Digital Economy: The Establishment and Application of Pricing Model for Personalized Order-Based Products by Using Big Data Technology

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Abstract. In order to solve the customer order in the face of enterprises how to quickly and accurately quotation. In this paper, we use big data technology to process and filter the data, and take the product cost estimation as the starting point, this paper puts forward an overall solution to the cost estimation of orders and quotation, that is, to estimate the product cost by using the activity-based standard cost estimation method, and to estimate the production cost of products, then, we use activity-based costing to calculate the non-production cost of the analyzed order, form the order cost, and finally form the order quotation. Combined with the actual situation of the enterprise, the calculation and analysis verify the correctness and advancement of the solution ideas. It solves the problems in cost estimation and quotation, and shows the application of digital economy in enterprises.

Keywords: Digital Economy · big data technology · product pricing · order production

1 Introduction

High and new technology has been widely used in the world, the manufacturing capacity of machinery and equipment has been greatly enhanced. Under the condition of large-scale Mechanized Production, the social productivity has been greatly enhanced, and the economic development has been promoted. With the rapid development of the economy, people's income is constantly increasing, the disposable income is greatly increased; at the same time, the productivity is increasing, making all kinds of goods are produced in large quantities. In addition to the basic practicability of commodities, people put forward higher and higher requirements for the products they consume in terms of function, appearance and uniqueness, so that consumers are more selective in their behavior and demand for products. More and more individual and customized. This demand for product personalization led to the emergence of order-based production. However, due to the difference in the cost accounting due to the difference in the raw materials and the manufacturing process used by the customers, how to collect the raw material purchasing information and the quick and accurate quotation are the problems

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faced by many custom-made enterprises, to solve this problem, use big data technology to process and screen the related massive data, according to the product raw material composition, production process and production technology to build a mathematical model, through the computer-aided calculation to achieve rapid and accurate quotation, to solve the practical problems in enterprises.

2 Literature Review

Germany is the first country in the world to study cost estimation, and the application of mathematical regression analysis to product cost estimation is also a leading attempt by German scholars, the relationship between product characteristic parameters (such as layer number, compressive strength, material quality, power, shape, etc.) and cost is obtained, and the parameter equation is established to estimate the cost of new product. American scholars have integrated computer programming into activity-based costing (ABC), which is used for product pricing by using cost estimation software. They use regression statistics to establish the cost model for the existing or produced product data, and propose a parameter estimation model based on activity-based costing [1]. P K for the Florida State University. Dean et al. put forward the method of Fuzzy multi-attribute cost estimation, which can estimate the cost of product according to the method of fuzzy calculation in the early stage of product design, so that the balance between design and cost control is better, improving the efficiency of product estimation [2]. At present, the domestic research on cost estimation mainly focuses on: parameter method and artificial neural network estimation method. (1) the parameter estimation method, based on the cost components or characteristics of a product, such as the size, shape, weight, and composition of the main raw materials of the product, uses the historical statistical data of the product cost, and calculates the parameters that have a greater impact on the product cost, establish the corresponding parameter model to estimate the cost of new products. (2) Neural network method neural network is a mathematical model of information processing by using a structure similar to the brain multi-element mapping synaptic connection. For example, Chen Guobin, according to four levels of customization: package customization, assembly customization, manufacturing customization and design customization, put forward a product cost estimation method based on customer demand cut-in point, an order-based pricing decision model based on artificial neural network is constructed, and the model is applied to an enterprise case [3].

3 The Establishment of Product Cost Estimation Model Based on Personalized Customization

The composition of product cost consists of direct material, direct labor and manufacturing cost.

1) The direct material cost estimation model
   M represents the set of direct Material costs of a product ($m \in M$), P represents the set of purchase prices of the raw materials of the product ($p \in P$), Y represents the set

of standard quantities of the raw materials consumed by the product (y ∈ Y), and m_j represents the direct material cost of the product in the J process, p_v represents the standard purchase prices of the raw materials V, y_{jv} represents the standard quantities of the raw materials V in the J process, because the formula of the direct material cost is M = YP, that is: the cost of the direct materials = quantity × unit price [4]

$$M = \begin{bmatrix} m_1 \\ m_2 \\ \vdots \\ m_j \end{bmatrix} = \begin{bmatrix} y_{11} & y_{12} & \cdots & y_{1v} \\ y_{21} & y_{22} & \cdots & y_{2v} \\ \vdots & \vdots & \ddots & \vdots \\ y_{j1} & y_{j2} & \cdots & y_{jv} \end{bmatrix} \begin{bmatrix} p_1 \\ p_2 \\ \vdots \\ p_v \end{bmatrix} \tag{1}$$

2) The direct labor cost estimation model
H represents the set of direct labor cost of a product (h ∈ H), and T represents the set of standard labor hours consumed by a job (t ∈ T), R represents the set of labor rates consumed by an activity (r ∈ R), W represents the first through the W process of producing the product, and h_j represents the direct labor cost of the J process of the product, R_W represents the standard labor cost of the w process, t_{jw} represents the labor consumption standard of the w process, so the direct labor cost H = TR, that is: The direct labor cost = the total labor cost x labor cost.

$$H = \begin{bmatrix} h_1 \\ h_2 \\ \vdots \\ h_j \end{bmatrix} = \begin{bmatrix} t_{11} & t_{12} & \cdots & t_{1w} \\ t_{21} & t_{22} & \cdots & t_{2w} \\ \vdots & \vdots & \ddots & \vdots \\ t_{j1} & t_{j2} & \cdots & t_{jw} \end{bmatrix} \begin{bmatrix} r_1 \\ r_2 \\ \vdots \\ r_w \end{bmatrix} \tag{2}$$

3) Manufacturing cost estimation model
Overhead consists of a series of activities. It is the set of the cost driver distribution rate of an activity multiplied by the number of factors corresponding to that activity, F represents the set of overhead costs of a product (f ∈ F), k represents the set of the actual number of job agents (k ∈ K), D represents the set of job agents assignment ratio (d ∈ D), and X represents x jobs in the indirect cost, f_j Represents the indirect cost of the product in the Jth Cost Library, k_{jx} represents the number of drivers of the x activity in the jth cost library, and d_x represents the x activity driver allocation rate. So the indirect cost F = KD

$$F = \begin{bmatrix} f_1 \\ f_2 \\ \vdots \\ f_j \end{bmatrix} = \begin{bmatrix} k_{11} & k_{12} & \cdots & k_{1x} \\ k_{21} & k_{22} & \cdots & k_{2x} \\ \vdots & \vdots & \ddots & \vdots \\ k_{j1} & k_{j2} & \ldots & k_{jx} \end{bmatrix} \begin{bmatrix} d_1 \\ d_2 \\ \vdots \\ d_x \end{bmatrix} \tag{3}$$

4) The model for estimating total product cost
C represents the set of estimated total product cost (c ∈ C), CJ represents the cost of the product, since the total cost of the product is equal to the direct material cost of

the product plus the direct labor cost of the product plus the cost of manufacturing allocated by the product [5].

$$C = M + H + F \text{ or}$$
$$\begin{bmatrix} C_1 \\ C_2 \\ \vdots \\ C_j \end{bmatrix} = \begin{bmatrix} m_1 \\ m_2 \\ \vdots \\ m_j \end{bmatrix} + \begin{bmatrix} h_1 \\ h_2 \\ \vdots \\ h_j \end{bmatrix} + \begin{bmatrix} f_1 \\ f_2 \\ \vdots \\ f_j \end{bmatrix} \tag{4}$$

4 Model Application and Computation

According to the model, we select the x Paper Limited Company's production process and department settings to apply and verify the model.

1) The direct material of product C in the processing cost center According to the calculation logic of various raw materials, and the price Table 1 of product C in the processing cost center, and according to the design, according to the information of the production statistics department, calculate the quantity of these auxiliary materials needed.
Using the mathematical model formula (1), the direct material cost of product C in the processing division can be calculated:

$$\mathrm{M} = \begin{bmatrix} \mathrm{m}_{\text{Flat rolling}} \\ \mathrm{m}_{\text{nails}} \\ \mathrm{m}_{\text{bundling}} \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 \\ 0.7 & 1 & 0.1 \\ 0 & 0.01 & 0.90 \end{bmatrix} \begin{bmatrix} 0 & 0.5 & 0.26 \\ 0 & 0.3 & 8 \\ 0 & 1.1 & 2.4 \end{bmatrix} = 1.05$$

2) In the process of product C's direct Labor in the cost center,
The task is analyzed through the measurement of man-hour, the statistics of activity quantity and the decomposition of activity. Then the finance department according to the Human Resources Department provided the number of production line personnel and wages calculated a standard staffing table to estimate the product of direct Labor.

Table 1. Purchase price of accessories

General category	Brand name	Unit	Tax Price
Binding agent	Borax	kg	0.5
Binding agent	Flake base	kg	0.3
Binding agent	Bridging agent	kg	1.1
Packing matter	Plastic bag	Strip	0.26
Packing matter	Buckle up	kg	8
Packing matter	Scotch tape	Volume	2.4

Table 2. Standard staffing table

Department	Paste Nail	Flat Rolling	Bundle up
Number of working days per month	21.75	26	26
Working hours a day	24	24	24
Total man-hour	522	624	624
Standard Salary (RMB/PERSON)	6444.2	8487.1	3845
Labor rate (per Hour/yuan)	12.3	13.6	6.2

Table 3. x Paper Co., Ltd. January 2022 manufacturing cost table by branch, unit: Yuan

Department	The manufacturing expenses
Flatbed family	4210
Printing Division	5987
Processing Division	3260

Using the mathematical model formula (2), the direct labor cost of product C in the processing department can be calculated according to Table 2:

$$H = \begin{bmatrix} h_{\text{Flat rolling}} \\ h_{\text{nails}} \\ h_{\text{bundling}} \end{bmatrix} = [0.01\ 0.02\ 0.01] \begin{bmatrix} 13.6 \\ 12.3 \\ 6.2 \end{bmatrix} = 0.44$$

3) The manufacturing expenses incurred by product C in the processing cost center Using Table 3 to calculate, under the activity-based costing method, each activity center selects the corresponding cost object according to the actual situation. This allows you to calculate the cost of the product through the cost library. That is, the number of drivers for the cost base to consume the basic activities multiplied by the corresponding cost driver allocation rate,

$$f = k * d = 2055/1000 * 1097/1000 * 0.32 = 0.71$$

4) Total cost incurred by product C in the processing cost center:

$$\text{Direct material} + \text{Direct Labor} + \text{manufacturing cost} = 1.05 + 0.44 + 0.71 = 2.2$$

3. Use mathematical model to estimate the cost of product A, B, C

(1) Estimate the cost of the processing center
According to the analysis of the production process of x Paper Co., Ltd, the process of corrugated box after printing is: slotting → tying → nailing, pasting → binding → corrugated box.
The corresponding cost objects for each process are as in Table 4.

Table 4. Costing sheet for each process Unit: Yuan

Cost Base	Cost type	Cost object	Product A costs	Product B costs	Product C costs
Flat Rolling	Direct material	None	0	0	0
	Direct Labor	Flat Mill	0.01	0.02	0.24
	Manufacturing expenses	Overhead for flat rolling	0.11	0.23	0.35
Subtotal of flat rolling cost			0.12	0.25	0.59
Paste Nail	Direct material	Binding agent	0.40	0.36	0.76
	Direct Labor	Paste-nailing	0.36	0.17	0.12
	Manufacturing expenses	Manufacturing cost of pasting operation	0.20	0.45	0.30
Nail cost subtotal			0.96	0.98	1.18
Bundle up	Direct material	Packing matter	0.1	0.1	0.29
	Direct Labor	Baling Man	0.01	0.08	0.08
	Manufacturing expenses	Manufacturing cost of Baling operation	0.01	0.06	0.06
Bundle cost subtotal:			0.12	0.24	0.43
Total cost of each process			1.20	1.47	2.2

Table 5. Product cost table Unit: Yuan

Product name	Tablet subtotal	Subtotal of printing cost	Subtotal processing cost	Total product cost
Product A	0.83	0.87	1.20	2.90
Product B	1.29	2.56	1.47	5.32
Product C	4.47	3.10	2.20	9.77

(2) Total product cost of x paper limited.
The total product cost of x paper limited consists of three parts, namely, the flat panel cost center, the processing cost center and the printing cost center. The cost centers of product a, product B and Product C are aggregated, the estimated cost of the final product is derived as in Table 5.

5 Conclusions

Through the model establishment and the implementation verification, uses the big data technology to carry on the order cost estimate and the quoted price, the x Carton

Company's cost estimate is quick, accurate, simultaneously also achieved the anticipated control effect, for example: 1, when the order quoted price, according to the quoted price model, we can select the high quality customers (Mori higher) to achieve the goal of cost control in advance. 2, through the application of activity-based costing, can clearly analyze the cost composition of each order, through the analysis of the difference between the actual cost of the order and the standard cost, to trace the causes of the difference, such as the confusion of feeding materials, the frequent substitution of materials, the poor quality of suppliers, the unstable process, the low efficiency of employees, etc. 3. In the process of cost analysis, sales policy and strategy can be adjusted according to the input-output and profitability of each customer's order.

References

1. Ingram, Albright, Hill (2022) Managerial Accounting Information for Decisions. CITIC Publishing House, pp 54–69
2. Dean Ting PK, Zhang C, Wang B (2019) Product and process cost estimation with fuzzy multi-attribute utility theory. Eng Econ 44(4):303–331
3. Chen G (2021) Cost estimation and pricing decision models for mass customization products. Southeast University, Nanjing, pp 13–14
4. Li Y (2021) Design and implementation of carton quotation system based on MOSS2007. Shanghai Jiaotong University, Shanghai, pp 34–35
5. Horngren CR, Stratton WO (2021) Introduction to Management Accounting. Peking University Press, pp 11–13

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