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Data Asset Value Evaluation Model of H Pharmaceutical Enterprise

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Abstract: This paper discusses how to construct the evaluation index system of data assets of listed companies (H Pharmaceutical Enterprises), and on this basis, constructs an evaluation model to evaluate the value of data assets by using the relevant data of the listed company, verify its scientific rationality and feasibility, and provide relevant theories and methods for the data assets of enterprises in the pharmaceutical industry. Firstly, based on the discussion of the sources and characteristics of H Pharmaceutical Enterprises' data assets, the analytic hierarchy process is used to construct the evaluation index system of its data asset value. Secondly, the replacement cost method and the multi-period excess income method are introduced; the value of data assets is calculated from two aspects: cost and income. Thirdly, the final value of data assets is adjusted by the fuzzy comprehensive evaluation method. This study offers a systematic and operational data asset value evaluation index system and evaluation methods for managing related enterprises. It provides a reference for enterprise management and offers theoretical support and practical guidance for evaluating data asset value in related industries.

Keywords: Data asset valuation; Pharmaceutical enterprises; Analytic hierarchy process; Replacement cost method; Multi-period excess return method.

1. Introduction

With the rise of big data technology, the economic value of data has been gradually mined, and data has become the fifth major factor of production after land, labor, capital, and technology [1]. In December 2022, China's CPC Central Committee and the State Council first proposed the "Data assets" concept at the national level. Later, policies like the "Data Elements X" Three-Year Action Plan (2024-2026) and the "Guidance on Strengthening Data Asset Management" were released, explicitly calling for accelerating the development of the data element market and promoting the compliant circulation of data assets.

This study focuses on the pharmaceutical industry for two key reasons. First, the industry's data is standardized and traceable in real time. Stringent regulatory policies have laid a solid foundation for standardized data management in pharmaceutical enterprises, reflected in their generally high Data Management Maturity Model (DCMM) ratings. Additionally, the fast-moving nature of pharmaceuticals makes enterprise data value easy to track and quantify.

Second, as pharmaceutical enterprises increase investment in data to meet the growing demand for proper data asset accounting, accurate value assessment becomes essential. Global technology market consultancy ABI Research predicts that the industry's data analytics spending will grow at a 27% annual compound rate, reaching $1.2 billion by 2030. This highlights the industry's focus on digital transformation and signals the continuous generation of high-value data assets. However, existing research mainly covers industries with active data transactions (e.g., internet, e-commerce), while the pharmaceutical industry lacks mature data asset valuation methods [2]. This gap makes it hard to quantify data asset value accurately, hindering their recognition in financial statements. Thus, building a scientific data asset value evaluation index system and model, and fairly reflecting values in financial statements, is an urgent task.

To ensure rational and scientific evaluation results for pharmaceutical enterprises' data assets, this study constructs an evaluation system from two dimensions: evaluation method selection and index weight allocation. Given strict regulations making market-based pricing of pharmaceutical data difficult, the replacement cost method works as data collection/processing costs are quantifiable [3-4]. The multi-period excess income method, combined with discount models, helps quantify future value by linking to free cash flows.

2. Related Research Progress

2.1. Definition of Data Assets

Scholars have defined data assets from multiple perspectives in recent years: Peng et al. (2024, resource perspective) view them as capitalized data resources meeting accounting asset standards [5]; Li Chunqiu et al. (2020, asset attributes) classify them as intangible assets [6], while Liu Jiang et al. (2023) call them non-monetary assets; Yuan Xiu'e et al. (2024, accounting) define them as enterprise-owned/controlled, measurable data bringing future economic inflows [7-8]; Tan Mingjun (2021, informatics) refers to legally collected, value-creating information [9].

In this paper, data assets are defined as "Data resources that are legally owned or controlled by an enterprise, can be reliably measured, and can bring economic benefits or potential economic benefits to the enterprise".

2.2. Characteristics of Data Assets

On the characteristics of data assets, domestic and foreign scholars mainly study the characteristics of data assets from the perspective of the attributes of data assets, the expression form and use characteristics of data, and the embodiment of value. Pa Jingping et al. (2024) discuss the characteristics of data assets from the perspective of data asset ownership, and argue that public data assets are shareable [10]. From the

perspective of the attributes of data assets, Li et al. (2024) proposed that data assets have five characteristics of big data, namely, Volume, Velocity, Veracity, Variety and Value. Ma et al. (2024) argue that data assets have the characteristics of intangible assets, such as non-physical form, non-monetary and identifiability, from the perspective of the existence form and Operation Mechanism of data assets [11]. Yang Xiaoqing (2024) found the dependence of data value on scenarios [12]. In addition, some scholars have analyzed the confirmation, traceability and valuation of data assets: Li Qingyi et al. (2022) proposed that the value of data assets is uncertain, and Zhang (2024) emphasized the exclusivity of data assets.

3. Construction of Data Asset Value Evaluation Index System and Model of H Pharmaceutical Company

3.1. Company Profile and Its Data Assets

To ensure the typicality of the research object and the feasibility of data acquisition, H Company is selected as the analysis sample. H Company is a pharmaceutical R&D, production, and sales enterprise, operating on a moderate scale. Its data management maturity assessment (DCMM) has reached the second level, placing it at a medium maturity stage within the pharmaceutical industry, and it has certain representativeness. The company attaches great importance to the driving effect of data elements on enterprise value, continues to invest resources in the construction of a data governance system, and cooperates with professional data governance institutions to promote the systematic management of enterprise data assets.

In view of the confidentiality and compliance requirements of the data, H Company has authorized this study to use the relevant data within the scope of the provisions. Code names represent the company name and platform information.

3.2. The Classification and Authorization Management of Data Assets of H Pharmaceutical Enterprises

To ensure clear scope, reliable sources, and evaluation accuracy, this paper first clarifies H's data asset classification/confirmation (considering asset characteristics for weight assignment) and guarantees legal compliance.

H classifies confirmable data assets (by scenario and value) into internal operational, market, and R&D types. It entrusts Z Company to govern data via Z's D platform (quality checks, compliance reviews), which screens source data (traceability, stability) into structured sets managed in three modules.

Table 1. Classification of data assets of pharmaceutical enterprises

Classification of data assets			Data Interpretation
Internal operational data assets	Production data	Production line data	Equipment running status, time series data, etc.
		Data of product quality	Quality inspection data, GMP, etc.
	Supply chain data	Raw material data	Raw material purchase data, raw material loss data, etc.
		Data warehousing	Raw Material Inventory, product inventory, etc.
Market data assets	Market research data	Customer data	Customer demand, customer loyalty and so on
		Industry data	Market size, growth trends, etc.
		Marketing data	Ad conversion rate
	Sales data	Sales figures	Sales data of products in hospitals and pharmacies
		Pricing data	Pricing impact, promotional impact
Research and development data assets	Research data	Compound Library data	Structures and properties of compounds
		Experimental data	Experimental data of pharmacology, toxicology, etc.
		Clinical data	Feedback data from clinical trials
	Formula data	Formula data	Patents on pharmaceutical formulations and processes

Table 1 shows the results of the classification of H Pharma's data assets, covering the core areas of business operations, marketing and R & D, providing a reliable basis for subsequent valuation.

3.3. The Construction of the Evaluation System

3.3.1. Construction Ideas of Data Asset Value Evaluation System

In this paper, a data asset value evaluation system based on the replacement cost method and the multi-period excess income method is constructed.

The final value of data assets is

$$V_{Economic\ value\ of\ data\ assets} = \mu * Q * V_{\text{Preliminary valuation results}} \quad (1)$$

3.3.2. Overview of the Methodology for the Valuation of Data Assets

To scientifically and systematically evaluate the value of data assets, it is necessary to clarify the dimensions of economic value and the corresponding evaluation methods to ensure that the value of both costs and benefits is reasonably quantified.

In this paper, the economic value of data assets is divided into cost dimension and income dimension, and the replacement cost method and multi-period excess return method are used to evaluate the economic value of data assets in each dimension. AHP calculates the weight of the two dimensions. Finally, the value of data assets is calculated by summation. Fig. 1 shows the evaluation system of economic value of data assets.

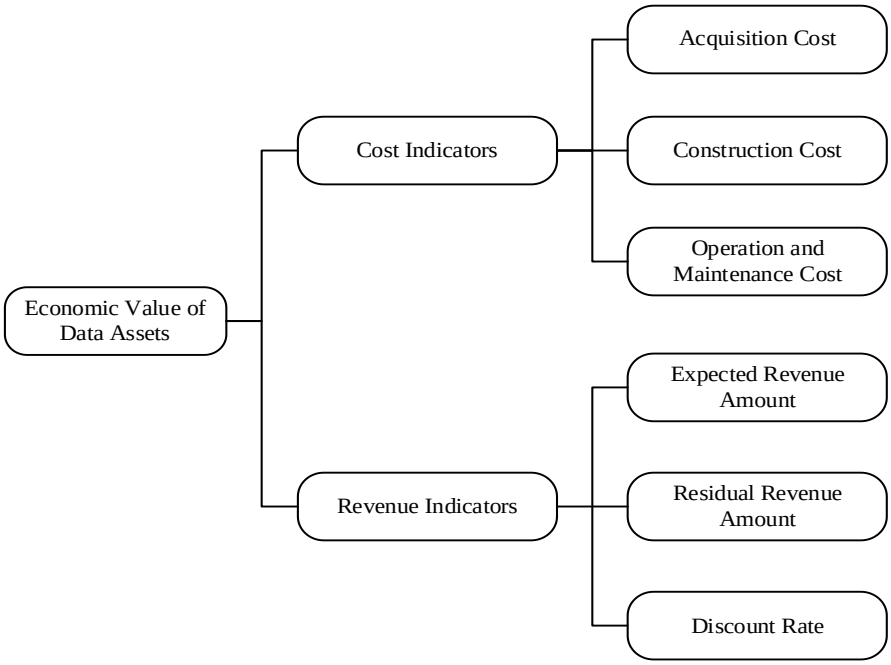

Figure 1. Evaluation system of economic value of data assets

3.3.3. Data Quality Indicators Selection and System Construction

The analytic hierarchy process is used to calculate the weight of data quality, which is used to adjust the value of data assets under different quality conditions.

Data quality evaluation index and its selection basis include the following aspects. Firstly, this paper systematically examines authoritative standards, including the International Monetary Fund Data Quality Assessment Framework, the National Statistical Quality Assurance Framework, the statistical quality assurance framework of Eurostat, and the national standard of the People's Republic of China.

Based on the analysis of keywords and research topics in domestic and foreign literature on data quality, this paper integrates literature on data quality dimensions to preliminarily establish a data quality evaluation index pool.

3.3.4. The Result of Weight Distribution of Data Asset Evaluation Index of H Company

In the research process, a total of 10 experts from the pharmaceutical industry, manufacturing industry, and data governance industry were invited to score the weights of indicators at all levels of data asset value.

To improve the adaptability and operability of the model in the pharmaceutical industry, the weights of the cost and income methods are scored. Combined with the previous analysis, the cost method measures the difficulty of resource input and replacement, while the income method focuses on future economic returns. The weighting process can balance the deviation caused by a single method, integrate the advantages of the two methods, and combine the expert's judgment on the applicability of the method. The weighting results are shown in Tables 2.

Table 2. Weight of cost method and income method

Methods	Weight
Replacement cost method	0.41
Multi-period excess return method	0.59

To reflect the relative importance of each data quality index in the overall value assessment, the weight score is calculated.

3.4. Quantification of Data Asset Valuation Metrics

3.4.1. Formulation of Quantitative Standards for Data Asset Value Assessment Indicators

It is the premise of applying the evaluation index of data asset value to practice to clarify the measurement method and scoring criteria of each index. On the basis of determining the weight of each index, the quantitative standards are formulated around the specific indicators in the evaluation model, so as to ensure that the model can be applied in H pharmaceutical enterprises, and then extended to the entire pharmaceutical industry.

The evaluation results under the cost dimension can be calculated according to the following formula:

$$V_1 = RC \cdot (1 + r) \tag{2}$$

$$RC = (C_1 + C_2 + C_3) \cdot \beta \tag{3}$$

In the formula, C_1 represents the acquisition cost, covering the direct costs incurred in data acquisition, cleaning and compliance. C_2 represents the construction cost, including the input of data infrastructure construction and processing flow development. C_3 represents the operation and maintenance cost, involving continuous update, maintenance, etc. β represents the daily price index of asset evaluation, RC represents the replacement cost of data assets, and r represents the profit margin of data assets.

The valuation results V_2 under the revenue dimension can be calculated according to the following formula:

$$V_2 = \sum_{i=1}^{n} \frac{E_{CF} - E_c - E_f - E_i}{(1+i)^t} \tag{4}$$

$$WACC = R_e \times \frac{E}{D+E} + R_d \times \frac{D}{D+E} \times (1 - T) \tag{5}$$

$$R_e = R_f + \beta \cdot (R_m - R_f) \tag{6}$$

The resulting economic value of the enterprise's data assets is as follows:

$$V_{Economic\ value} = V_1 \cdot \omega_{V1} + V_2 \cdot \omega_{V2} \quad (7)$$

Where and represents the weight determined by AHP for each dimension, respectively.

3.4.2. Replacement Cost Results

In this paper, the replacement cost of data assets is calculated by the product of the historical cost of data assets and the replacement coefficient of data assets. Without data asset market reference prices, the replacement cost method (replacement cost = data assets' historical cost × replacement coefficient) is practical and reflects reconstruction costs well.

First, H Company's 2020-2024 historical cost data (from procurement, infrastructure, cloud services, etc.) is 591,368,736.52 yuan.

Second, the replacement coefficient has two types: price (using 5-year CPI for non-labor costs) and manpower (using 5-year average pharmaceutical wage growth for labor costs).

Based on the replacement cost method, the replacement cost is estimated at $611,333,285.80.

In view of the current policy that data assets are generally included in the category of intangible assets, the return on assets is selected as the reasonable profit rate of data assets, which is 14.01% according to the overall return on assets of the company.

After formula (1) calculation:

$$V_1 = 696{,}981{,}079.14$$

3.4.3. Excess Return Method

In the case that data assets continue to create economic benefits, their value is reflected in the future excess return. Therefore, by extracting and discounting the excess returns attributed to data assets, the actual contribution of data assets to corporate earnings can be measured more directly and comprehensively.

Considering the external environmental factors in recent years lead to fluctuations in operating income, to increase the reliability of the results, through the statistics of the operating income of H Enterprise in 10 years, the fitting function is obtained, according to this formula, the operating income of the company in the next four years is predicted, and the operating income of the company in the next four years is shown in table 3.

Table 3. Company's forecast value from 2025 to 2028(in Yuan)

	2025	2026	2027	2028
Operating income Forecast	14,716,737,07	15,483,307,907	16,249,878,595	17,016,449,283

According to the proportion of each index and the predicted value of operating income, the specific amount of each index in the next 4 years is calculated.

Taking the forecast of the contribution value of current assets in 2025 as an example, the specific calculation formula is: current assets contribution = Average balance of current assets × return on investment of current assets, the average balance of current assets in the year is 16,274,627,296.81 yuan, the return rate of current assets investment is 3.1% of one-year bank loan rate (December 2024) , and the contribution value of current assets is 536,448,765.97 yuan, which can further predict the contribution value of current assets in the next few years. Similarly, the contribution of fixed assets and other intangible assets can be calculated and predicted, both using a five-year bank loan rate of 3.6% return on investment.

$$V_2 = 769{,}549{,}714.25 \text{ yuan}$$

Economic value of available data assets = V_1 *0.41+V_2 *0.59=739,796,613.65 yuan

3.5. Application of Fuzzy Comprehensive Evaluation Method

3.5.1. Specific Analysis

The fuzzy comprehensive evaluation method can effectively correct the subjective deviation in the evaluation results of the analytic hierarchy process and improve the objectivity of the evaluation. The steps are as follows:

First, determine the factor set U and evaluation set k. Combined with the hierarchical structure model, the evaluation results of data quality indicators are taken as the key correction objects in the fuzzy comprehensive evaluation method, and the factor set U is set as:

$$U = \{\varepsilon 1, \varepsilon 2, \ldots, \varepsilon m\} \quad (8)$$

Where m is the number of secondary influencing factors of data quality under the data asset value evaluation system of pharmaceutical enterprises.

The evaluation of the factors affecting the value of data assets is divided into N grades. After the discussion of the field experts, the grade number N is set to 5, and the evaluation set K is {excellent, good, medium, poor, bad}, the corresponding assignment of each grade is J = {1.0,0.8,0.6,0.4,0.2}.

Secondly, the fuzzy evaluation matrix is constructed. Many experts are invited to score according to the actual situation of the index, and the evaluation proportion of each grade is counted, and the fuzzy evaluation matrix M is obtained by calculation.

$$M = \begin{bmatrix} j_{11} & j_{12} & \cdots & j_{15} \\ j_{21} & j_{22} & \cdots & j_{25} \\ \vdots & \vdots & \ddots & \vdots \\ j_{61} & j_{62} & \cdots & j_{65} \end{bmatrix} \quad (9)$$

Third, determine the weight vector. Using the analytic hierarchy process, the weight set W = (W1, W2, ..., W6) of U is calculated based on expert opinions

$$\sum_{i=1}^{6} w_i = 1 \quad (10)$$

Fourth, calculate the correction coefficient. The weighted average method is used to calculate the fuzzy matrix and weight vector:

$$I=W*M=(i1,\ i2,\ \ldots,\ i5)$$

$$\mu = \frac{\sum_{i=1}^{n} J_i \times I_i}{\sum_{i=1}^{n} I_i} \quad (11)$$

Finally, the revised value of the data asset is derived:

$$V = \mu * Q * V_{\text{economic value}} \quad (12)$$

3.5.2. Fuzzy Comprehensive Evaluation Method to Adjust the Results

According to the principle of the fuzzy comprehensive evaluation method, the factor set u = {normative, integrity, accuracy, consistency, timeliness, accessibility} is selected.

According to the scores of many experts, the fuzzy evaluation matrix M is as follows:

$$M = \begin{bmatrix} 0.4 & 0.4 & 0.2 & 0 & 0 \\ 0.2 & 0.8 & 0 & 0 & 0 \\ 0.8 & 0.2 & 0 & 0 & 0 \\ 0.2 & 0.4 & 0.4 & 0 & 0 \\ 0.2 & 0.4 & 0.4 & 0 & 0 \\ 0.4 & 0.4 & 0.2 & 0 & 0 \end{bmatrix}$$

It is calculated as: Weight set W = (0.17, 0.17, 0.19, 0.15, 0.15, 0.17)

Fuzzy comprehensive evaluation vector I= (0.38, 0.43, 0.19, 0.00.0.00)

The correction coefficient μ = 0.84

The data asset value of Company H was V = 554, 117, 583.70 yuan.

4. Conclusion and Prospect

Data assets play an increasingly prominent driving role for enterprises, so analyzing and evaluating their value is of great practical significance. Through an in-depth study of data asset evaluation methods and applications, this paper develops a value evaluation system for pharmaceutical enterprise H Company. It uses the analytic hierarchy process, replacement cost method, multi-period excess income method, and fuzzy comprehensive evaluation method to evaluate and quantify data asset value.

This paper expands the data asset valuation research system through theoretical innovation and method improvement. It enriches relevant research results by building a valuation model suitable for pharmaceutical enterprises to provide reference for subsequent application of related theoretical models. It also proposes index selection criteria and quantitative methods. To address gaps in current studies, it conducts in-depth research at H Company with industry experts to solve problems of unclear index criteria and lack of quantification.

Finally, the paper proposes building a classification framework by referencing national standards to enhance data asset tradeability, and establishing a dynamic data asset monitoring and evaluation model to facilitate timely responses to value changes and support enterprise resource allocation.

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