
DEA Evaluations of the Business Performance: A Case Study of Ecology Industry in Taiwan

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Abstract

There are many diversified methods that can assess the business performance of the ecology industry. Usually, administrators use their experience to conduct their judgment, which lacks scientific and systematic objective evidence. Therefore, it can easily cause mistakes in the administration. Data Envelopment Analysis, a linear planning technique in research, is one of the methods that can be used to assess business performance and is often used to solve this issue. Through the information from the input and output items, this study was conducted to measure the relative business performance of eco-enterprises. In real practice, data collection and an analysis of each department are usually used to offer objective reference values and benchmark for learning, before suggestions are offered for specific directions and goals for improvement in order to help eco-enterprises enhance their business performance.

Keywords: performance assessment, DEA, relative performance, ecology industry, benchmark for learning

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INTRODUCTION

Performance evaluation is a systematic and effective analysis activity process that can establish the consensus for goals between the organization and individuals and promote the possibility of the realization of those goals. It has double significance for organizations. Firstly, an analysis of the utilization of previous resources could indicate whether the organization is equipped with efficiency or not. Secondly, whether it is equipped with the prospective influence. The help of continuous improvements following past mistakes can guide the setup of future goals and the direction of resource allocation (Gronroos and Ojasalo 2004).

Clarke (1992) mentioned that all input and output items of the DEA model are produced by mathematics planning to avoid the subjective decision of evaluators, which is in line with the principle of objectivity. Therefore, the data envelopment analysis by Marvin and Rajeev (2005) is most suited for those welfare organizations whose cost and income could not be evaluated. This study is conducted to establish a measurement model for the efficiency analysis and input analysis of ecology industry. A two phase method is adopted. When the performance analysis of the DEA

of the first stage is completed, second stage through a DEA, the input and output information of the quantified investment items are used to measure the relative business performance of each department. Chang, and Ram (2005) pointed out the problems and offered appropriate suggestions based on the analysis. In the meantime, the evaluation of the relative business performance of each department is explored.

RESEARCH METHOD

Research Design

Sherman (1984) pointed out that whether or not an experimental or field research method is adopted, a DEA can assess the efficiency frontiers. Lewin and Minton (1986) believed that a DEA could be used for the assessment of organizational performance and organizational design. This study used CCR and BCC model, the BCC model by Banker, Charnes and Cooper (1984) is used to measure technology efficiency. Charnes, Cooper and Rhode (1981) believed that a DEA can be applied to an organizational diagnosis.

The Selection of Input and Output Items

Rhonda et al. (1998) made use of DEA to evaluate the business performance of 554 personal eco-enterprises with different styles. Hean Tat Keh and

Table 1. The Relationship among Production Efficiency, Technology Efficiency and Scale Efficiency

Company name	Production Efficiency	Technology Efficiency	Scale Efficiency	Scale Returns	Frequency of Reference	the number of departments for study			
						15	60	65	66
10 Taihao Enterprise Co., Ltd.	82.26	100	82.26	Fixed	0	15	60		
11 Tongli Environmental Engineering Co., Ltd.	46.94	49.55	94.73	Increased	0	15	60	65	66
12 Zhengchang Enterprise Co., Ltd.	100	100	100.00	Fixed	1	12			
14 Zhongping Huanqing Co., Ltd.	83.48	100	83.48	Fixed	0	12	15		
15 Xin Xin Xin Industrial Co., Ltd.	100	100	100.00	Fixed	18	15			
20 Shenghuang Development Co., Ltd.	16.79	32.65	51.42	Increased	0	15	66		
21 Tonglin Industrial Co., Ltd.	11.66	19.32	60.35	Increased	0	15	66		
22 Guanghua Service Agency Co., Ltd	17.75	42.13	42.13	Increased	0	15	66		
23 Zhiyuan Enterprise Co., Ltd	24.3	34.8	69.83	Increased	0	15	65		
24 New Hsinchu Environmental Protection Engineering Co., Ltd.	11.61	14.64	79.30	Increased	0	15	45	65	
30 Dafu Environmental Protection Technology Co., Ltd.	22.97	23.03	99.74	Decreased	0	15	60	66	
31 Jianli Environmental Consultant Co., Ltd.	79.4	100	79.40	Fixed	0	15	60	66	
32 Yefeng Environmental Protection Co., Ltd.	24.3	36.03	67.44	Increased	0	15	60	66	
33 Jijia Environmental Protection Co., Ltd.	81.3	87.72	92.68	Increased	0	15	60	65	66
34 Chenxi Environmental Protection Engineering Co., Ltd.	48.54	48.58	99.92	Decreased	0	42	66		
40 Qiyang Environmental Protection Technology Co., Ltd.	34.14	35.79	95.39	Increased	0	15	60	66	
41 Xinju Exhibition Environmental Protection Co., Ltd.	33.18	41.35	80.24	Increased	0	15	60	66	
42 Weicheng Environmental Protection Co., Ltd.	100	100	100.00	Fixed	2	42			
43 Dixin Environmental Protection Co., Ltd.	94.79	100	94.79	Fixed	0	15	42	66	
44 Hedong Environmental Protection Engineering Co., Ltd.	83.23	92.08	90.39	Increased	0	15	60	s	
45 Dingfeng Environmental Protection Co., Ltd	100	100	100.00	Fixed	2	45			
46 Environmental Transport Co., Ltd.	26.46	100	26.46	Fixed	0	45	60	65	
60 Daqing Environmental Protection Enterprise Co., Ltd.	100	100	100.00	Fixed	13	60			
61 Acer Environmental Cleaning Co., Ltd.	52.21	64.12	81.43	Increased	0	15	60	65	66
62 Qianlong Environmental Protection Co., Ltd.	35.71	49.66	71.91	Increased	0	15	60	66	
65 Xinding Environmental Protection Co., Ltd.	100	100	100.00	Fixed	6	65			
66 Xinxin Environmental Protection Enterprise Co., Ltd.	100	100	100.00	Fixed	14	66			

Source: concluded by this study

Singfat Chu (2003) adopted DEA to evaluate the business performance of the online ecology industry in Australia. In the selection of the input and output items, this study adopts the previous literatures and the structure of the income accounts, as follows: the number of part-time employees, the salary of full-time employees, the salary of part-time employees. The output items are: turnover, commercial gross profit, operating performance and the number of customers.

Define Decision-Making Units (DMUs)

Golany and Roll (1989) pointed out that in an assessment of the DEA, firstly, the appropriate DMUs have to be defined and chosen for analysis. Secondly, based on the establishment of targets and standards, the input and output indicators of the relative and appropriate DMUs are determined. Golany and Roll (1989) pointed out that the number of organizations waiting to be assessed shall be double or more than that of the sum of the number of input and output items of the DMUs waiting to be assessed. The analysis results will be equipped with the highest credibility and interpretability.

It is discussed based on the following four aspects: (1) Efficiency analysis (2) Slack variable analysis (3) Scale return analysis (4) Sensitivity analysis.

EMPIRICAL STUDY AND ANALYSIS

Collection of Data

The research data is based on the actual business performance of each Environmental Protection Company in Taiwan. Each department of this Environmental Protection Company are regarded as one DMU. In total, there are 27 DMUs, three input and four output items.

Efficiency Analysis of the Cases

In **Table 1**, among the 27 units, the DEA results are shown as follows:

(1) In terms of production efficiency : there were 7 units (12, 15, 42, 45, 60, 65, 66) where production efficiency achieved 100. (2) In terms of technology efficiency: there are 12 units (10, 12, 14, 15, 31, 42, 43, 45, 46, 60, 65, 66) where production efficiency has achieved 100. (3) In terms of scale efficiency: there are 7 units (12, 15, 42, 45, 60, 65, 66) where production efficiency has achieved 100. (4) In terms of scale returns: there are 12 units (10, 12, 14, 15, 31, 42, 43, 45, 46, 60, 65, 66) where the scale returns stay at the CRS stage, which means that the business of these 12 units have achieve the best production scale. (5) In terms of the number of times for reference, No. 15 enjoys the highest with 18 times, which means that the business enjoys the strongest stability.

Sensitivity Analysis

(1) Indicate that the number of part-time workers does not affect the assessment indicators in this study. (2) Salary of the full-time workers is one of the important influence indicators. (3) Salary of part-time workers is the one that affects performance assessment ability. (4) Turnover is the one affecting performance assessment ability. (5) Commercial gross profit does not affect the indicators. (6) Business performance does not affect the indicators.

Analysis of Potential Improvement Values

From the perspective of the ratio of the contribution of input items, business managers can determine that the adjusted order of the resources of each relatively inefficient unit can be used as a reference for business decisions. Taking unit 10 as an example, for all input items, the ratio of the contribution of the salary of part-time workers is 71.6%, which is relatively high and the top priority shall be given to improvements. In terms of the output items, the ratio of the contribution for business turnover is 100%. Therefore, how to promote business turnover through activities shall be given the top priority for the improvement of business performance. In this order, the business performance of each relatively efficient unit could be promoted respectively.

CONCLUSION

This study is based on a set of reasonable and appropriate business performance assessment methods. Through the adoption of this kind of method and tool, it can not only offer advice for business operators with relatively definite directions and goals, but also examine the blind spots in the business management.

The operators of ecology industry are speeding up the expansion of their business scale, enhancing their market share and promoting business performance and productivity, which is the key to a sustainable business. This study shows that, from the perspective of the ratio

of the contribution of the input items, business managers can determine the order of the change in the resources of each relatively inefficient unit. In fact, the business efficiency of each unit will affect the level of the operation and the improvement of productivity. Using the research method adopted in this study, a set of tools can be offered to solve these difficult and complicated issues.

EMPIRICAL STUDY AND SUGGESTIONS

(1) Ecology industry operators shall accelerate the integration in order to expand the business scale, increase market share and further enhance business performance and productivity. In the current domestic market, there are too many eco-enterprises in Taiwan and they have high homogeneity and often overlap with each other. The operators are often trapped by the dilemma of fierce competition and the loss of talent. Taking the biggest eco-enterprises in Taiwan, as an example, for online shopping, the exposure ratio of the secondary towns is not enough. In response to the demands of the current industrial development, the Internet can be used to co-develop customers, enhance market penetration and actively attract customers to augment the business turnover with the establishment of small-scale eco-enterprises in secondary towns.

(2) In terms of the operations, units shall pay more attention to the trend of product diversity for future competition. In addition, the operation will conduct active contact with manufacturers, and the launch time of new products shall be in line with the display time to complement the optimum sales of the products. For example, Unit

(3) In terms of technology efficiency, except for Unit 15 that can be used as a reference, Unit No.24 should conduct in-depth research into the knowledge of its products. Unit No.24 could conduct cooperation with Unit 31.

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