HOTEL INVESTMENT STRATEGIES, LLC

Improving the Efficiency & Profitability of Hotel Portfolios

Hotel Investment Strategies, LLC

It seems like a paradox; profitable hotels that are inefficient, and unprofitable or marginally profitable hotels that are highly efficient! While there is generally a correlation between efficiency and profitability, we have often found profitable hotels hiding serious inefficiencies because they have enjoyed buoyant market conditions; factors outside the control of management. Similarly, we have found unprofitable hotels or marginally profitable hotel that were highly efficient!

The most effective efficiency analysis is therefore one that controls for external factors and matches a hotel's performance on its internal, controllable factors. Because no two hotel markets are the same, evaluating a hotel's performance and efficiency is one of the most challenging issues facing management.

Making use of a technique known as **Data Envelopment Analysis** (DEA), investors can control these external factors and identify significant annual expense savings not identified with traditional financial and operating ratio analysis!

DEA has become an increasingly popular management tool for evaluating and improving lodging operating performance since Morey and Dittman's seminal article in 1995[1]. Over the last twenty years DEA has been used to maximize productivity and profits in corporate travel departments, restaurants, casinos and hotel portfolios.

[1] Morey, R.C and Dittman, D.A. (1995), "Evaluating a Hotel GM's Performance. A Case Study in Benchmarking," Cornell Hotel and Restaurant Administration Quarterly, 36(5), 30-35.

What our clients a saying.....

"It was a pleasure working with you Ross on our recent engagement. I found your analysis and findings very helpful in quantifying efficiency and productivity across our portfolio and identifying hotels that were demonstrating best practices within our group. Our response to the study will deliver value to our managers and shareholders over the long-term. I'll look forward to the next time that we work together."

Jay H. Shah, Chief Executive Officer, Hersha Hospitality Trust

Data Envelopment Analysis

DEA is a linear programming based performance measurement tool. It is a multi-factor productivity analysis technique for measuring the *relative* efficiencies of a homogenous set of decision making units, such as hotels, departments, sub-departments or individuals. Typically, productivity measures evaluate a hotel relative to an "average" or comparable hotel. In contrast, DEA compares each hotel, in a pre-defined set of individual hotels, or the "peer group", based on an efficiency score in the presence of multiple input and output factors.

Benefits - Implementation

As a management tool, DEA has the potential to help hotel investors and operators substantially improve hotel productivity and profits while maintaining service quality. DEA identifies annual expense savings not identified with traditional financial and operating ratio analysis.

DEA uses a hotel's existing data and applies a mathematical technique (see accompanying box on

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the last page) to combine all the performance ratios into a single *efficiency score*. It identifies the areas or departments for improvement - based on the performance of its pre-selected peer group. Targets for improvement are therefore objective, realistic and achievable.

Understanding the Measurement of Hotel Efficiency

Each hotel has a number of employees, rooms, and managers, or *inputs*. In addition, hotels employ *output* measures such as room revenue, occupied room nights, revenue per available room (RevPAR), market share, service quality, etc. DEA's comparisons are based on the performance characteristics of the efficient hotels to identify specific inefficiencies of the other hotels in the peer group.

Important assumptions:

a) if a hotel, in the pre-specified group of peer hotels, is capable of a specific level of performance, then other hotels should also be able to achieve those levels, if they operate efficiently.

b) multiple hotels can be combined to form a composite hotel with composite inputs and composite outputs. The key to the analysis lies in finding the "*best*" composite hotel for each existing hotel. If the composite is more efficient than the original hotel by either making more output with the same input or making the same output with less input then the original hotel is inefficient.

c) DEA controls for external factors such as competition or wage rates to compare hotels on internal, controllable variables, such as room payroll and marketing expenses.

Why Use Data Envelopment Analysis?

Ratio analysis, and expenses as a percentage of revenue, is the most common method of assessing performance in the lodging industry. However, ratio analysis is not as effective when multiple non-commensurate inputs and/or outputs are involved. The difficulty arises from the fact that each performance indicator generally reflects only one input and output level and so it is difficult to achieve an overall view of the performance of a hotel when not all performance indicators indicate a similar level of performance. Therefore, while ratios are easy to compute, their interpretation can be misleading, especially when two or more ratios provide inconsistent information.

DEA is a technique that brings key productivity ratios together to produce a *simultaneous measure of productivity* with a wider scope, with hotels evaluated based on observed performance characteristics of the efficient hotels in the peer group and not on "average or comparable" performance.

How Does Data Envelopment Analysis Work? – A Case Study of 12 Full-Service Hotels

The case study involves a hotel investor with a large portfolio of hotels located in primary and secondary markets throughout the U.S. The investor is interested in examining the efficiency of twelve full-service hotels managed by a major management company. (The names and locations of the hotels have been changed to maintain confidentiality; the operating data are actual.) The hotels range in size from 223 to 484 rooms with an average of 327 rooms. The operational goals of the hotels are similar, as are their operating characteristics. Given the importance of the rooms department to overall profitability, the investor is particularly interested in measuring the efficiency of the room department in each hotel. For this simple example, two inputs and three outputs were identified for the rooms department.

The inputs were room payroll for full-time employees (FTE) and other room expenses. The outputs were room nights, rooms revenue and guest satisfaction. (See Exhibit 1.) (Note that discrete, qualitative variables, such as guest satisfaction are easily incorporated in the analytical framework.)

Question: which hotels were the best performing, and where can improvements be made?

The investor initially analyzed room revenue per room payroll FTE and room department profit for each hotel. Examining the ratio of room revenue per room payroll FTE informed the investor which hotel was best at generating room revenue, and room nights per room payroll FTE provided another set of scores. Some hotels were located in highly competitive markets and appeared low in some ratios, but were performing well overall. Combining all the scores and identifying improvements in performance is the purpose of DEA. DEA generates an overall efficiency score for each hotel. Those hotels doing best in any particular ratio are deemed "*efficient*". For the rest DEA optimizes their performance relative to their "*efficient peers*". The result is a set of potential improvements for each input (resource) and output (product/service). As DEA recognizes relative differences, a hotel that excels in generating room nights will be compared with other similar hotels. This is shown in the "*frontier plot*" illustrated in Exhibit 2.

The Philadelphia Hotel has performed the

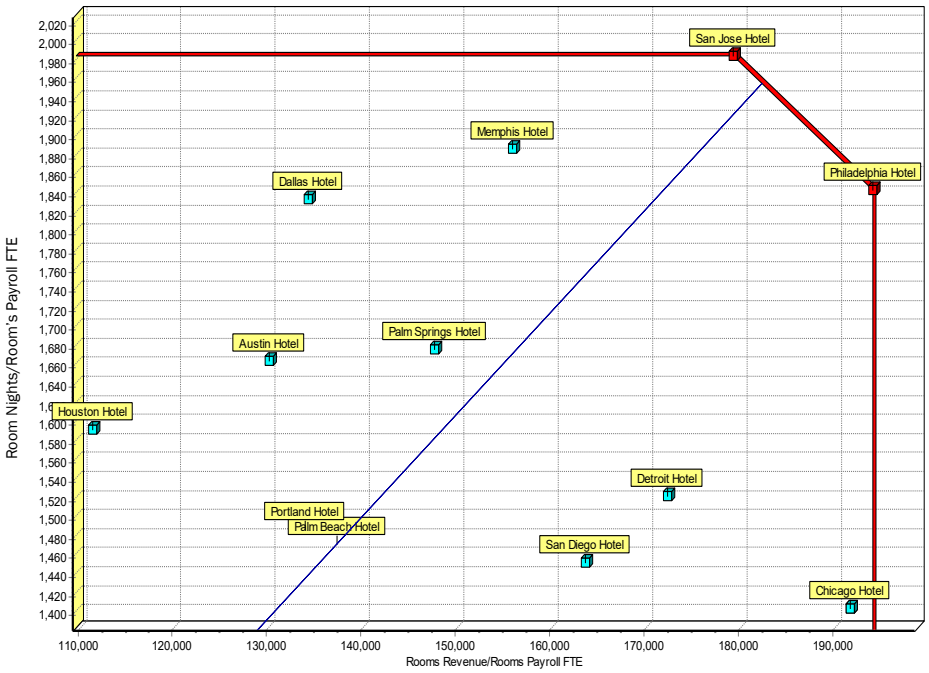
Exhibit 1: Inputs and Outputs for Rooms Department

	Input 1	Input 2	Output 1	Output 2	Output 3
Hotel	Rooms Payroll FTE #	Rooms Other Expenses ($)	Rooms Revenue ($)	Room Nights #	Guest Satisfaction (%)
Austin Hotel	59.4	$1,026,452	$7,725,179	98,918	73
Chicago Hotel	57.7	$717,224	$11,059,311	81,081	85
Dallas Hotel	57.3	$897,849	$7,685,247	105,075	80
Detroit Hotel	55.2	$1,089,881	$9,507,074	84,014	79
Houston Hotel	61.0	$728,788	$6,781,000	97,072	77
Memphis Hotel	44.4	$381,806	$6,921,914	83,876	90
Palm Beach Hotel	68.5	$1,028,366	$9,395,172	100,825	89
Palm Springs Hotel	52.3	$600,383	$7,706,467	87,617	76
Philadelphia Hotel	33.5	$663,919	$6,499,508	61,795	83
Portland Hotel	43.2	$696,157	$5,773,461	64,184	68
San Diego Hotel	47.3	$804,396	$7,732,905	68,706	75
San Jose Hotel	42.4	$550,367	$7,589,370	84,088	77

"Using DEA, one can determine how effectively a restaurant or hotel is using resources – and also identify factors that are beyond managers' control. DEA focuses managers' attention on specific actions that will improve productivity. DEA holds great promise for studies aimed at enhancing productivity in hospitality-related operations."

Dennis Reynolds
Ivar B Haglund Endowed Chair In Hospitality Business Management
School of Hospitality
Business Management
Washington State University

Exhibit 2: Efficiency Frontier



best in the rooms revenue/rooms payroll FTE ratio while the San Jose Hotel has performed the best in the room nights/rooms payroll FTE ratio. Together, these hotels form what is known as the "*efficiency frontier*" — the visual representation of the most efficient hotels. The Palm Beach Hotel has a line through it from the origin to the frontier. The Palm Beach Hotel's position along the line represents its relative efficiency - if it were to move along the line to the frontier, it would then be efficient. The hotel's score in this case is 75.2 percent.

As already explained in the DEA framework hotels are compared with other hotels of similar performance. For example, the Chicago Hotel is generating almost as much room revenue per room payroll FTE as the Philadelphia Hotel which will be in the Chicago Hotel's peer group.

Fundamental Analytical Steps

There are three fundamental tasks when executing a DEA study:

1. **defining and selecting the hotels to use in the analysis:** the hotels selected should be similar so that comparisons are meaningful. They should also be performing sufficiently different so that DEA can discriminate between them.

2. **deciding which factors to use for inputs and outputs:** inputs and outputs define the basis on which the efficiency of hotels is to be assessed. DEA accommodates inputs and outputs that cannot be easily converted to dollars. Furthermore, inputs and outputs free of any theoretical production function can be used. Input variables can either be "controlled" or "uncontrolled". An uncontrolled input is one which is outside the direct control of management, such as the number of competitors, the location of the hotel and the size and volatility of the market.

3. **implementing DEA and interpreting the results:** the primary choice is between maximizing the outputs for the inputs used (getting more out of the process) or minimizing the inputs to produce the same output (reducing resources used). Decisions on whether the analysis should assume constant returns to scale or variable returns to scale also have to be made

Output – Interpreting Results

The information provided by DEA includes efficiency scores, potential improvements, reference comparisons, reference contributions and summary graphs. The primary output of the analysis is an efficiency score for each hotel or department, along with a graph and table for the hotel or department's potential improvements. Summary graphs and tables provide insights into the data, enabling the investor to concentrate on the important areas for improvement.

Continuing with the previous case-study, based on the simple analysis of two inputs and three outputs, six hotels were found to be 100 percent efficient in the rooms department, while the rest had efficiency scores ranging from ninety-six percent in the case of the Houston Hotel to eighty-four percent in the case of the Portland Hotel.

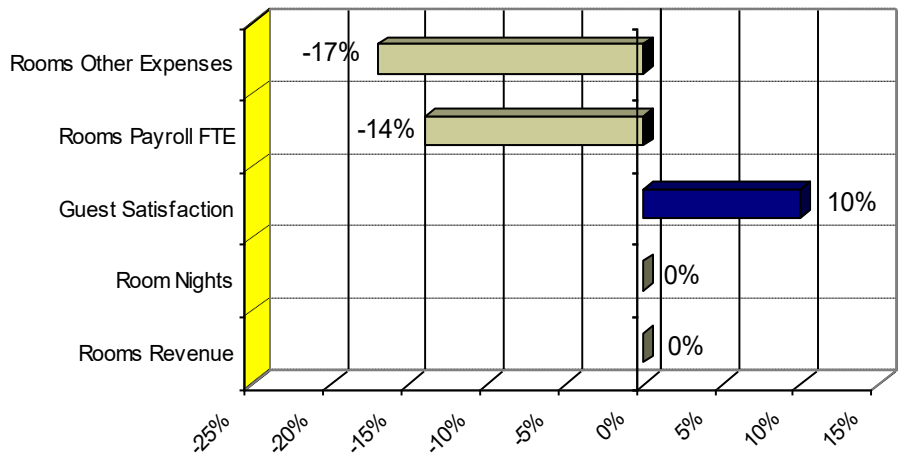
The reference set frequency, column two in Exhibit 3, identifies how many times efficient hotels were used as a basis for comparison for the inefficient hotels in the analysis, or how many times they appear in the peer group of inefficient hotels. The higher the frequency with which an efficient hotel appears in column two in Exhibit 3, the more likely it is that it is an example of an efficient hotel for inefficient hotels to emulate. The San Jose, Chicago and Dallas Hotels are clearly the major "role models" for the inefficient hotels.

Efficient hotels do not contribute equally when an inefficient hotel attempts to achieve the performance levels of efficient hotels. We define the reference set for an inefficient hotel, column three in Exhibit 3, as the number of efficient hotels associated with it. Some reference set hotels are more im-

Exhibit 3: Efficient and Inefficient Hotel Rankings

Hotel	Efficiency Score	Reference Set Frequencies	Reference Set Hotels or Peers
1 Philadelphia Hotel	100	2	
2 Palm Beach Hotel	100	0	
3 San Jose Hotel	100	4	
4 Memphis Hotel	100	3	
5 Chicago Hotel	100	4	
6 Dallas Hotel	100	4	
7 Houston Hotel	96		4, 6
8 Detroit Hotel	94		3,5,6
9 Palm Springs Hotel	92		3,4,5,6
10 Austin Hotel	90		3,5,6
11 San Diego Hotel	85		1,3,5
12 Portland Hotel	84		1,4

Exhibit 4: DEA Identified Potential Improvements in the San Diego Hotel



portant than others. The Detroit Hotel has in its set the San Jose, Chicago and Dallas hotels and is operating ninety-four percent as efficiently as they are. The reference set of a hotel can provide insights as to why it is under performing and indicates the areas for improvement. DEA also generates a reference contributions display which provides information on which hotels contribute most to setting its targets for improvement. This identifies the key hotel for comparison.

Exhibit 4 shows the target input and output levels needed for the hotel to become "fully" efficient. Therefore, the San Diego Hotel should reduce its other room expenses by 17 percent and rooms payroll FTE by 14 percent and increase its guest satisfaction by 10 percent, to become as efficient as its peer hotels, San Jose, Philadelphia and Chicago.

In total, room payroll FTE for the inefficient hotels was targeted to decline by 11.2 percent or 35.6 FTE, from 318.3 FTE to 282.7 FTE, an annual expense saving of $815,000. Rooms other expenses was targeted to decline by 19.5 percent or $967,000. The average guest satisfaction rating for the inefficient hotels was targeted to increase by 8.3 percentage points.

The reference comparison graph highlights a hotel's weaknesses, indicating the relative performance of the hotel compared with one of its closest peers from its reference set (See Exhibit 5.) Exhibit 5 displays a comparison between the San Diego and San Jose hotels. The input and output values for the San Diego Hotel have all been scaled to 100 percent. The San Jose Hotel's input and output values are expressed as a percentage of San Diego's values.

Exhibit 5 shows that while the San Jose Hotel is deploying 68 percent and 89 percent of San Diego's other room expenses and room payroll FTE, respectively, the San Jose Hotel achieved 22 percent more room nights, slightly less in rooms revenue and a marginally higher guest satisfaction rating. The result of such a comparison would prompt an investigation into why the San Jose Hotel is able to achieve the same or much higher outputs from significantly less inputs than the San Diego Hotel.

The DEA output also includes an evaluation of the variables and their effects on the efficiency scores. It identifies those variables that are contributing to efficiency. The total potential improvements graph provides an insight into the areas where the greatest efficiency gains can be made for the entire portfolio of hotels.

Conclusion

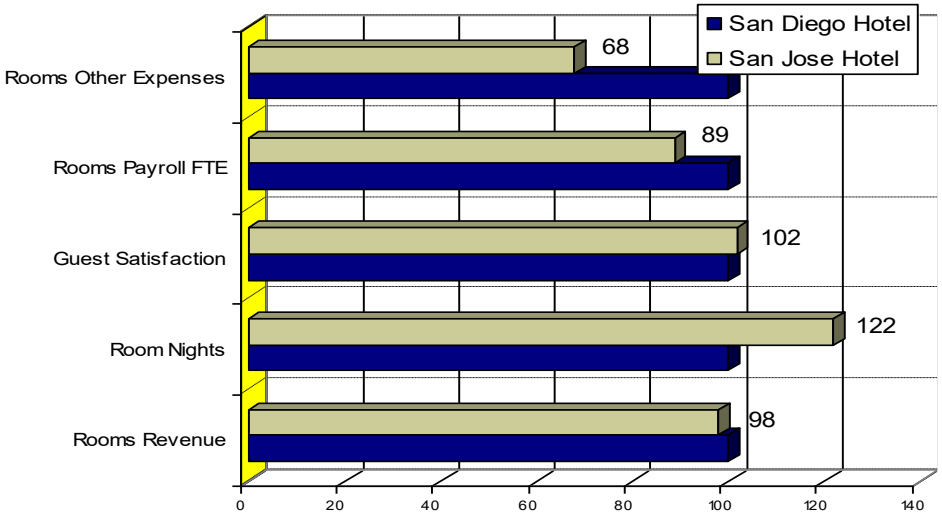
DEA enables hotel investors, owners and operators to:

- identify high performers to locate "best practices" .
- identify under-performers to locate "poor practices".
- set realistic, peer based improvement targets.
- identify the largest potential efficiency gains in a portfolio of hotels.
- provide management with an analytical tool to help allocate resources more effectively.
- inform strategy development.
- monitor efficiency changes over time, and
- identify where to give rewards for good performance.

DEA allows the incorporation of many different factors in a single process, so that an overall performance score is produced instead of a plethora of separate ratios, which can be difficult to compare.

For hotel owners, operators and investors, whether the objective is higher profits or higher overall shareholder value or larger market share and/or more satisfied customers, DEA provides a useful additional analytical tool to better understand relative performance and efficiency, as well as help identify specific areas of improvement

Exhibit 5: DEA Output, Reference Comparisons



The Mathematics of Hotel Productivity and Efficiency Using DEA

Hotel productivity can be defined as the ratio of weighted sum of outputs to weighted sum of inputs. Assuming controllable inputs and constant returns to scale, the productivity of a hotel can be written as Equation 1. While a hotel's outputs and inputs can be measured and entered in this equation without standardization, determining a common set of weights can be problematic at best. Hotels may well value outputs and inputs quite differently. This potential problem is addressed through optimization in the following CCR model.

$$P_o = \frac{\sum_{r=1}^{s} U_r Y_{ro}}{\sum_{i=1}^{m} V_i X_{io}} \qquad \text{Equation 1}$$

where s = number of outputs (e.g. room nights, total revenue, guest satisfaction, etc.)
U_r = weight of output r
Y_{ro} = amount of output r produced by the observed hotel
m = number of inputs (e.g. payroll hours, number of rooms, etc.)
V_i = weight of input i
X_{io} = amount of input i used by the hotel

$$\text{Maximize } P_o = \frac{\sum_{r=1}^{s} U_r Y_{ro}}{\sum_{i=1}^{m} V_i X_{io}} \qquad \text{Equation 2}$$

$$\text{subject to : } \frac{\sum_{r=1}^{s} U_r Y_{rj}}{\sum_{i=1}^{m} V_i X_{ij}} \le 1 \text{ for each hotel in the sample}$$

where $j = 1, \ldots, n$ (number of hotels).

$$\text{Maximize } P_o = \sum_{r=1}^{s} U_r Y_{ro} \qquad \text{Equation 3}$$

subject to

$$\sum_{i=1}^{m} V_i X_{io} = 1$$

$$\sum_{r=1}^{s} U_r Y_{rj} - \sum_{i=1}^{m} V_i X_{ij} \le 0$$

$$U_r, V_i \ge \varepsilon$$

$$\text{Maximize } P_o = \sum_{r=1}^{s} U_r Y_{ro} + C_o \qquad \text{Equation 4}$$

subject to

$$\sum_{i=1}^{m} V_i X_{io} = 1$$

$$\sum_{r=1}^{s} U_r Y_{rj} - \sum_{i=1}^{m} V_i X_{ij} - C_o \le 0$$

$$U_r, V_i \ge \varepsilon$$

CCR Model

Charnes, Cooper and Rhodes (1978)[i] addressed the problem by allowing a hotel to adopt a set of weights that will maximize its productivity ratio without the same ratio for other hotels exceeding 1. Introduction of this constraint converts the productivity ratio into a measure of relative efficiency. The earlier equation can be re-written in the form of a fractional programming problem as Equation 2. Equation 2 represents the *ratio form* of DEA. However, Equation 2 has an infinite number of solutions. To avoid this problem, we convert Equation 2 to the more familiar components of a linear programming problem. In Equation 3, known as the *multiplier form*, the denominator is set to a constant and the numerator is maximized.

In order to prevent an output or an input being mathematically omitted in calculation of efficiency, the smallest value weights U and V are permitted to have are non-zero small positive numbers (e). Equation 3 represents constant returns to scale with controllable inputs. It is a primal linear programming problem that models *input contraction*.

BCC Model

Banker, Charnes and Cooper (1984)[ii] introduced a new variable in the CCR model that allowed the measurement of technical efficiency without scale efficiency i.e. pure technical efficiency. The BCC primal linear programming problem is depicted in Equation 4. The variable returns to scale model that allows for the effect of uncontrollable inputs was developed by Banker and Morey in 1986.[iii] While it is not shown here, it is probably the most relevant approach to assessing the relative efficiency of hotels.

I Charnes, A., Cooper, W.W. and Rhodes, E. (1978) Measuring the Efficiency of Decision Making Units. *European Journal of Operational Research* **2**, 429-444.

ii Banker, R.D., Charnes, A. and Cooper, W.W (1984) Some Models for Estimating Technical and Scale Inefficiencies in Data Envelopment Analysis. *Management Science* **30** (9), 1078-1092.

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Hotel Investment Strategies is a global hotel investment advisory firm that uses pioneering analytical techniques and innovative quantitative methods to assist investors and managers of hotels, eliminate costly surprises, make better decisions, and add business value to their bottom line.

With an office in **Greater New York** and a representative office in **Jakarta**, **Indonesia**, the firm services its clients, which include banks, private investors, REITs and hotel management companies, in the United States, South-East Asia, Australasia, Europe, and Dubai.

The firm's Founder & CEO is Ross Woods, an experienced hotel investment advisor with over 30 years of global experience in the acquisition, development, management, and disposition of hotel and related hospitality real estate assets.

He has broad experience evaluating investment opportunities with start-up, workout, turnaround, and high-growth hotel investments and making profitable investment decisions.