Research on Optimization Technology of Cost Management and Control of Power Grid Enterprises under the Background of Smart Grid Application

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Abstract: With the continuous advancement of power science and technology, strengthening the intelligent construction of power grids has become one of the key development strategies of power grid enterprises. The invoice terminal in the business hall of a power grid enterprise is an important link between the power grid and power customers, and it is also an important indicator of the intelligent level of the power grid. For this reason, the grid enterprise has invested a lot of money in the investment and construction of the invoice terminal and technology upgrade. However, the lack of in-depth cost-effective analysis of the input of the invoice terminal by the power grid enterprises has caused problems of low capital input efficiency of the invoice terminal from time to time. Therefore, this paper selects F provincial-level grid enterprise business hall invoice terminal as the research object, combines the DEA theory to carry out the input cost effectiveness evaluation, and analyzes the main factors affecting the output effect of the invoice terminal, in order to further promote the intelligent development of the power grid. Provide reference and reference for the effect of enterprise capital input and output.

1 INTRODUCTION

At present, as social and economic development enters a new normal, external supervision and inspection have become stricter, electricity prices and the complexity of the operating environment have increased, and the implementation of the deepening of the strategic system of power grid companies and the continuous improvement of high-quality development requirements. In this context, power grid companies must attach great importance to cost input and output effects and improve cost management efficiency.

Literature (Jin, 2021) analyzed the current status and problems of cost accounting management of power grid companies, and based on the perspective of comprehensive budget management, proposed a cost accounting optimization strategy for power grid companies. Literature (Wang, 2020) starts from the situation faced by power grid enterprises and the status quo of cost management, and proposes measures to strengthen lean cost management of enterprises, which provides a reference for enterprises to improve their cost management level. From the perspective of supply chain, the literature (Wu, 2021) takes T Grid Company as the specific research object, conducts in-depth research on T Grid Company's infrastructure projects, finds the shortcomings of T Grid Company's cost management, and proposes corresponding optimization suggestions. Literature (Xu, Ling, Cheng, Wang, 2019) analyzed the impact path of the power transmission and distribution price reform on the cost management, fixed asset management, investment management and budget management of power grid enterprises, and proposed a "one foundation, three grasps" financial management strategy. Literature (Zou, Zhang, Wu, Chen, 2020) based on the traditional weighted average cost of capital calculation method, introduced the risk adjustment coefficient of power grid projects, proposed a weighted cost of capital (WACC) model suitable for power grid companies' overseas investments, and obtained key international regions through empirical analysis. Based on the WACC calculation results, a regression fitting analysis was carried out through WACC and credit risk rating quantitative indicators, and a credit rating risk adjustment model was proposed.

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It can be seen from the above that the relevant research on the cost input-output effect of power grid enterprises is still blank. Therefore, it is necessary for this article to select the typical business types of power grid companies to carry out cost input effectiveness analysis and research.

2 INVOICE TERMINAL BUSINESS INTRODUCTION

2.1 Business Background

With the popularization of the mobile Internet, the public has put forward higher requirements for service quality while the demand for electricity continues to increase. On this basis, the invoice terminal has gradually become an important part of the business hall of the power grid company. From the experience point of view, high-quality service means friendliness and convenience, which is conducive to improving the business environment. Relying on technical advantages and understanding of customers' own needs, the invoice self-service terminal provides customers with a strategy of efficient experience. Adding self-service can alleviate the problem of excessive traffic in traditional business halls, make up for the lack of original business hours, and provide customers with better service. Come for easy, convenient and considerate service. As an extension and supplement of the service of the business hall, the self-service

Figure 1: Wall-mounted multi-function self-service terminal.

Figure 2: Through-the-wall multi-function self-service terminal.

invoice terminal has gradually become an indispensable strategic means and tool.

2.2 Necessity Analysis

As a self-service payment channel for customers, the invoice terminal can effectively divert the payment business in the physical business hall, shorten the time for customers to pay in the business hall, and reduce the overall service and marketing costs of the enterprise. It is an effective part of the physical business hall. Compared with the traditional service mode, self-service terminals have obvious advantages: First, self-service terminals adopt human-computer interaction, which avoids problems such as customer dissatisfaction caused by service attitude and service quality. Second, labor costs are getting higher and higher, and the advantages of self-service terminals in saving labor and reducing operating costs will become increasingly prominent. The third is that the self-service terminals put in place extend the service hours of the business halls, provide customers with more convenient services, and improve the cost-effectiveness of business outlets. Fourth, self-service terminals, as modern and automated advanced equipment, have established a good public image for power grid companies.

2.3 Service Objects and Objectives

Service object: electricity customers with various needs such as business application, list printing, invoice printing, scanning code payment, etc.

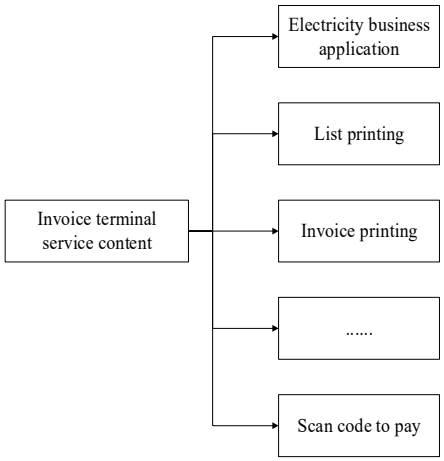

Figure 3: Invoice terminal service content.

Service objectives: First, to effectively relieve the pressure of queuing in the business hall and improve the efficiency of business settlement. The second is to save human resources, reduce labor costs and the total operating costs of business halls. The third is to improve the work efficiency and quality of the staff in the business hall, and reduce the workload of the staff.

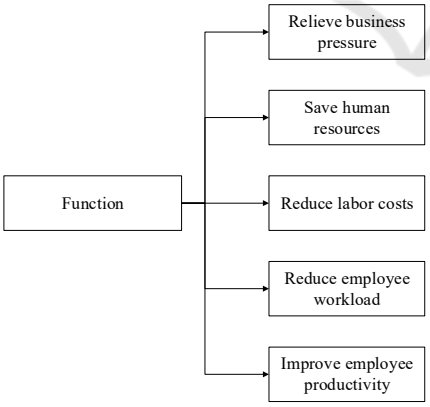

Figure 4:Invoice terminal function.

3 RESEARCH ON THE EFFECTIVENESS ANALYSIS SYSTEM OF INVOICE TERMINAL COST INPUT BASED ON DEA THEORY

3.1 Basic Ale of DEA Theory

There are many types of DEA models, among which the theory of the C^2R model is relatively complete. Competing power companies are the decision-making units. There are a total of n power companies. Each power company has m types of input (X) and s types of output (Y), DWU_j's input and output $x_j = (x_{1j}, x_{2j}, ..., x_{mj})^T$, $y_j = (y_{1j}, y_{2j}, ..., y_{sj})^T$, $j = 1,2,L,n$.

$$\begin{cases} \max \dfrac{u^T y_0}{v^T x_0} \\ s.t. \dfrac{u^T y_j}{v^T x_j} \le 1 \\ u \ge 0, v \ge 0 \end{cases} \tag{1}$$

Among them, $v = (v_1, v_2, \cdots, v_m)^T$ and $u = (u_1, u_2, \cdots, u_s)^T$ respectively represent the weight coefficients of m types of input and s types of output. The Charnes-Cooper transformation of the above formula can be transformed into an equivalent linear programming model:

$$\begin{cases} \min \theta \\ s.t. \sum_{j=1}^{n} x_j \lambda \le \theta x_0 \\ \sum_{j=1}^{n} y_j \lambda_j \ge v_0 \\ \lambda_j \ge 0, j = 1,2,\cdots n, \theta \in E_1^+ \end{cases} \tag{2}$$

The model after being processed by non-Archimedes infinitesimal (ε):

$$\begin{cases} \min[\theta - \hat{e}^T S^- + \hat{e}^T S^+] \\ s.t. \sum_{j=1}^{n} x_j \lambda + S^- = \theta x_0 \\ \sum_{j=1}^{n} y_j \lambda_j - S^+ = y_0 \\ \lambda_j \geq 0, j = 1,2,\cdots n, \theta \in E_1^+, S^- \geq 0 \end{cases} \quad (3)$$

Among them, $\hat{e}^T = (1,1,L,1)^T$, if $\theta_0 = 1$, $S^- = 0$, $S^+ = 0$ are satisfied, then DWU_{j0} is called DEA.

Suppose the optimal solution of the model is θ^0, λ^0, S^{0-}, S^{0+}, if $\theta^0 = 1$, and $S^{0-} = 0$, $S^{0+} = 0$, then DMU is called DEA effective; if $\theta^0 = 1$, and $S^{0-} \neq 0$, $S^{0+} \neq 0$, then DMU is called weak DEA effective; if $\theta^0 < 1$, the DMU is said to be non-DEA valid.

Its economic significance is: if a decision-making unit is DEA effective, from the perspective of the production function, it is both technically effective and scale-effective, that is to say, for these decision-making units, the input X and the output obtained Y has reached the optimum.

3.2 Construction of Cost-effectiveness Analysis Index System

Based on the invoice terminal cost input characteristics and output effect, the analysis index system is shown in the table below:

Table 1. Cost benefit analysis index system.

Investment index	Number of invoice terminal configuration
	Number of employees
	Investment costs
Effectiveness and output effect index	Frequency of bill printing

4 EMPIRICAL ANALYSIS

This paper takes the cost input of F provincial power grid enterprise Z and N as the cost effectiveness analysis.

4.1 Analysis of the Cost and Input Situation

Z company invested a total of 80 invoice terminals, with a total cost of 2,178,400 yuan. Among them: 26 receipt printing terminals were funded by the provincial company, and M company leased in by means of financial leasing, with a total cost of 278,200 yuan. 54 units were funded by M company, of which 14 QR code scanners were purchased through low-value consumables at a total cost of 70,000 yuan, and 40 integrated business handling terminals were leased in the form of operating leases, with a total cost of 1,830,200 yuan. The usage of invoice terminals in 9 regions of Z company is shown in the figure below:

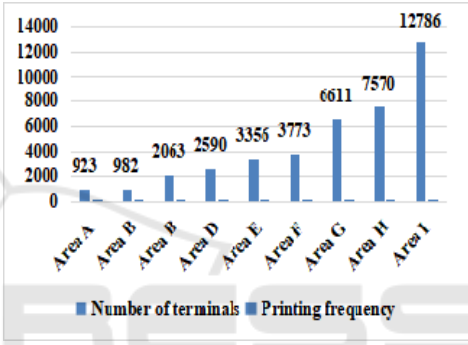

Figure 5: Comparison of invoice terminals in different regions of Z company.

It can be seen from the above figure that the use frequency of invoice terminals in Z company is uneven, with great differences.

N Company N's 90 invoice terminals, with a total cost of 2,610,200 yuan, were all purchased by Ningde Company. Among them: 28 three-in-one smart self-service payment terminals and 9 QR code scanning printers were rented in operating leases at a cost of 1,995,600 yuan; 14 self-service invoice printers were rented in by financial leasing at a cost of 447 million yuan; 39 Two QR code scanners were purchased as low-value consumables at a cost of 167,600 yuan and a total cost of 2,610,200 yuan. The usage of invoice terminals in 7 regions of company n is shown in the figure below:

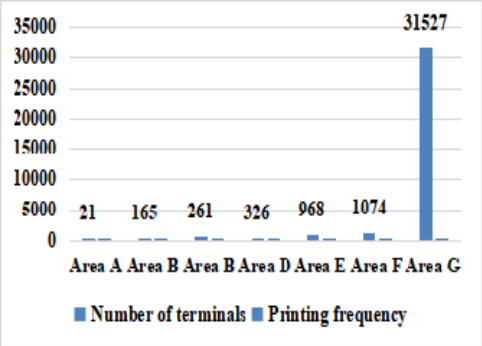

Figure 6: Comparison of invoice terminals in different regions of N company.

It can be seen from Figure 6 that the use efficiency of invoice terminal of company n is much lower than that of company Z.

4.2 Conclusion of Cost-effectiveness Analysis based on DEA Theory

Combined with the DEA analysis and conclusions, combined with the actual use of the invoice terminal, the problems with the cost input of the invoice terminal of the F provincial grid enterprise are as follows:

1) Lack of standards for terminal launch At present, there is no unified standard for terminal release. Terminal release control is extensive. Business halls declare purchases according to their needs, and then allocate them to business halls according to business volume and passenger flow. There is a large discretionary power and no unified release standard has been formed. Unified management and control.

2) The terminal utilization rate is uneven Z company and N company's invoice terminal use frequency is uneven, there is a large deviation in input-output effect, it is necessary to comprehensively consider factors such as regional economy, business hall traffic, business volume and other factors to rationally optimize the number of terminal inputs.

4.3 Improvement Suggestions

First, the unified and clear terminal delivery standards. Formulate scientific and reasonable terminal delivery standards, standardize the source of funds, conduct unified control over the terminal demand declaration, and then give delivery after professional examination and approval, strengthen lean control, to provide institutional guarantee for the standardized operation of the terminal.

Second, to establish a terminal regular analysis mechanism. Strengthen data acquisition, timely and accurately obtain various business data of terminal operation through application platform, improve analysis efficiency, conduct multi-dimensional comparative analysis of the terminal use efficiency by collecting data, strengthen closed-loop control, trace the root cause according to analysis results, and reasonably allocate idle resources in the region to ensure the overall use efficiency of the terminal.

Third, optimize the allocation of resources and utilization efficiency. Comprehensive control the demand of terminal use, and study measures according to local conditions to improve the efficiency of terminal use. Based on the problem of low use efficiency of terminals in individual business halls, consider the overall coordination, allocation and revitalization within the region, so as to improve the penetration rate and utilization rate of terminals in the whole region. At the same time, the promotion of online electronic invoice may bring negative impact to the business hall terminal, including whether terminal purchase scientific, cost economy, reasonable additional input, use efficiency, etc., it is necessary to analyze the terminal utilization efficiency, the overall control around the use of the terminal, provide support for subsequent decisions.

The fourth is to strengthen the depth of feasibility study and quality control. Further improve the depth and quality of the feasibility study. In response to the insufficient depth of the project application materials, it is required to analyze and evaluate the customer groups, main service targets, type and scale of enterprises, business hall traffic, business volume and other subdivisions during the application, and fully demonstrate them. The necessity, rationality and economy of the terminal placement plan to avoid over-configuration, advanced configuration and capital waste.

4.4 Factor Naming

Table 3 shows the factor load matrix after rotation, the first common factor has a greater load on variable quick ratio, current ratio, cash ratio, total asset growth rate, asset liability rate, cost and expense utilization rate, this shows that these six variables are highly correlated and fall into one category, which is called the solvency factor, and the second public factor, which has a greater load on the Yield valve and operating profit margin, puts the two variables

into the same category, the third public factor has a greater load on the turnover rate of accounts receivable and the growth rate of net profit, and is named as the development capacity factor, it's called the operational capability factor.

5 CONCLUSIONS

The investment in the construction of the invoice terminal in the business hall of the power grid enterprise has not only improved the intelligent application level of the power grid, but also improved the customer's intelligent power consumption perception level. This article takes the business hall invoice terminal, one of the smart grid application technologies, as the research object, with the goal of improving its input and output effects, and builds a DEA theory-based business hall invoice terminal cost effectiveness evaluation technology, which effectively guides the funds of power grid enterprises Invest in the improvement of lean management level to help the continuous improvement of the intelligent level of the power grid.

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