP order flow

Based on the order state machine model, the specific process of order automation processing includes : D1 collection verification ; d2 order verification ; d3 production audit ; d4 Purchase confirmation ; d5 was issued for production. Its specific structure is shown in Figure 9 :

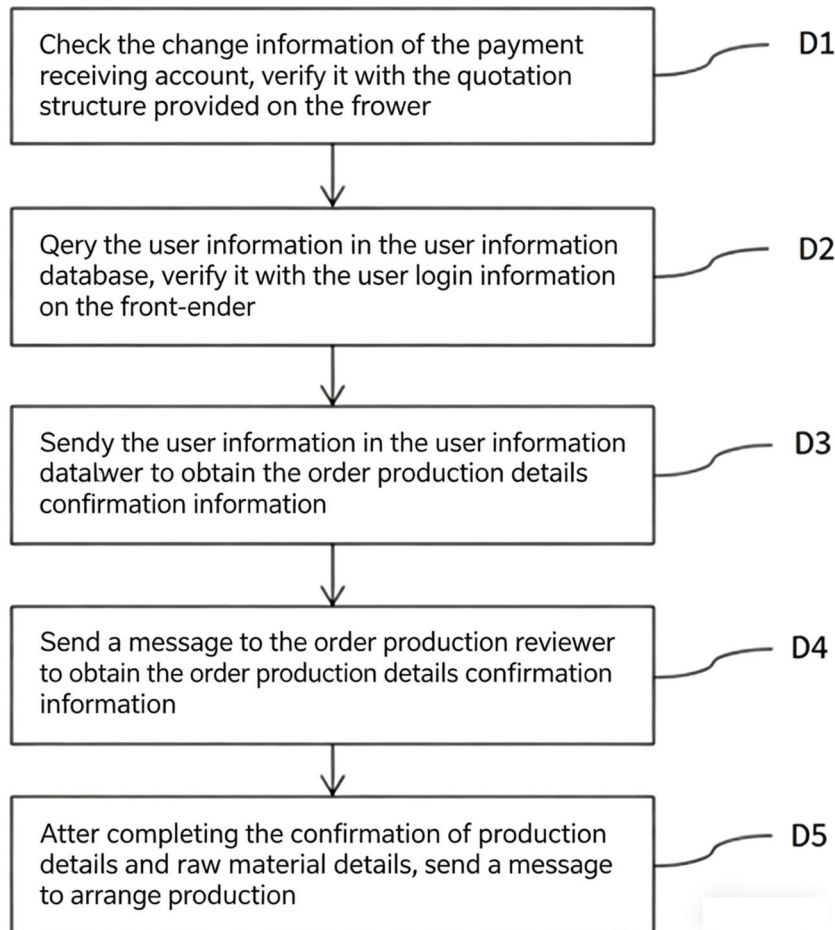


Figure 9. ERP system order processing flow

The state transition satisfies :

$$S_{produce} = \delta(S_{check}, Confirm) \tag{20}$$

### 3.6 Technical Advantages

- (1) Parameter standardization, price rules can be unified and traceable ;
- (2) Multidimensional linkage constraints to avoid illegal configuration ;
- (3) Formulated real-time pricing, millisecond price ;
- (4) The front end is directly connected with ERP, and the whole order process is closed-loop.

## 4. System Simulation and Result Analysis

### 4.1 Simulation Scheme

Simulation object : 6 kinds of mainstream door type ( single open, double open, child mother, invisible, single shift, double shift glass ).

Comparison group : traditional manual quotation + manual ERP process.

Indicators : quotation time, accuracy, order processing time, concurrent response.

Environment : SpringBoot + MySQL + ERP interface simulation.

#### 4.2 Simulation Formula and Evaluation Index

Efficiency improvement rate :

$$\eta = \frac{T_{trad} - T_{sys}}{T_{trad}} \times 100\% \quad (21)$$

Accuracy :

$$Acc = \frac{N_{right}}{N_{total}} \times 100\% \quad (22)$$

#### 4.3 Simulation Results

**Table 1.** Simulation results

Index	Traditional Method	Proposed System	Improvement Rate
Average quotation time	145s	1.4s	99.03%
Quotation accuracy	71.2%	99.3%	+28.1%
Order-to-production duration	5.2h	58min	81.5%
100-concurrency response	Timeout/block	< 2s	Stable

#### 4.4 Analysis of Results

- (1) The quotation speed is significantly improved, from the minute level to the second level ;
- (2) Formulaic valuation eliminates manual errors, and the accuracy rate is close to 100 % ;
- (3) ERP direct connection greatly shortens the order circulation and production preparation time ;
- (4) The system is stable and available in high concurrency scenarios to meet the needs of online malls.

### 5. Conclusion

Aiming at the industry pain points such as low quotation efficiency, poor real-time price, front-end and back-end data islands, high manual dependence, and non-standard valuation, this paper proposes a one-click quotation system and method that integrates product configuration theory, multi-dimensional linkage constraint model, real-time intelligent valuation model, and order state machine model. By constructing a standardized price database, realizing the linkage interaction of front-end parameters, one-click trigger formula intelligent pricing, and order direct connection ERP production, a digital closed-loop of the whole process from online customization to offline production is formed. The simulation results show that the system is much better than the traditional manual mode in terms of quotation speed, accuracy and order processing efficiency, and effectively solves the problems of slow quotation, miscalculation, chaotic process and poor coordination. The scheme is versatile and extensible, and can be widely used in home customization of wooden doors, glass doors, aluminum alloy doors and other doors, and can be extended to the fields of whole house customization, building materials home, etc. It provides important technical support for mass customization and digital upgrading of home industry.

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