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**Research Article**

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# Comprehensive Evaluation of Development Performance of Iron and Steel Logistics Enterprises Based on DEA Model in the Background of "Internet plus"

**Wang Meng*[1], Zhou Li-hui[1], Li Meng[1], Song Zi-ming[2]**

[1]North China University of Science and Technology Tangshan, China-063000
[2]Nanjing Vocational and Technical College, Nanjing China-210016

**Abstract** To research on the Development Performance of Iron and Steel Logistics Enterprises under the Perspective of "Internet Plus", this paper based on the theory of input-output and uses the method of Data Envelopment Analysis (DEA). Research chooses six enterprises, located in Changzhou, Baoshan, Jiangyin, Suzhou, Zhangjiagang and Kunshan, to carry on this research. And draws a conclusion that enterprise lies in Baoshan makes good use of Internet resources and makes the input-output efficiency. Further predictable combination of steel logistics and the Internet will be the future development of steel logistics industry, a major trend.

**Keywords** Internet plus steel logistics DEA model Performance Evaluation

## Introduction

### Definition and the Importance of Iron and Steel Logistics

Iron and steel logistics industry is to "steel" as the carrier, "logistics" for the operation, "Information" as the core, Set steel trade, e-commerce, three logistics as one. Customer flow, capital flow, information flow, logistics to Mutual promotion, mutual integration, Is covering the construction industry, metallurgical industry, information industry, modern logistics industry of the four cross-industry in particular, Steel logistics includes steel (and its raw materials) transport, storage, handling, carrying, packaging, processing, distribution, information platform and business sectors such as electricity.

Steel as a commodity, always has been the main business of the logistics industry. However, with the global economic downturn in recent years, China's economic slowdown, Iron and steel industry has appeared Serious oversupply situation, Steel logistics industry also fell into the trough. At present, China's steel logistics industry mainly exists Supply and demand structure does not match, Capital flows need to be bridged by steel traders, Logistics chain segmentation obvious features. Faced with this grim situation, iron and steel enterprises, iron and steel logistics enterprises in order to seek development, they must achieve transformation. At the same time, With the "Internet plus" strategy to rise to the national level, "Internet plus" industry development model has been fully applied to the tertiary industry, and also to the first and second industry penetration [1]. In this context, Iron and steel logistics industry can also hope that leverage the ecological integration brings new opportunities for the iron and steel enterprises and the development of iron and steel logistics industry.

### Research Status of Development of Iron and Steel Logistics Enterprises

Now, there are few researches on the development of steel logistics enterprises. In 2010,Wang Jian to establish a logistics operation, logistics information, logistics management, logistics finance A total of 14 indicators in four areas, Using multi-level fuzzy comprehensive evaluation method, Establish the steel logistics enterprise development performance comprehensive evaluation model, and conducts empirical analysis [2]; Chen Xiufeng

Combining the status quo of China's logistics enterprises, Combine the Financial indicators and non-financial indicators ,Establish a more comprehensive logistics enterprise performance evaluation index system, Using multi-level fuzzy comprehensive evaluation method, System analysis of the logistics business status quo, On the managers and the parties based on business performance, Formulate the Future development strategy provides an important basis. However, with the rapid development of the Internet, Steel logistics enterprises and the Internet combined closely. The study on the development of iron and steel logistics enterprises in the Internet plus background is scarce. Therefore, this paper uses the idea of input-output, established DEA evaluation model, Evaluate the development performance of iron and steel logistics enterprises under the Internet and visual field [3].

**DEA Model Introduction**

In DEA, the organization that measures performance is generally referred to as the decision making unit,Assumptions: There have $n$ decision units $(j=1,2,\cdots,n)$ ,each decision units has $m$ input items $(i=1,2,\cdots,m)$ and $s$ out items $(r=1,2,\cdots,s)$ .in the same, $x_{ij}$ means the i[th] input of the j[th] decision unit and $y_{rj}$ means the r[th] output of the j[th] decision unit.

Because of the different status and role of various output and input in the process of enterprise development, it is necessary to evaluate the decision-making unit to "integrate" his input and output, think of them as a business process with only one overall input and one overall output, so that we to give each input and output the appropriate weights. $v_i$ is a measure of the i[th] type of input and $u_r$ as a measure of the r[th] type of output [4].

Taking the efficiency index of the $j_0^{th}$ decision unit as the goal and the efficiency index of all the decision units (including the $x^{th}$ decision unit) as the constraint, formatting $C^2R$ model:

$$\begin{cases} \max h_{j_0} = \dfrac{\sum_{r=1}^{s} u_r y_{rj_0}}{\sum_{i=1}^{m} v_i x_{ij_0}} \\ \dfrac{\sum_{r=1}^{s} u_r y_{rj_0}}{\sum_{i=1}^{m} v_i x_{ij_0}} \le 1 \qquad j=1,2,\cdots n \\ v=(v_1,v_2,\cdots v_m)^T \ge 0 \\ u=(u_1,u_2\cdots u_m)^T \ge 0 \end{cases}$$

The effectiveness of decision making unit $j_0$ is explained by the optimal solution of linear programming. It can be seen from the model that the effectiveness of decision element $j_0$ is relative to all other decision making units.

To facilitate the discussion and calculation, the further introduction of the slack variable $s^+$ and the remaining variable $s^-$, the above inequality constraints become equality constraints, can become:

$$\begin{cases} \min \theta \\ s.t. \sum_{j=1}^{n} \lambda_j x_j + s^+ = \theta x_0 \\ \sum_{j=1}^{n} \lambda_j y_j - s^- = y_0 \\ \lambda_j \ge 0, \quad j=1,2,\cdots n \\ \theta \qquad\qquad , s^+ \ge 0, s^- \le 0 \end{cases}$$

Where $\theta$ is the optimal value of the linear programming.

The $C^2R$ model can be used to judge whether the company's production activities are both technically effective and scale effective. The sufficient condition for the decision-making unit to be DEA effective is that the optimal value of the planning is equal to 1, and for each optimal solution, $\lambda^*$, $s^{*-}, s^{*+}$ and $\theta^*$ have $s^{*-}=0$, $s^{*+}=0$.

**Empirical Research**

**The Selection of Steel Logistics Enterprise**

Steel because of its bulky, heavy weight, In the steel logistics for transport has a certain requirement, Now China's iron and steel logistics industry developed mainly in the coastal areas [5]. Iron and steel from the production to give customers through a lot of logistics companies during the period. In order to simplify the research problem, this article takes the area as the unit to carry on the research, comprehensive evaluation of the performance of steel logistics enterprises in the region.In the area of choice through the steel network can be found in Changzhou, Jiangyin, Zhangjiagang, Suzhou, Kunshan, Baoshan Iron and Steel to transport six units,Therefore,selected the above-mentioned six regions as the research objects.

**Input - Output Index Selection**

According to the cost of steel logistics enterprises [6], in the steel logistics process, these costs can be divided into six areas, namely:

(1) Cost Value: That is the cost of steel logistics. The beginning of the Iron and steel logistics transport process, the steel itself has a certain value, that is, the starting point of logistics steel prices.

$$\text{Cost value}=\sum_{i=1}^{n}\text{Steel price}\times\text{Number}\quad n=1,2,3\cdots$$

(2) Network Order Value: A number of steel because the next single time for different steel distribution programs, In the use of the network fast orders, with single, you can more convenient and efficient logistics to improve efficiency and reduce logistics costs.

$$\text{Network Order Value}=\sum_{i=1}^{n}\text{orders network Number}\times\text{Unit order cost}$$

(3) Human value: In the steel logistics transport process, need a large number of employees, Each employee's labor for the entire steel logistics process to produce a certain value. These values are used as inputs to the steel logistics process. $\text{Human value}=\sum_{i=1}^{n}\text{Number}\times\text{ a person value}$

(4) Material value: Steel logistics as a bulk cargo logistics, resulting in more demand for goods. In the transport process and transit process, the consumption of these items as an input in the steel logistics process indicators.

$\text{Material value}=\sum_{i=1}^{n}\text{Number}\times\text{Unit material value}$ , in the process of logistics and transportation unit of material value of 90.

(5)Sales value:

$$\text{Sales value}=\sum_{i=1}^{n}\text{Cost value}+\text{Time value}+\text{Human value}+\text{Material value}+\text{Expected profit}$$

among them, $\text{Expected profit}=\sum_{i=1}^{n}\text{Expected profit of steel logistics}\times\text{Quantity of steel}$

(6)Brand Value:

$$\text{Brand Value} = \frac{\text{Cost value} + \text{Time value} + \text{Human value} + \text{Material value}}{\text{Time value}}$$

Steel is transported to the destination through various modes of transportation, at this point ,with the current steel market changes, there will be a change in the price of steel. The price of steel after the arrival of the destination is recorded as sales value, as the output of steel logistics process indicators. In addition, an iron and steel logistics enterprises, in the process of iron and steel transport efficiency, service quality, transportation quality will affect the development of an enterprise [7]. This paper selects the brand value as the output index in the evaluation of the development of iron and steel logistics enterprises. According to the above index system, the data of each decision-making unit are as table 1

**Table 1**: The input and output data table of the decision unit

| Starting point | Destination | Input | | | | Output | |
|---|---|---|---|---|---|---|---|
| | | Cost value | Network Order Value | Human value | Material value | Sales value | Brand Value |
| Su zhou | Chang zhou | 31860 | 53100 | 29250 | 51840 | 150862 | 306667 |
| | Bao shan | 35640 | 74700 | 66600 | 46980 | 160161 | 328333 |
| | Jiang yin | 25110 | 62100 | 41400 | 51030 | 140414 | 383056 |
| | Su zhou | 32130 | 72900 | 57600 | 39690 | 152753 | 311875 |
| | Zhangjiagang | 25920 | 82800 | 75600 | 25110 | 150715 | 277407 |
| | Kun shan | 35910 | 63900 | 71100 | 38880 | 152482 | 364047 |

To determine the five areas of the development of iron and steel logistics enterprise performance advantages and disadvantages, into the above DEA model, construct a linear programming model based on the five listed companies a month of input and output, determine the company's operating performance. The weighted average of the quarterly input (or output) delivered to the five regions is used as the input (or output) for the entire operating period.

Assume transportation to Changzhou as a decision making unit $j_0$ ,Establish a linear programming model,lead into Slack and residual variables $\min Z_D = \theta$ ,Using MATLAB to solve the linear programming equation as follow table 2

**Table 2**: Evaluation of DEA Effectiveness of Listed Companies

| Destination | | Chang zhou | Bao shan | Jiang yin | Su zhou | Zhang jiagang | Kun shan |
|---|---|---|---|---|---|---|---|
| **Weight vector** | $\lambda_i, i = 1,2,3\cdots 5$ | 0.5001 | 0 | 0 | 0.3298 | 0 | 1 |
| | | 0 | 0 | 0 | 0 | 0 | 0 |
| | | 0 | 1 | 0 | 0.1653 | 0 | 0 |
| | | 0 | 0 | 0 | 0 | 0 | 0 |
| | | 0.3312 | 0 | 0 | 0.5226 | 1 | 0 |
| | | 0.2280 | 0 | 1 | 0.0067 | 0 | 0 |
| **Remaining variable** | $s_1^-$ | 0 | 0 | 0 | 3.0578 | 0 | 0 |
| | $s_2^-$ | 0 | 0 | 1.5324 | 0 | 0 | 0 |
| | $s_3^-$ | 5.2422 | 0 | 0 | 0 | 0 | 0 |
| | $s_4^-$ | 0 | 0 | 0 | 0 | 0 | 0 |
| **Relaxation variable** | $s_1^+$ | 0.0029 | 0 | 0 | 0.0144 | 0.1620 | 0.0086 |
| | $s_2^+$ | 0.0567 | 0 | 0 | 0.0315 | 0.7287 | 0.0420 |
| **DEA rms** | $\theta$ | 0.9178 | 1 | 1 | 0.9805 | 1 | 1 |

**DEA Validity Analysis**

As can be seen from the table Jiangyin, Baoshan, Zhangjiagang, Kunshan DEA Valid values $\theta$ are 1,So at least weak for the DEA. In addition Baoshan its relaxation variable, the remaining variables $S^+$, $S^-$both are 0, which proved that Baoshan is an effective decision-making unit of DEA. Indicating Baoshan's transport performance is relatively effective, *i.e.*, transport to the local input-output efficiency is obvious, and its input and output also are relatively balanced. Changzhou, Suzhou Self-control DEA Valid values $\theta$ Are less than 1, neither DEA weakly effective nor DEA effective. The smaller the $\theta$ value, the lower the efficiency of transporting steel logistics to the region which is the lowest in the six regions compared to Changzhou Iron and Steel Logistics. According to the value of network orders can be seen, Changzhou is located in the Mainland, the logistics industry and the Internet industry is relatively low efficiency, the mode of transport is relatively simple, So the logistics efficiency relative to Baoshan, Jiangyin and other places is relatively low. For enterprises with low logistics efficiency, the logistics efficiency can be improved by optimizing the logistics route, shortening the transit time of logistics, optimizing the distribution mode and so on. In addition, according to the relaxation variable theorem, we can calculate the target improvement value, that is, the level that the steel logistics company can achieve in theory. The performance of steel logistics companies in Changzhou, Baoshan, Jiangyin, Suzhou, Zhangjiagang and Kunshan were evaluated by data envelopment analysis (DEA). The results show that Baoshan transport is relatively effective, that is, the company's input-output efficiency is obvious.

**Conclusion**

In the past two years, although the efficiency of China's steel logistics has been improved, the level of logistics specialization has also continued to improve, but overall, China's steel logistics costs are still high. Conform to the development trend of "Internet plus" development trend, China's logistics industry to stimulate vitality. With the widely use of big-data, cloud computing, the net of things, and the new model of logistics fulfill of the characteristics of the Internet emerging. The application of "Internet plus" model in the steel logistics industry will bring the logistics industry new vitality.

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