The Measurement of Operating Efficiency: A Case Study of Fong Shan Tourism Plaza

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Abstract: This paper presents an empirical study in which Data Envelopment Analysis is used to evaluate the operating efficiency of 12 business units and 182 stores of Fong Shan Tourism Plaza. Land size, equipment investment, sales costs, operating expenses, and number of personnel are selected as input variables, while turnover, number of customers and customer satisfaction are output variables. We found that five variables are reserved after factor reduction by correlation analysis. These 12 business units are categorized into 3 groups based on efficiency scores. In each group, cultural booth, mini-train, self-store, and ice cream store are the relatively efficient business units and flower market and heritage area are the most inefficient business units. Moreover, dual analysis shows that business expenses, sales costs, and equipment investment have high priority for improvement. Finally, according to sensitivity analysis results, sales costs and business expenses are key factors to the efficiency scores of each business unit.

Key-words: leisure, DEA, operating efficiency, dual analysis, measurement, tourism,

1 Introduction

Ever since the practice of "two-day weekend" policy in 2001, fashions of leisure and travel has been increasing in Taiwan. Recreation-related industries become flourishing. Various types of tourism plazas are springing up under implementation and counseling by the government. Average tourism plazas require bigger land size and larger invested capital. Diversifying business units are introduced to enrich the plaza content. However, it is essential for plaza managers to understand how to evaluate the operating efficiency of every business unit.

However, performance evaluation factors are typically multi-dimensional and it is difficult to evaluate the relative performance of business units. This study adopted Data Envelopment Analysis to evaluate comparative operating efficiency of DMUs in Fong Shan Tourism Plazas from the operator's perspective. Managerial implications and suggestions are proposed as reference for operators while selecting DMUs and improving the equipment.

Taiwan Sugar Corporation was established as a state-run enterprise in 1946. In recent years, it has been endeavoring to sustainable development in diversification. Fong Shan Tourism Plaza is a newly developed industry of Taiwan Sugar Corporation. Diversifying business units and numerous stores are stationed in. Ever since its establishment, visitors and shoppers crowd on weekends and holidays. Under limited resources, it needs effective management and well-arranged allocation to improve overall operating performance.

To sum up, this study has the following objectives. First, DEA analysis is employed to discuss comparative operating performance of every DMU in Fong Shan Tourism Plaza. Plaza managers can refer to the results while selecting DMUs in the future. Second, DMUs can be categorized into clusters by comparative operating performance. Reference for improvement can be provided for decision makers. Third, managerial implications are drawn by the research results to propose suggestions of resource reallocation or improvement for those DMUs with comparatively lower operating performance to improve overall performance of Fong Shan Tourism Plaza.

2 Literature Review

2.1 Data Envelopment Analysis (DEA)

DEA was first introduced by Farrell in 1957 which used the concept of production frontier to evaluate productive efficiency under an assumption of constant returns to scale. However, this single-input / single-output technique had some limitations. Building on the ideas of Farrell (1957), Charnes, Cooper and Rhodes (1978) developed DEA as a measuring method which was used to analyze the relative efficiency level that concerns with multi-input and multi-output condition under the assumption of constant returns to scale, so-called the CCR model. Moreover, Banker, Charnes and Cooper (1984) first introduced the assumption of variable returns to scale. This model is known as the BCC model.

2.2 DEA-Based Studies in Tourism and Leisure Industry

To date, DEA has been widely used in tourism and leisure industry with multi-input and multi-output condition. Many researches have adopted DEA to evaluate operational performance among several DMUs in different industry. DEA was applied in a variety of fields, including hotels, travel agencies, national parks, and tourism resorts. However, very few papers have used DEA to examine the performance of tourist regions or tourism plazas.

Chen (2009) modified the original DEA model to acquire the overall efficiency of a Taiwanese hotel chain and to rank its business units under a common basis. Five inputs (number of employees, total surface area of floors, guest rooms, operating expenses, and depreciation expenses) and five outputs (occupancy rate, rate of guest satisfaction, number of guests, room revenue and other revenue) were selected based on literature and expert consulting. Two hotels in the hotel chain were identified as strategically important hotels as they had high efficiency scores and were thus the benchmarks in the whole enterprise. Although the study focused on a discussion of the CCR model, the programming model could also be applied to other DEA models.

Hsu (2006) analyzed the operating efficiencies of leisure farms in Yilan. Data of 25 leisure farms were collected and the results showed that human resources and capital were two essential inputs. Jiang (2007) targeted and assessed 20 B&Bs registered in Gu-Keng Area, Yuling County. Building size and water and electricity expenses were inputs while revenue was outputs. Technical efficiency, scale efficiency, production efficiency, returns to scale and sensitivity analysis were analyzed by means of DEA. Influences of every input and output on the overall efficiency were discussed through efficiency affection index.

Hsieh and Lin (2010) utilized relational network DEA to construct an evaluation model for analyzing the efficiency and effectiveness of international tourist hotels (ITHs) in Taiwan. 57 ITHs were evaluated and the rankings of these ITHs across operation types and locations were provided as benchmarks for ITHs in order for improvement.

Wang, Chang and Ho (2010) evaluated 11 tourism and leisure companies investing in Taiwan through three-stages Data Envelopment Analysis. The data of years 2006, 2007 and 2008 were analyzed. At each stage, different inputs and outputs were applied. The results showed that at first stage six companies were considered relatively efficient while seven were relatively efficient at the second stage. Finally, six companies were deemed as relatively efficient at the third stage.

Barros (2005) assessed the efficiency and productivity of 43 pousada hotels in Portugal for the year 2001 by means of output-oriented DEA method. Seven input indicators and three output indicators were measured. The results showed that the majority of the target hotels were efficient. The study also suggested that scale economies and location were major issues in determining a unit's efficiency.

3 Methodology

3.1 Selection of Research Subjects and Data Source

Twelve business units of Fong Shan Tourism Plaza have been identified as DMUs. Data for the study have been collected from visits and investigations. Originally, five inputs and three outputs have been considered to evaluate the relative efficiencies of different business units. Inputs and outputs and their operational definitions are listed in Table 3.1. Data of land size, equipment investment, rents/utilities expense of operating expenses, and customer satisfaction of outputs in Table 3.1 are gathered from the administrative department of Fong Shan Tourism Plaza. Others are collected as primary data by interviewing 182 shops via a questionnaire. The twelve DMUs of Fong Shan Tourism Plaza has different number of shops. As this study is to discuss the comparative operating efficiency of DMUs, data from

each shop are aggregated by DMU for analysis. The original input and output data of DMUs of Fong Shan Tourism Plaza is shown in Table 3.2.

Item	Variables	Unit	Operational Definitions
Inputs	Land Size (X1)	M^2	Land size for every business unit
	Equipment Investment (X2)	NTD	Equipment investment by every business unit
	Sales Costs (X3)	NTD per month	Average purchasing costs for every business unit per month
	Number of Personnel (X4)	Number per month	Average number of personnel for every business unit per month, and 160 hours of temporal personnel is calculated as one personnel (8 hours/day * 20 days/month)
	Operating Expenses (X5)	NTD per month	Average operating expenses for every business unit, including rents, utilities expense, salaries expense (The base salary for a staff is NTD 17,280.)
Outputs	Sales Revenue (Y1)	NTD per month	Average sales revenue for every business unit
	Number of Customers (Y2)	Number per month	Average number of customers for each business unit (calculated by low/high season)
	Customer Satisfaction (Y3)	% per month	Average customer satisfaction (satisfaction = 1 – (number of customers who make complaints – number of customers)

Table 3.1 Inputs and Outputs and Their Operational Definitions

3.2 Selection of Inputs and Outputs

Five inputs and three outputs are preliminarily selected for this study. One rule of thumb there are inputs and outputs combined. Since there are only twelve DMUs, variables reduction is needed to increase the discriminating power of the DEA. Although there is no need to set production formula beforehand for DEA, inputs and outputs could be selected through correlation analysis. Table 3.3 shows that there should be at least twice as many DMUs as the relationship between inputs and outputs for this study.

3.3 Research Design

This research attempts to evaluate the operating efficiency of Fong Shan Tourism Plaza. Constant returns to scale is assumed; that is, outputs increase by same proportional change where inputs increase by a constant factor. An input-oriented mode is adopted which refers that inputs are control variables. In addition, this study focuses on efficiency analysis to find out resource utilization and provide managerial implications. No prior information or examination is available for evaluation. Hence, this study will employ DEA with an input-oriented CCR model to measure the operating efficiency. Data will be processed with DEA-Solver Software.

4 Empirical Results

According to the study objective, data envelopment analysis of inputs and outputs has been carried out using CCR assumptions. DEA-Solver Software is utilized and all results are shown accordingly**.**

4.1 Efficiency Analysis

Efficiency scores of DMUs, virtual multiplier of inputs and outputs, and reference groups are shown in Table 4.1. A number of three clusters, labeled E, F and N, are identified after the analysis. Cluster E includes DMU 3, 7, 8 and 12 whose efficiency score of 1, indicating that these DMUs have comparative efficiency which makes them as reference groups. Cluster F is a vacant one. DMU 1, 2, 4, 5 6, 9, 10, 11 are forming cluster N. Their efficiency score is less than 1, indicating these DMUs are relatively inefficient. Efficiency improvement can be done through dual analysis.

Next, virtual multiplier represents relative importance of every input and output. The bigger the virtual multiplier, the more contribution it will have to the operating efficiency. Because of different measurement units of variables, it is difficult to recognize the importance of each variable respectively. We need virtual multiplier of particular variable to make a comparison between DMUs. Comparative efficiency of DMUs, virtual multiplier, and reference group is shown in Table 4.1.

After DEA analysis, Cultural Booth (DMU3), Mini-Train (DMU7), Self-run Shops (DMU8) and Ice Shop (DMU12) are four efficient DMUs which have been referred by other inefficient DMUs six times, five times, four times and twice respectively. The more times the DMU being referred by others, the more comparative efficiency and robustness the DMU will possess. It is shown in Table 4.1 that Cultural Booth (DMU3) has the highest reference. Four efficient DMUs are eliminated after the first DEA analysis. The remaining eight inefficient DMUs are analyzed again with DEA analysis. The result indicates there are six efficient DMUs which are Weekend Flower Market (DMU1), Agricultural Specialty Center (DMU2), Comprehensive Market (DMU4), Chinese Restaurant (DMU9), Playground (DMU10), and Orchid Garden

DMU	Shops	Inputs					Outputs		
		Land Size (M^2)	Equipment Investment (NTD)	Sales Costs (NTD / month)	Operating Expenses (NTD / month)	Number of Personnel (Number / month)	Sales Revenue (NTD / month)	Number of Customers (Number / month)	Customer Satisfaction (% / month)
1 Weekend Flower Market	72	1,094	1,770,489	1,680,998	604,245	26	2,798,575	11,747	100.000
2 Agricultural Specialty Center	14	1,365	1,300,000	208,026	177,186	8	322,580	3,264	100.000
3 Cultural Booth	40	317	594,500	1,194,160	547,233	24	2,419,000	18,715	100.000
4 Comprehensive Market	15	919	6,169,967	357,018	300,308	9	609,500	4,905	99.918
5 Daily Flower Market	20	724	2,589,532	642,864	691,598	25	1,021,880	7,564	100.000
6 Heritage Area	15	383	1,099,282	545,800	253,390	11	892,000	283	99.293
7 Mini-Train	1	413	1,000,000	16,667	68,340	3	92,000	1,600	100.000
8 Self-run Shops	1	1,359	32,237,868	4,767,000	442,045	12	5,928,000	73,942	99.997
9 Chinese Restaurant	1	863	27,121,289	1,669,000	524,730	16	2,731,000	5,460	100.000
10 Playground	1	496	15,421,533	116,667	242,478	4	300,000	3,000	100.000
11Orchid Garden	1	327	5,401,088	50,000	73,760	2	150,000	40	100.000
12 Ice Shop	1	159	4,947,351	103,000	132,820	4	360,000	4,200	100.000

Table 3.2 Original Input and Output Data of DMUs of Fong Shan Tourism Plaza

Correlation Coefficient	Inputs(X)					Outputs(Y)		
	X1	X2	X3	X4	X5	Y1	Y2	Y3
X1	1.0000	0.3984	0.5764	0.3537	0.2768	0.5358	0.5001	0.2209
X2	-	1.0000	0.7213	0.2017	-0.0679	0.6802	0.6440	0.2149
X3	-	-	1.0000	0.4961	0.3707	0.9850*	0.9402*	0.1065
X4	-	-	-	1.0000	0.9484*	0.5879	0.3311	0.1299
X5	-	-	-	-	1.0000	0.4835	0.2065	0.0454
Y1	-	-	-	-	-	1.0000	0.8945*	0.1204
Y2	-	-	-	-	-	-	1.0000	0.1769
Y3	-	-	-	-	-	-	-	1.0000

*p.0.8

Table 3.3 Relationship between Inputs and Outputs

(DMU11). Two inefficient DMUs are left which are Daily Flower Market (DMU5) and Heritage Area (DMU6). Hence, these twelve DMUs are categorized into three clusters. DMUs with efficiency scores of 1 at the first DEA analysis are benchmarks among other DMUs. Decision makers could focus on the inefficient DMUs whether to redeploy DMUs or to improve managerial strategies in order to improve overall operating performance of the tourism plaza.

DMU	Efficiency Score				Virtual Multiplier of Outputs		Reference Group
		Equipment Investment (10^{-4})	Sales Cost (10^{-4})	Operating Expenses (10^{-4})	Sales Revenue (10^{-4})	Virtual Multiplier of Inputs	
1 Weekend Flower Market	0.9958	ε	ε	ε	ε	ε	3,8
2 Agricultural Specialty Center	0.6695	ε	ε	ε	ε	2.0511	3,7
3 Cultural Booth	1.0000	ε	ε	ε	ε	0.1268	3
4 Comprehensive Market	0.6563	ε	ε	ε	ε	ε	3,7,12
5 Daily Flower Market	0.7119	ε	ε	ε	ε	ε	3,7
6 Heritage Area	0.8026	ε	ε	ε	ε	ε	3,12
7 Mini-Train	1.0000	ε	0.1714	ε	ε	0.6971	7
8 Self-run Shops	1.0000	ε	ε	ε	ε	ε	8
9 Chinese Restaurant	0.9525	ε	ε	ε	ε	ε	3,8
10 Playground	0.6328	ε	ε	ε	ε	ε	7,12
11Orchid Garden	0.8267	ε	0.1414	ε	ε	ε	7,12
12 Ice Shop	1.0000	ε	ε	ε	ε	0.2364	12

Table 4.1 Comparative Efficiency of DMUs, Virtual Multiplier,

4.2 Sensitivity Analysis

Sensitivity analysis in DEA is mainly used for discussing the variation of efficiency scores of remaining DMUs by introducing or eliminating one specific DMU. Moreover, it is to discuss the variation of efficiency score of every DMU by introduce or eliminate an input or an output.

Since the efficiency score of every DMU is measured comparatively, it will be changed accordingly when the number of DMUs is changed. If the eliminated DMU has an efficiency score less than 1, the efficiency scores of remaining DMUs will stay unchanged. If the eliminated DMU has an efficiency score higher than 1 and is referred by other DMUs, there might be two consequences. If this DMU is not in the reference group of one specific DMU, there is no change of efficiency score of this specific DMU. On the contrary, if this DMU is in the reference group of one specific DMU, there will be changes of efficiency score of this specific DMU.

From Table 4.1, it is shown that eight inefficient DMUs are not listed in the reference groups of other DMUs, including Weekend Flower Market, Agricultural Specialty Center, Comprehensive Market, Daily Flower Market, Heritage Area, Chinese Restaurant, Playground, and Orchid Garden. No change will be brought to the efficiency scores of the remaining DMUs if any DMU above is removed. However, Cultural Booth, Mini-Train, Self-run Shops, and Ice Shop, all have an efficiency score higher than 1 and are in the reference group of other DMUs. The deletion of any of these DMUs will introduce variation on the efficiency scores of other DMUs. For example, if DMU 3 (Cultural Booth) is removed, six DMUs will have changed efficiency scores including Weekend Flower Market, Agricultural Specialty Center, Comprehensive Market, Daily Flower Market, Heritage Area, and Chinese Restaurant.

An increase or a decrease in the number of inputs or outputs will cause variations in the efficiency scores of DMUs. If the removed input or output has a corresponding multiplier close to 0, there will be limited influence on the efficiency score of DMU. When increasing or decreasing inputs or outputs, it is necessary to re-perform DEA to examine the variation in efficiency scores by any increase or decrease of variables.

Each input and output is removed one by one. DEA is re-performed according to see if the sensitivity on the efficiency scores and the result is shown in Table 4.2. If equipment investment, or sales revenue, or number of customers being deleted, the number of comparatively efficient DMUs remains four. It is indicated that these three variables has little influence on the efficiency scores. However, if sales cost or operating expenses being removed, the number of comparatively efficiency DMUs decreases to two. It shows that these two variables are key evaluation items in this study which have influences on the efficiency scores of every DMU.

DMU	Original Efficiency Score	Equipment Investment Deleted	Sales Cost Deleted	Operating Expenses Deleted	Sales Revenue Deleted	Number of Customers Deleted
1 Weekend Flower Market	0.9958	0.9176	0.9958	0.8088	0.5168	0.9958
2 Agricultural Specialty Center	0.6695	0.5698	0.4024	0.6695	0.6695	0.6561
3 Cultural Booth	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4 Comprehensive Market	0.6563	0.6317	0.2961	0.5669	0.4494	0.6563
5 Daily Flower Market	0.7119	0.5099	0.3109	0.7119	0.5757	0.7119
6 Heritage Area	0.8026	0.8026	0.7292	0.7728	0.0310	0.8026
7 Mini-Train	1.0000	1.0000	0.3949	1.0000	1.0000	1.0000
8 Self-run Shops	1.0000	1.0000	1.0000	0.6428	1.0000	1.0000
9 Chinese Restaurant	0.9525	0.9525	0.4840	0.5545	0.1620	0.9525
10 Playground	0.6328	0.6328	0.1011	0.4658	0.4569	0.6328
11Orchid Garden	0.8267	0.8267	0.1516	0.5435	0.0180	0.8267
12 Ice Shop	1.0000	1.0000	0.3125	0.7256	1.0000	1.0000
Number of Efficient DMUs	4	4	2	2	4	4

Table 4.2 Sensitivity Analysis of Deletion of One Particular Input or Output

4.3 Dual Analysis

For the comparatively inefficient DMUs, a projection analysis is performed with a dual analysis and the efficiency scores to understand the usage of inputs and performance improvement of inefficient DMUs. In this study, eight DMUs are considered inefficient including Weekend Flower Market, Agricultural Specialty Center, Comprehensive Market, Daily Flower Market, Heritage Area, Chinese Restaurant, and Orchid Garden. The dual analysis result is shown in Table 4.3.

From Table 4.3, it is shown that the slack variables between inputs and outputs are all 0 for those DMUs with efficiency scores of 1. There is no room for improvement. However, for those DMUs with efficiency scores less than 1, there is room for improvement. By combining the slack variables from

DMU	Efficiency Score	Inputs			Outputs	
		Equipment Investment (NTD)	Sales Cost (NTD)	Operating Expenses (NTD)	Sales Revenue (NTD)	Number of Customers (Number)
1 Weekend Flower Market	0.9958	0	228075.7	0	0	10885.4
2 Agricultural Specialty Center	0.6695	0	0	5772.2	6569.4	0
3 Cultural Booth	1.0000	0	0	0	0	0
4 Comprehensive Market	0.6563	0	0	0	0	1237.7
5 Daily Flower Market	0.7119	0	0	183719.0	0	1789.0
6 Heritage Area	0.8026	513975.8	0	0	0	6661.4
7 Mini-Train	1.0000	0	0	0	0	0
8 Self-run Shops	1.0000	0	0	0	0	0
9 Chinese Restaurant	0.9525	21122439.5	0	0	0	19354.1
10 Playground	0.6328	5964955.2	0	0	0	1154.8
11Orchid Garden	0.8267	2446967.6	0	0	0	1796.3
12 Ice Shop	1.0000	0	0	0	0	0

Table 4.3 Dual Analysis of Twelve DMUs of Fong Shan Tourism Plaza

Table 4.3 and the original data from Table 3.2, degree of improvement and improvement objective for these Twelve DMUs are shown in Table 4.4. Agricultural Specialty Center (DMU 2), for example has an efficiency score of 0.6695. Input data are 1,300,000 for equipment investment, 208,026 for sales costs and 177,186 for operating expenses; while output data are 322,580 for sales revenue and 3,264 for number of customers. Through the dual analysis, this DMU can improve its efficiency score to 1 by decreasing of NTD 429,650, NTD 68,753 and NTD 52,788 in equipment investment, sales cost, and operating expenses and by increasing of NTD 6,509 in sales revenue.

From Table 4.4, inputs for equipment investment, sales cost, operating expenses can be cut by NTD 17,220,722, NTD 2,582,646, and NTD 1,478,641 respectively to increase sales revenue by NTD 6,569 and to increase the number of customers by 42,879. Operating expenses improved the most by 36.44% and followed by sales cost (23.63%) and equipment investment (17.28%).

After DEA analysis, we need further explanations for the difference in operating performance between DMUs. Practical improvement suggestions should be proposed to solve managerial problems and to increase overall performance. Traditional ratio analysis was unable to evaluate multiple inputs and outputs. This study takes Fong Shan Tourism Plaza as an example and employs DEA analysis to evaluate operating performance of these twelve DMUs. From Table 4.5, it is indicated that the efficient cluster has bigger ratios than the inefficient group among six ratios between inputs and outputs other than sales revenue/sales cost. Therefore, DEA is more objective than ratio analysis to evaluate the operating performance of multiple inputs and outputs.

4.4 Managerial Implications

After efficiency analyses at two stages, these twelve DMUs of Fong Shan Tourism Plaza are categorized into three clusters according to their efficiency scores. The first cluster is the most efficient one, including four DMUs which are Cultural Booth, Mini-Train, Self-run Shops, and Ice Shop. The second cluster is the second most efficient one, including six DMUs which are Weekend Flower Market, Agricultural Specialty Center, Comprehensive Market, Chinese Restaurant, Playground and Orchid Garden. The third cluster is the most inefficient one, including two DMUs which are Daily Flower Market and Heritage Area.

One common characteristic was found among the four DMUs in Cluster 1 after investigation that they are all near No.1 Parking Lot. Visitors could go for shopping directly after they entered the Plaza. Location became the biggest advantage for Cluster 1. In addition, there are kinds of snacks and handicrafts in Cultural Booth. Kids are always attracted by mini-train. Self-run Shops provide all kinds of specialties and staples. Visitors can purchase every kind of ices and beverages at Ice Shop. These four DMUs meet general consuming demands of major visitors. Because a large number of visitors at weekends, visitors are always lining up to pay bills and shopping space is inadequate. It is suggested that the Plaza should remain this cluster and should enlarge its business space to increase sales revenue and the number of customers.

DMUs of Cluster 2 are those with distinguishing features. Weekend Flower Market and Orchid Garden supply all sorts of gardening and planting staff. Comprehensive Market and Agricultural Specialty Area sell diversifying specialties. Meals, beverages and wedding banquet services could be obtained at Chinese Restaurant. Playground is just suitable for kids and parents. Practically, these DMUs of Cluster 2 are all far away from parking lots and most of the visitors go for shopping with purposes and leave straightly after they complete the deal. It is unable to lengthen duration time of visitors to increase the consumption. These DMUs separately have fixed flows of customers but it is unable to share these customers. We recommend that this cluster be remained for abundance in this Plaza. Routes and facilities should be improved to bring other visitors to this Cluster, finally increasing the number of customers and sales revenue.

Cluster 3 is an inefficient one. However, small improvement will increase efficiency scores substantially. There are 34 booths in Daily Flower Market and 25 booths in Heritage Area, all under separate management and operation. Inefficiency comes to existence because an excessive number of employees, separate management and operation for that operating costs and sales costs are unable to be cut, and overlapping customers. Two suggestions are provided. First, it is recommended that this Cluster be weeded out. Second, this Cluster should be operated and managed by one single enterprise.

5 Conclusion

Development of tourism plazas needs large land size and huge cost of capital. Since there is increasing competition in tourism and leisure industry, we need performance analysis methods to evaluate comparative

DMU	Item	Inputs			Outputs	
		Equipment Investment (NTD)	Sales Cost (NTD)	Operating Expenses (NTD)	Sales Revenue (NTD)	Number of Customers (Number)
1 Weekend Flower Market	Original	1,770,489	1,680,998	604,245	2,798,575	11,747
	Improvement	-7,436	221,016	-2,538	0	10,885
	Objective	1,763,053	1,902,014	601,707	2,798,575	22,632
2 Agricultural Specialty Center	Original	1,300,000	208,026	177,186	322,580	3,264
	Improvement	-429,650	-68,753	-52,788	6,569	-
	Objective	870,350	139,273	124,398	329,149	3,264
3 Cultural Booth	Original	594,500	1,194,160	547,233	2,419,000	18,715
	Improvement	0	0	0	0	0
	Objective	594,500	1,194,160	547,233	2,419,000	18,715
4 Comprehensive Market	Original	6,169,967	357,018	300,308	609,500	4,905
	Improvement	-4,049,349	-234,311	-197,092	0	1,238
	Objective	2,120,618	122,707	103,216	609,500	6,143
5 Daily Flower Market	Original	2,589,532	642,864	691,598	1,021,880	7,564
	Improvement	-1,843,488	-457,655	-308,630	0	1,789
	Objective	746,044	185,209	382,968	1,021,880	9,353
6 Heritage Area	Original	1,099,282	545,800	253,390	892,000	283
	Improvement	-368,308	-438,059	-203,371	0	6,661
	Objective	730,974	107,741	50,019	892,000	6,944
7 Mini-Train	Original	1,000,000	16,667	68,340	92,000	1,600
	Improvement	0	0	0	0	0
	Objective	1,000,000	16,667	68,340	92,000	1,600
8 Self-run Shops	Original	32,237,868	4,767,000	442,045	5,928,000	73,942
	Improvement	0	0	0	0	0
	Objective	32,237,868	4,767,000	442,045	5,928,000	73,942
9 Chinese Restaurant	Original	27,121,289	1,669,000	524,730	2,731,000	5,460
	Improvement	-4,710,588	-1,589,723	-499,805	0	19,354
	Objective	22,410,701	79,278	24,925	2,731,000	24,814
10 Playground	Original	15,421,533	116,667	242,478	300,000	3,000
	Improvement	-3,793,791	-73,827	-153,440	0	1,155
	Objective	11,627,742	42,840	89,038	300,000	4,155
11 Orchid Garden	Original	5,401,088	50,000	73,760	150,000	40
	Improvement	-2,018,112	-41,335	-60,977	0	1,796
	Objective	3,382,976	8,665	12,783	150,000	1,836
12 Ice Shop	Original	4,947, 351	103,000	132,820	360,000	4,200
	Improvement	0	0	0	0	0
	Objective	4,947, 351	103,000	132,820	360,000	4,200
Total	Original	99,652,899	11,351,200	4,058,133	17,624,535	134,720
	Improvement	17,220,722	2,682,646	1,478,641	6,569	42,879
	Improvement(%)	17.28%	23.63%	36.44%	0.04%	31.83%

Table 4.4 Degree of Improvement and Improvement Objectives for Twelve DMUs

Number of DMUs	ratio	Sales Revenue / Equipment Investment	Sales Revenue / Sales Cost	Sales Revenue / Operating Cost	No. of Customers / Equipment Investment	No. of Customers / Sales Cost	No. of Customers / Operating Cost
3	Efficient Cluster	0.2269	1.4470	7.3914	0.0025	0.0162	0.0827
9	Inefficient Cluster	0.1450	1.6746	3.0776	0.0006	0.0069	0.0126
Mean		0.1859	1.5608	5.2345	0.0016	0.0115	0.0477

Table 4.5 Ratios and Means between Inputs and Outputs for the Efficient and Inefficient Cluster

operating performance of every DMU in tourism plazas. With better allocation and utilization of resources, we hope to improve overall operating performance which will increase enterprise competitiveness.

This study employs DEA analysis from the operator's perspectives to evaluate comparative operating performance of every DMU in Fong Shan Tourism Plaza. After the analysis, we found there are four efficient DMUs including Cultural Booth, Mini-Train, Self-run Shops and Ice Shop which could be deemed as benchmarks for other DMUs. After deleting Cluster 1, eight remaining DMUs are analyzed again – which we called the 2nd-stage analysis. Daily Flower Market and Heritage Area are two inefficient DMUs.

Through sensitivity analysis, it is found that two inputs which are sales cost and operating expenses have bigger influences on operating performance. So, the plaza administers could increase operating performance by improving sales cost and operating expenses. Moreover, dual analysis found eight comparatively inefficient DMUs. For input improvement, operating expenses improved the most by 36.44% and followed by sales cost (23.63%) and equipment investment (17.28%). Sales revenue increased by NTD 6,569 and to increase the number of customers by 42,879 after improvement.

The research results could be applied to business practices in tourism plazas. Overall operating performance is closed linked with arrangement and resource allocation in tourism plazas. With proper arrangement and resource allocation, overall operating performance and competitiveness of tourism plazas could be improved.

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