Research on Enterprise Value Evaluation of Electronic Manufacturing Industry

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Abstract: Based on the operating characteristics of electronic and communication equipment manufacturing enterprises, which are different from other enterprises, the unique value activities of each business are analyzed. On this basis, the formation, change and realization process and characteristics of enterprise value of electronic and communication equipment manufacturing enterprises are clarified, so as to determine the evaluation index of enterprise value. The entropy weight method and AHP method are used to calculate the index weight, and then the grey relational analysis method is used to calculate the comprehensive score and ranking of enterprise value management. Through the analysis of the current management situation of electronic communication equipment manufacturing enterprises, especially the main problems and reasons existing in the management, it is clearly pointed out that the enterprises under the current management system need to update the management concept and improve the management methods and means in their daily operation and management.

Keywords: Value Management, Entropy Weight Method, AHP, Grey Correlation Analysis.

1 INTRODUCTION

Since the reform and opening up, China's electronics and communication equipment manufacturing industry has developed rapidly by relying on its advantages of cheap labor and low-cost land. By undertaking international industrial transfer and contract manufacturing of multinational companies, it has achieved rapid development, occupying a low-end position in the global electronic and communication equipment manufacturing industry chain.

With the disappearance of demographic dividend in China, the weakening of low-cost factor advantage, the global economic downturn, overcapacity, environmental pollution and a series of problems, the sustainable development trend of China's electronic and communication equipment manufacturing industry is not optimistic.

The main problem in the development of electronic and communication equipment manufacturing industry is the lack of core innovation ability. The level of economic development and technological R&D investment objectively limit the development of core innovation capability. Insufficient investment in technology R&D, on the one hand, is related to insufficient attention paid by enterprises, and on the other hand, it is related to the

BDEDM 2023, January 06-08, Changsha, People's Republic of China
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DOI 10.4108/eai.6-1-2023.2330339

characteristics of high risk and low conversion rate of R&D investment. In addition, China is in the middle and low end of the global industrial chain, and developed countries often occupy favorable conditions in the core links of R&D and design, gain the profits of the vast majority of products, and set up high technical barriers to China, which is very unfavorable to the development of China's electronic and communication equipment manufacturing industry. The lack of high-quality compound and professional talents also leads to the inability to change the status quo of industry development.

2 LITERATURE REVIEW

Value management is a comprehensive management mode based on enterprise value evaluation and aiming at value growth. Different organizational forms of enterprises have a common goal -- to create value or maximize value. Enterprise theory researchers are devoted to exploring how enterprises should operate to achieve value growth. Based on the theory of value chain, improving the management of enterprise value, analyzing the driving factors of enterprise value, and clarifying the value proposition are the starting points of transformation and development. In this process, it is necessary to take into account the needs of employees, enterprises, customers, supply chain enterprises, industrial chain enterprises and other stakeholders, and provide value-creating products and services for stakeholders.It includes positions focusing on operational efficiency, professional business efficiency, users aiming at customer value, and industrial ecology with platform vision. At the same time, the value creation ability of enterprises also comes from the spontaneous order force within enterprises, and only with the help of scientific and reasonable management structure can value be effectively created and realized， however, the management structure mainly consists of three parts: structural rationality, process rat ionality and behavioral rationality[3]. Some scholars pay attention to the internal management of enterprises and propose that innovative enterprises should choose appropriate value management mode to alleviate contradictions. Employee stock ownership plan, innovative strategic alliance, leading users and process outsourcing and other value management modes can be considered in the list[5]. Based on the perspective of value creation, the system can be constructed from three aspects: the formation process of overall value, the key mechanism affecting value, and the evaluation method of enterprise value[6]. The focus of value management has different performance in different stages of enterprise development. For example, the formation mechanism of the value of Internet enterprises is significantly different in different stages of the life cycle, such as the start-up stage, growth stage, maturity stage and decline stage. The enterprise value in the start-up stage and growth stage mainly depends on flexible non-financial indicators. The enterprise value in the maturity and decline period is mainly affected by the financial indicators of profitability, and the interaction between financial indicators and non-financial indicators affects the formation of the value of Internet enterprises.

In the context of value management, the enterprise value evaluation system is constructed, and the value chain is used to effectively integrate the overall value and operating value of the enterprise. The evaluation of each important link along the production process is conducive to the discovery of problems existing in the enterprise value management system and the study of optimization strategies, so as to improve the quality of enterprise value management. The study found that service innovation is an important source of value acquisition for manufacturing enterprises, which can be carried out from four aspects: changing business processes, enhancing

customer value, enhancing customer satisfaction and enhancing competitiveness. Traditional enterprise value evaluation lacks consideration of industry factors and less consideration of industrial chain, so it lacks evaluation of long-term investment value of enterprises[1]. Some studies take the value evaluation of listed logistics companies as an example, and carry out comprehensive evaluation combined with the industrial chain of logistics companies, so as to reflect the position and role of the company in the industrial chain. Starting from the overall value of the industry chain, this paper comprehensively considers the service object, market share, dependence on the industry chain, entry and exit difficulty and other factors of logistics companies, takes these factors as important considerations in the value evaluation of logistics companies, analyzes the value point of logistics companies, so as to more accurately evaluate the market value of logistics listed companies.

3 SELECTION OF INDICATORS

According to the value chain theory proposed by Michael Porter, there are two forms of value chain. One is the value chain between business activities within an enterprise, which is called enterprise value chain; the other is the value chain between enterprises, which mainly focuses on upstream and downstream enterprises, which is called industry value chain. The index system construction of this paper focuses on two aspects, namely enterprise value chain and industry value chain. At the same time, Porter believes that the value creation of an enterprise, namely the enterprise value chain, is composed of a series of different but interrelated production and operation activities, including basic activities and auxiliary activities. Basic activities include internal logistics, production operations, external logistics, marketing and sales, service, etc., while supporting activities include procurement, technology development, human resource management and corporate infrastructure. Based on the theory of value management, the evaluation index system of value management is constructed. The basic activities of the first-level index include procurement logistics, manufacturing operation and sales. The procurement logistics index in this paper relates to the utilization efficiency of means of transport, which belongs to internal and external logistics in internal and external logistics. Therefore, the procurement logistics index is classified as the basic activity part of the first-level index. Secondary activities in Tier 1 include R&D design, finance, intangible assets and human resources. R&d design belongs to technology development in auxiliary activities, finance belongs to enterprise infrastructure, and human resources belong to human resources management. As a part of the high-tech manufacturing industry, the electronic and communication equipment manufacturing industry is significantly more dependent on patented technology and brand value than the general manufacturing industry. Therefore, the index of intangible assets is added to the first-level index for overall evaluation and measurement. On the basis of the first-level indicators, considering the availability of data and referring to existing research literature, 24 second-level indicators with high frequency are used to construct, as shown in the following table1and table2:

Table 1: First order index

First order index		
Research and design	Procurement logistics	Manufacturing operation
Sales	Financial	Intangible assets
The human resources	Supplier (upstream)	Dealers (downstream)

Table 2: Secondary index

Secondary index		
R&d investment intensity	R&d human capital	Capitalization rate of R&D investment
Procurement efficiency	Transport vehicle utilization efficiency	The number of production employees in the group
Utilization efficiency of machinery and equipment	Ratio of labor costs to operating expenses	Ratio of marketing costs to operating expenses
Accounts receivable turnover	Profit margin on sales	profitability
Debt paying ability	Operation ability	Ratio of intangible assets to total assets
Intangible assets per share	Proportion of employees with educational background	Average annual compensation of employees
The largest supplier accounted for the total purchase	The top five suppliers accounted for the total purchase	Related supplier procurement in the first five accounts for the total procurement
Largest customer accounts for total sales	The top five customers accounted for total sales	The first five related party sales accounted for the total sales

4 INDEX WEIGHT CALCULATION

In the process of comprehensive evaluation, the determination of weight is indeed very important and will have a decisive impact on the final result. The disadvantage of subjective empowerment is that it relies too much on expert opinions, and the result of empowerment is related to the knowledge structure, work experience and preference of the evaluator, with a color of subjective judgment and a certain degree of arbitrariness. When the sample data changes, the weight will also change. According to the statistical rule, with the increase of the sample size, the change of the weight should be smaller and smaller, and eventually tend to a stable value. However, in the actual evaluation process, it is impossible to make the sample data reach a large enough size, and only approximate value can be obtained under the limited samples. It can be seen that both empowerment methods have their own characteristics and shortcomings: subjective empowerment is inheritable and results are stable, but its shortcomings are that the results are highly subjective and limited by researchers' perspectives and cognition. However, the results of objective weighting are more transparent and objective, but the results are not stable. From the perspective of economic significance, the results do not reflect the relative importance of evaluation indicators, but reflect the degree of dispersion or information content of indicators, which is also a great limitation for the application of economic research. Based on this, the combinatorial weighting method is put forward as formula(1).

$$\lambda_{max} = \sum_{i=1}^{n} \frac{(AW)_i}{nW_i} \tag{1}$$

This weighting method can just complement each other's weaknesses and take advantage of each other's strengths, so it has good characteristics.

4.1 Entropy weight method

Entropy weight method is an objective evaluation method. Its basic idea is to determine the objective weight according to the variability of the index. In the process of specific use, entropy weight method calculates the entropy weight of each index by using information entropy according to the variation degree of each index, and then corrects the weight of each index by entropy weight, so as to obtain relatively objective index weight. Generally speaking, if the entropy weight of an index is smaller, the greater the variation degree of the index value is, the more information is provided, the greater the role it plays in the comprehensive evaluation, and the greater its weight is. The specific steps are as follows:

4.1.1 Construct judgment matrix

Construct judgment matrix, the formula is as follows:

$$\mathrm{R}' = \begin{bmatrix} \mathrm{r}'_{11} & \mathrm{r}'_{12} & \cdots & \mathrm{r}'_{1\mathrm{n}} \\ \mathrm{r}'_{21} & \mathrm{r}'_{22} & \cdots & \mathrm{r}'_{2\mathrm{n}} \\ \vdots & \vdots & \ddots & \vdots \\ \mathrm{r}'_{\mathrm{m}1} & \mathrm{r}'_{\mathrm{m}2} & \cdots & \mathrm{r}'_{\mathrm{mn}} \end{bmatrix} (\mathrm{i} = 1,2,\ldots,\mathrm{m};\mathrm{j} = 1,2,\ldots,\mathrm{n}) \tag{2}$$

4.1.2 Establishing a standardized matrix

Establishing a standardized matrix，the formula is as follows:

$$\mathrm{R} = \begin{bmatrix} \mathrm{r}_{11} & \mathrm{r}_{11} & \cdots & \mathrm{r}_{11} \\ \mathrm{r}_{11} & \mathrm{r}_{11} & \cdots & \mathrm{r}_{11} \\ \vdots & \vdots & \ddots & \vdots \\ \mathrm{r}_{11} & \mathrm{r}_{11} & \cdots & \mathrm{r}_{11} \end{bmatrix} (\mathrm{i} = 1,2,\ldots,\mathrm{m};\mathrm{j} = 1,2,\ldots,\mathrm{n}) \tag{3}$$

4.1.3 Determine the weight of objective indicators

Determine the weight of objective indicators，the formula is as follows:

$$h_j = -\frac{1}{\ln m}\sum_{i=1}^{m} a_{ij} \ln a_{ij} \; (i = 1,2,\ldots,m; j = 1,2,\ldots,n)$$

$$\mathrm{A_{ij}} = \frac{\mathrm{r_{ij}}}{\sum_{\mathrm{i=1}}^{\mathrm{m}} \mathrm{r_{ij}}} \tag{4}$$

4.2 Analytic Hierarchy Process

Analytic Hierarchy Process (AHP) is a weight calculation method based on network system theory and multi-objective comprehensive evaluation

method. On the basis of in-depth analysis of the nature of complex problems, influencing factors and internal relations. Using less quantitative information, the thinking process of decision making is mathematized. Thus, it provides a simple decision-making method for complex decision-making problems with multiple objectives, multiple criteria or no structure. This method combines qualitative and quantitative analysis, uses the experience of decision makers to judge the relative importance of each indicator, and gives a reasonable weight to each indicator.

4.2.1 Construct judgment matrix

Construct judgment matrix，the formula is as follows:

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix} \tag{5}$$

4.2.2 Check consistency

1. Calculate the elements of each row of the judgment matrix and multiply them to obtain the following result：

$$M_i = \prod_{j=1}^{n} a_{ij} \ (i.j = 1,2,\dots,n)$$

$$W^* = \sqrt[n]{M_i} \tag{6}$$

2. Vector normalization

Vector normalization，the formula is as follows:

$$W_i = W^* / \sum_{i=1}^{n} W^* \tag{7}$$

3. Consistency of judgment matrix

To judge matrix consistency, the following formula is used to calculate the value of CI：

$$\mathrm{AW} = \begin{bmatrix} W_1/W_1 & W_1/W_2 & \cdots & W_1/W_n \\ W_2/W_1 & W_2/W_2 & \cdots & W_2/W_n \\ \vdots & \vdots & \cdots & \vdots \\ W_n/W_1 & W_n/W_2 & \cdots & W_n/W_n \end{bmatrix} \begin{bmatrix} W_1 \\ W_2 \\ \vdots \\ W_n \end{bmatrix} = \lambda \begin{bmatrix} W_1 \\ W_2 \\ \vdots \\ W_n \end{bmatrix}$$

$$\mathrm{CR}=\frac{\mathrm{CI}}{\mathrm{RI}} \quad CI=\frac{1}{n-1}\left(\lambda_{max}-\mathrm{n}\right) \tag{8}$$

Table 3: RI

n	1	2	3	4	5	6	7	8	9
RI	0.00	0.00	0.52	0.89	1.12	1.26	1.36	1.41	1.46

In the process of hierarchical analysis, when the consistency ratio is less than 0.1, it is considered that the degree of inconsistency of the judgment matrix is within the allowable range, and there is satisfactory consistency, and the consistency test is passed.

The data of the AHP in this paper come from the questionnaires filled out by industry experts and professors, and the importance of the indicators is compared pairwise by using the scaling method, and finally the weight of the indicators is obtained. The data rely on the judgment and experience of each expert and are therefore somewhat subjective. Different from the analytic Hierarchy Process (AHP), the data used in the entropy weight method come from 394 A-share listed companies and are manually collated through the 2020 annual reports. It can accurately and realistically reflect the real situation of each company and has certain objectivity. In order to improve the accuracy of index weight calculation, this paper uses a combination of analytic hierarchy process and entropy weight method to calculate index weight.

5 SYNTHETIC ANALYSIS

5.1 Data standardization

The analysis index system was determined according to the analysis purpose, and the analysis data was collected n valuation objects were set to form the following matrix:

$$\left(X_1',X_2',\ldots,X_m'\right)=\begin{bmatrix}x_1'(1) & x_2'(1) & \ldots & x_m'(1)\\ x_1'(2) & x_2'(2) & \ldots & x_m'(2)\\ \vdots & \vdots & \ddots & \vdots\\ x_1'(n) & x_2'(n) & \ldots & x_n'(n)\end{bmatrix} \tag{9}$$

Due to the different physical meaning of each factor in the system, the dimension of the data is not necessarily the same, which is not convenient for comparison, or it is difficult to get the correct conclusion when comparing. Therefore, in the gray correlation analysis, it is generally necessary to carry out dimensionless processing of data. In this paper, the common equalization method is adopted, that is, to obtain the average value of each index data, and then divide each data by the corresponding average value of the index, as shown in the formula:

$$\mathrm{X_n'}=\frac{\mathrm{X_n}}{\mathrm{X_a}} \quad \text{Formula} \tag{10}$$

The matrix after standardized data processing is obtained:

$$(X_1', X_2', \dots, X_m') = \begin{bmatrix} x_1'(1) & x_2'(1) & \dots & x_m'(1) \\ x_1'(2) & x_2'(2) & \dots & x_m'(2) \\ \vdots & \vdots & \ddots & \vdots \\ x_1'(n) & x_2'(n) & \dots & x_n'(n) \end{bmatrix} \quad (11)$$

5.2 Determine sequence of reference

The reference sequence should be an ideal comparison standard. The reference sequence can be constituted by the best and worst values of each index, or other reference values can be selected according to the purpose of evaluation, which are denoted as:

$$X_0' = (X_0'(1), X_0'(2), \dots, X_0'(m)) \quad (12)$$

5.3 Determine the maximum and minimum values

Determine the maximum and minimum values，the formula is as follows:

$$\begin{aligned} \Delta\min &= \min|X_0'(k) - X_i'(k)| \\ \Delta\max &= \max|X_0'(k) - X_i'(k)| \end{aligned} \quad (13)$$

5.4 Determine the correlation coefficient and correlation degree

Determine the optimal and the worst correlation coefficient, the formula is as follows:

$$\delta_i(k) = \frac{min_i|X_0(k) - X_i(k)| + \rho^* max_{i=1}|X_0(k) - X_i(k)|}{|X_0(k) - X_i(k)| + \rho^* max_{i=1}|X_0(k) - X_i(k)|} \quad (k = 1,2, \dots, m) \quad (14)$$

Determine the optimal and the worst correlation coefficient matrix, the formula is as follows:

$$(X_1^*, X_2^*, \dots, X_m^*) = \begin{bmatrix} X_1^*(1) & X_2^*(1) & \dots & X_m^*(1) \\ X_1^*(2) & X_2^*(2) & \dots & X_m^*(2) \\ \vdots & \vdots & \ddots & \vdots \\ X_1^*(n) & X_2^*(n) & \dots & X_m^*(n) \end{bmatrix} \quad (15)$$

5.4.3 Relative correlation coefficient and correlation degree

Relative correlation degree = optimal correlation degree (optimal correlation degree + worst correlation degree)

Calculate the relative correlation degree of each company and arrange it in descending order to get the top 15 companies, as shown in the following table 4:

Table 4: Enterprise comprehensive ranking

Serial number	Company name	Relative correlation degree
1	Montage Technology Co.,ltd.	0.4524
2	Hengyu Datacom Aviation Equipment Co.,ltd.	0.4383
3	Jingjia Microelectronics Co.,Ltd.	0.4373
4	Sino Wealth Electronic Ltd.	0.4348
5	Maxscend Microelectronics Co.,ltd.	0.4341
6	Jushri Technologies, Inc.	0.434
7	China Spacesat Co.,Ltd.	0.4318
8	Quantumctek Co.,Ltd.	0.4311
9	Bestechnic (Shanghai) Co., Ltd.	0.4293
10	Glarun Technology Co.,ltd.	0.4289
11	Unistrong Science & Technology Co.,Ltd.	0.4283
12	All Winner Technology Co.,ltd.	0.4266
13	SG Micro Corp.	0.4261
14	Will Semiconductor Co.,ltd.	0.4259
15	Chengdu Xgimi Technology Co.,ltd.	0.4257

6 CONCLUSION

The value management evaluation index system and value driving factors of electronic and communication equipment manufacturing enterprises restrict and promote each other. With the help of the evaluation index system, value drivers penetrate into the enterprise management, all departments and all employees, giving full play to their role in creating enterprise value. The evaluation system comprehensively and accurately measures and evaluates the value created by the value drivers, giving full play to the value evaluation function of the evaluation system. The comprehensive evaluation results of electronic and communication equipment manufacturing companies are very favorable to the companies in the industry. Through the evaluation of the value management level, we can guide the market to select enterprises with better value management level, establish brands in the industry, and promote the positive and healthy development of the industry. At the same time, it can help enterprises find the gap between themselves and the average level of the industry, understand the existing problems and areas in need of improvement, encourage enterprises to accelerate the implementation of rectification, so as to improve the level of enterprise value management.

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