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Abstract

Purpose: Restaurant revenue management practices and profit optimization techniques are evolving into more complex data analysis processes. The "big data" revolution has created a wealth of information on revenue, pricing, key operational performance indicators, and various productivity/efficiency variables. Advanced research analysis that can identify these key factors across multiple operating units may be useful to restaurant managers unaccustomed to data analytics or those seeking a deeper understanding of unit-level business performance. The overarching goal of this study was to utilize mixed research methods across conceptually dissimilar units of a multi-unit chain restaurant, enabling researchers to build on the resulting outcomes and restaurant operators to apply it to optimize unit-to-unit profit.

Design/Methodology: A mixed research methodology was used to evaluate multidimensional operating efficiencies and labor productivity across multiple restaurant concepts. Data envelopment analysis (DEA), between-unit multidimensional analysis, and within-unit ratio analyses were utilized. While DEA was applied as a primary diagnostic tool to identify productivity/efficiency benchmarking factors, supplemental between- and within-unit measures provided more in-depth information regarding the effects of operating expense variables.

Findings: Restaurant analytics that effectively measure input and output variables between and within multiple units promote a data-rich organizational culture. For the small multi-unit organization that was the focus of this study, this is certainly the case. DEA diagnostic results to inform targeted analysis to particular units of operation indicated that all units are operating at maximum efficiency in terms of generating sales given the respective numbers of seats and square footages. However, subsequent analyses indicated multiple problems in terms of expense management. This same approach may help other operators optimize operations.

Originality/value: The proposed model provides restaurant operators the opportunity to identify the impact of different operating expense variables and their impact on overall profitability. The use of the polygon analysis in itself makes complex sensitivity analysis of certain operating variables to profit outcomes a much easier process. We recommend other operators perform similar analyses in order to enhance operational productivity.

Keywords: restaurant analysis, data envelopment analysis, productivity/efficiency factors

Introduction

The hospitality industry has always sought to maximize productivity and efficiency. Given the sheer volume of data available to restaurant operators today, alternative methods of analysis are necessary to extract and synthesize information with the intent to improve operational performance. In foodservice, given decreasing profit margins and increasing worldwide competitiveness, interest in optimizing profitability has never been greater.[1]

Numerous hospitality researchers have applied data envelopment analysis (DEA) to measure efficiency among units in multi-unit organizations and to establish benchmarks for these units. DEA is a non-parametric statistical application that includes multiple input and output variables used to establish productivity indexes for multiple units in various hospitality-related settings.[2] While prior studies have enriched our understanding of the benefits of using DEA, none has explored a small restaurant chain comprised of multiple concepts.

Restaurant financial performance is characterized by multiple variables or inputs related to productivity and operating efficiency. Therefore, input-output models deserve further consideration as viable analytic and diagnostic tools for identifying restaurant profit-optimization opportunities.[3] Further, because multiple combinations of inputs and outputs exist within a given restaurant chain, no previous study has tested every combination of operating statistics that are typically available to restaurant managers. This must be done in order to build the best possible input-output model, one that identifies opportunities for productivity and efficiency improvement at the unit level when other indicators (food, labor, and other expenses) show no apparent operational shortcomings. Once overarching performance indicators are identified across a common frontier, more targeted analysis of performance at each of the operating units can strengthen the overall results. This targeted, multidimensional analysis can provide deeper insight into the strengths, weakness and opportunities for improvement practices across multiple operating units.

The purpose of this study was to employ mixed research methods by applying three different statistical analyses: DEA, between-unit multidimensional polygon analysis, and within-

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[1] As Ahrens and Chapman (2004) reported, the maximization strategy is particularly advantageous when applied in a multi-unit restaurant setting.

[2] Reynolds (2003) underscored the importance of productivity assessment in the hospitality industry and recommended data envelopment analysis (DEA) as an appropriate research approach.

[3] Gronroos and Ojasalo (2004) posited that measuring productivity in the restaurant service process is related to how effectively input resources are transformed into perceived value for customers.

unit ratio analyses to evaluate key operating expense performance indicators.[4] DEA was used as a diagnostic tool in concert with multidimensional factor and data ratio analyses to explore relevant combinations of operating metrics and efficiency outcomes across multiple diverse dining concepts. Future researchers will be able to build on the results of this research, and restaurant operators will be able to apply the results in order to optimize unit-to-unit profit.

Background

This study focused on multi-unit restaurant operations. While such operations exhibit many common characteristics in terms of productivity levels, labor costs, cuisine positioning, service styles, and physical footprints, they often vary in production/efficiency outcomes across multiple units. As noted earlier, research surrounding the productivity and efficiency of hospitality services is gaining in importance with the development of viable research models.[5] A multidimensional approach has the advantage of analyzing several factors at the same time in order to identify and assess multi-unit performance productivity. Variables such as cost of goods sold and labor management efficiencies or lack thereof may be used in the analysis. The multidimensional research approach considered in this study has several benefits including: (1) restaurant managers can analyze any quantifiable cost attribute, (2) restaurant managers can analyze more than one or two cost attributes at a time, (3) the "unit free" scale enables meaningful comparison of select factors and profit performance, and (4) restaurant managers can use a comprehensive labor cost variable across multiple departments to benchmark acceptable ranges of performance.[6]

Applying DEA and multi-factor polygon analysis as part of a multidimensional research analysis to restaurant operations requires a clear understanding of the overall operating environment. In addition to traditional operating variables and financial ratios associated with food cost, labor cost, and other expenses, the more advanced approach to restaurant analytics and profit optimization proposed in this paper involves utilizing both DEA and targeted unit-level

[4] Drawing from conventional literature on restaurant revenue management, key performance indicators such as RevPASH (revenue per available seat hour), demand trending, mix of sales, and multi-factor polygon analysis were utilized (Kimes, 2004; Kimes & Wirtz, 2002; Susskind, Reynolds, & Tsuchiya, 2004; Cohen, Mesika, & Schwartz, 1998).

[5] The researchers cite O'Donnell, Rao, & Battese (2008) for introducing the concept of metafrontier analytics to measure productivity in service industries and Oh and Lee (2010) for refining this approach. Similarly, the metafrontier approach or data envelopment analysis has been applied by researchers to estimate hotel efficiency and productivity (Hsieh & Lin 2010; Salman Saleh, Assef, & Son Nghiem, 2012; Chiu & Huang, 2011; Chung & Kalnins, 2001).

[6] According to Cohen, Mesika, and Schwartz (1998), "by plotting these factors as a polygon on a radar chart, allows restaurant managers to consider more than two attributes at a time when devising optimal performance benchmarks" (n.p.).

analysis to evaluate a broader spectrum of factors. These factors include square footage, seating areas, parking, customer flows (i.e., reservations, cancellations, walk-ins), rent, management fees, gross profit, corporate overhead, real estate taxes, RevPASH, demand trending, and mix of sales. These variables suggest that it is possible to optimize multi-unit profitability through increased understanding of overall operational efficiency in specific units of an enterprise.

The large number of input and output variables associated with small-chain, multiple restaurant units makes it necessary to identify key similarities and differences across all operating units in order to identify unit-level profit-optimization opportunities, that is, the ideal profit output based on a meta-frontier of productivity compared to various operating efficiency benchmarks.

Methodology

A small chain located in the eastern United States was selected for this study. This chain was selected because it represented a new generation of restaurant companies that are seeking market share in a given geography by operating multiple yet dissimilar units within an urban setting. These units operated in multiple dayparts and showcased distinct cuisines or concepts (e.g., a steakhouse and a seafood bar). The company, which included five restaurants, was also selected because the researchers were given full access to the firm's financial data, including multiple performance metrics. Key indicators are provided table 1 in order to illustrate differences while protecting the company's anonymity.

Table 1: General Restaurant Information Multi-Unit Comparisons

Unit #	Square Footage	Number of Seats	Food Cost %	Food Sales (000s)	Beverage Cost %	Beverage Sales (000s)	Labor Cost (000s)	Net Income (000s)
Unit 1	8,000	240	46.34	$21,509	24.90	$10,640	$7,883	$1,670
Unit 2	10,000	200	44.52	$8,959	23.40	$3,541	$3,148	$869
Unit 3	8,000	140	38.99	$4,464	23.15	$2,224	$1,886	$134
Unit 4	6,000	299	33.23	$3,665	20.49	$3,191	$2,253	($306)
Unit 5	12,000	500	27.19	$6,267	25.39	$4,033	$3,143	$835

The researchers identified the following potentially viable input and output factors: number of days open per year, availability of valet parking (more important in urban locations), number of seats, interior square footage, hours of operation, number of annual covers per dining area (e.g., bar, dining room, outdoor dining), total annual covers, food cost, beverage cost, food lost to spoilage, back-of-the-house labor, front-of-the-house labor, bar labor, other labor, corporate overhead labor, total labor, rent, expenses related to supplies, repairs and maintenance, other operating expenses, complimentary food and beverages in dollars, management fee, total expenses, operating income, other revenue, taxes, and net income.[7]

To avoid problems with collinearity when applying DEA, inputs should not be correlated to one another, and outputs should not be correlated with any other variables.[8] On the other hand, each input must be statistically correlated to at least one output. A related concern stems from the small number of restaurants in this study given the DEA convention whereby the number of inputs multiplied by the number of outputs must be less than twice the number of units in the analysis. Prior to conducting the analysis, the researchers determined the correlations among input and output variables.

In terms of correlations, the number of seats was significantly correlated with the number of annual covers (r = .93, p < .05). With the exception of *other* expenses¸ there was a statistically significant correlation between every pair of expenses (min. r = .90, p < .05). Moreover, food and beverage costs were significantly correlated with the respective sales categories (r = .99, p < .05 for both) and food, beverage, and labor costs were highly correlated with sales (min. r = .98, p < .05). Operating income was highly correlated with food cost (r = .93, p < .05) and labor cost (r = .88, p < .05). Finally, net income was significantly correlated with food sales (r = .89, p < .05) and corporate labor cost (r = .93, p < .05).

After determining appropriate correlations and following the DEA process, the authors conducted a within-unit between-unit multidimensional polygon factor analysis.[9] For the multidimensional profile of each of the five restaurant unit(s) operating expense variables were normalized and plotted on a polygon radar chart. The key operating expense variable for each unit level was assessed by comparing its polygon profile to the acceptable polygon profile based on all operating units within the chain and compared to industry standard benchmarks provided by the National Restaurant Association. The resulting polygon graphical outputs illustrate whether the particular unit's operating expense variable(s) fall within the acceptable or best

[7] Following Reynolds's (2003) recommendations, the researchers explored the potential input and output factors for each restaurant.
[8] As noted by Reynolds and Thompson (2007), a test for correlations is needed.
[9] The multidimensional operating expense factor analysis was adapted from the Cohen, Mesika, and Schwartz (1998) polygon menu item/menu contribution research methodology.

practice range among all the units in the chain. See Annex 1 for an example using the polygon graphical outputs.

Results

Due to the aforementioned collinearity with potential input and output factors, conducting a complex DEA was not possible. However, utilizing simple DEA diagnostic results to inform targeted analysis to particular units of operation indicated that all units are operating at maximum efficiency in terms of generating sales given the respective numbers of seats and square footages.

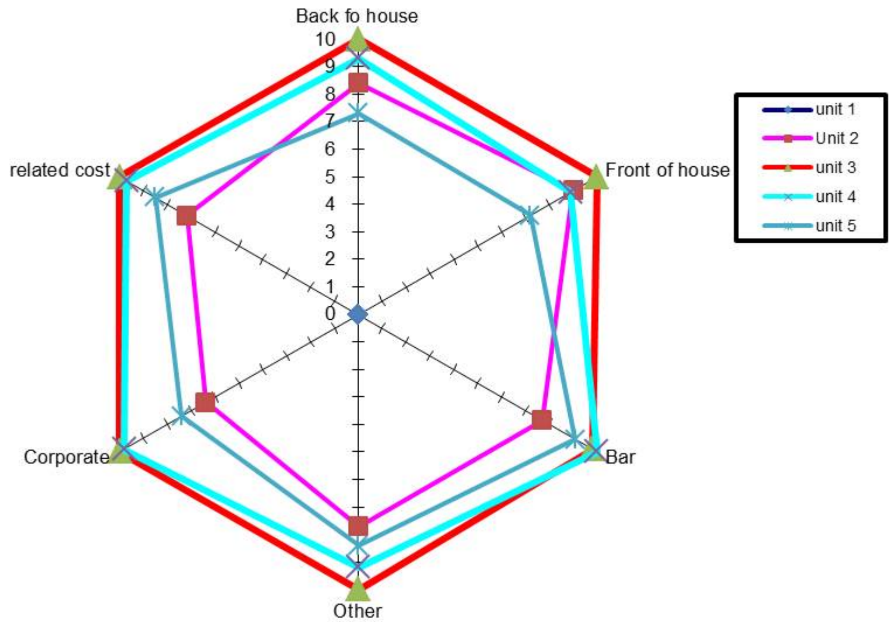
Phase II of the research sought to extend the investigation through between- and within-unit analysis of opportunities utilizing multidimensional polygon analysis.

The between-unit analysis focused on labor costs that were consistently expensed across all five operating units. Those labor cost attributes were broken down into six variables: (1) Back of the house, (2) front of the house, (3) bar, (4) corporate, (5) related, and (6) other. Due to the wide range of labor cost dollars across all units, normalization calculations were performed to establish the acceptable efficiency scales to be plotted on the polygon axis (depicted in Table 3).

The between-unit analysis depicted in Figure 1 depicts unit 1 at zero since it has the highest labor costs of all units in all labor variable factors. The labor variable factors are based on normalization calculations and scaling from 0-1 as unsatisfied with 5-10 as ideal. Additionally, unit 3 reflects the ideal labor variable performance in other reported areas between all units. Whereas, unit 2 indicates least ideal labor cost performance in both back and front of house as well as bar, other and corporate labor costs.

The within-unit analysis of unit 1 yielded by the DEA methodology indicates potential improvement of 10% by more effectively maximizing total sales (relative to the other four units). To further address the sales opportunity for unit 1, a multi-year, demand-trending RevPASH analysis was conducted to identify high/low demand periods and map revenue per seat hour. Annual demand patterns indicated that October was the peak month for sales on an annual basis; however, the most recent (2012) performance figures reflect the weakest monthly cover output for the past three years. Unsurprisingly, overall demand for unit 1 is variable with the lowest annual quarter-to-quarter demand period being quarter one (Q1). Taking into account the DEA analysis that reflected a potential 10% efficiency improvement for unit 1 in sales, the restaurant's

Figure 1: Between-Unit Labor Cost Polygon Chart



operators must decide whether to increase revenues in low demand periods or in high demand periods, or both.

Furthermore, within-unit analysis of unit 1 reveals a similar pattern for October RevPASH. Interestingly enough, unit #1 RevPASH declined at a 2.8% higher rate than demand for the same three-year period, with demand declining only 1.8%. This would further confirm the demand trend and signal to these operators that there may be an opportunity to drive sales efficiency during their highest demand month of the year, as well as their overall first quarter.

Supplemental margin/ratio unit-level labor analysis of unit 4 indicates that they exhibited slightly lower labor output efficiency than the other units in terms of labor management in the front- and back-of-house factors. Trending in labor management for unit 4 indicates that there are significant issues regarding both front- and back-of-house labor productivity. Unit 4 in particular is shown to have the highest combined overall labor expense margin at 33.6%, almost twice the level of unit 3, which operates the most efficiently of all units in the system at 15.0% total labor expense. However, unit 4 does show favorable bar labor efficiency as compared with the other units. Still, the annual net income loss of $306,000 or -5.2% can be attributed primarily to unfavorable labor productivity output as compared with other units.

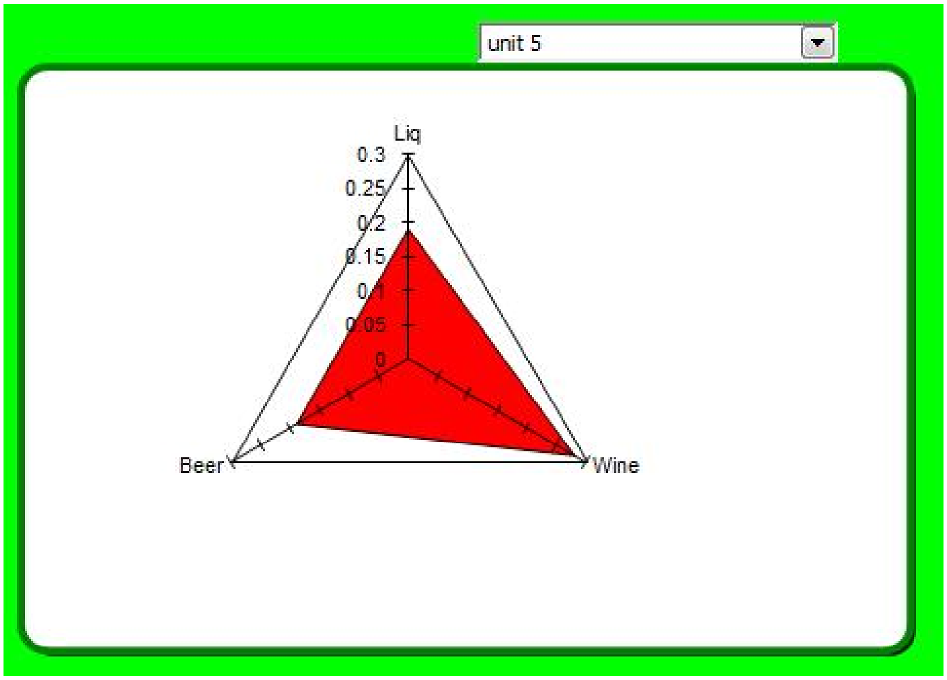
Additional targeted analysis of unit 4 indicated a peculiar relationship between total revenue mix and net income losses (Table 2). Insofar as unit 4 shows a high margin ratio of beverage sales to food sales of 45.5%, the corresponding net income should have been more favorably affected when compared with other operating units in the chain. Results shown in Table 2 indicate that unit 4 had the second most efficient food cost of goods sold margin at 33.2%, with the lowest among the operating units at 27.1% and the highest at 46.3%.

Table 2: Unit 4 Net Income Annual Output/Overall Mix of Sales Multi-Unit Comparisons

Unit	Food Sales (000s)	FCGS %	Beverage Sales (000s)	BCGS %	Total Sales (000s)	Bev to Total Sales mix %	Net Income (000s)	Total Net Income %
Unit 1	$21,509	46.3	$10,640	25.2	32,149	33.0	$1,640	5.1
Unit 2	$8,958	44.5	$3,541	23.1	12,500	28.3	$869	6.9
Unit 3	$4,463	38.9	$2,223	23.5	6,687	33.2	$134	2.0
Unit 4	$3,665	33.2	$3,191	20.4	$6,856	46.5%	($306)	(-5.2)
Unit 5	$6,266	27.1	$4,032	16.5	10,299	39.1	$956	9.2

According to the benchmark operating expense margins from the NRA, the researchers established benchmarks to evaluate restaurant operations in terms of beverage cost margins. The lower quartile of overall beverage cost margin is 0.2, which means the costs are lower than the benchmark. The upper quartile of it is 0.25, which means the costs are higher than the benchmark. Given the ideal net operating income and beverage performance of unit 5, further within-unit analysis of beverage mix-cost margin revealed the ideal range achieved by liquor, followed by beer and wine categories (Figure 2). Given the lower cost margin of liquor, unit 5 and its associated high beverage sales appears to be driving the high net operating income performance.

Figure 2: Beverage Mix Margin of Unit 5



Discussion

Multiple-unit diagnostic research provides restaurant operators with the opportunity to undertake more robust corrective actions and improvement strategies to optimize profits. At the core of DEA analysis and multidimensional polygon analysis is the capability to identify factors and key operating cost margin factors and compare those factors with overall unit productivity/efficiency performance. Subsequently, the identified factors can be broken down into either controllable or uncontrollable variables in analyses that identify necessary actions. Restaurant managers can focus on operating cost variables that fall under their control to improve operating productivity and efficiency.

In this particular study, DEA and between-unit, targeted unit-level analyses alerted a small chain restaurant to those key performance indicators that need improving across individual units. Based on NRA's benchmarks, the operations of all five units are not at optimal efficiency. However, among the five units, unit 2 operates most efficiently. The first three units are faced with food and beverage cost problems. Unit 4 and unit 5 are faced with labor cost problems. Specifically, although unit 1 had the highest annual sales of $32,149,000 and net income of $1,640,000 or 5.1%, it has a greater opportunity for top-line sales improvement in relation to its expense output during both peak and low-demand periods. Furthermore, unit 4, despite achieving exceptional beverage revenue mix of sales on the top line, still suffers from significant annual net income loss of $306,000. Framing these operational problems in terms of input/output variables and key operating expense margins, comparative factors across multiple units more clearly illustrated that unit 4 was the least efficient of the five units in the chain. Comparative benchmarking of key performance indicators across all operating units in the chain indicated that unit 4 could improve its net income through increased focus on labor efficiency and productivity while still maintaining favorable mix of sales and cost of goods sold contribution margins.

This study contributes to existing research in this area by providing a step-by-step method for researchers and industry practitioners to identify the ideal combination of inputs and outputs, an acceptable or ideal profile for unit performance, and an in-depth consideration of target areas beyond typical management metrics (see Table 3). Moreover, operators can apply the same operational analyses to enhance operational productivity.

Table 3: Summary of Research Sequence

Research Question(s)	Analyses	Implications
Which combination of inputs and outputs provides the best possible input-output model?	*Phase 1:* Data envelopment analysis (DEA)	Able to determine which inputs/outputs (beyond typical factors) that should be considered by restaurant operators
What is the acceptable or ideal polygon profile for each unit compared to other units? Compared to industry benchmarks?	*Phase 2:* Multi-factor polygon analysis	Able to determine if units fall within acceptable or best practice ranges
When focus areas are determined based on Phase 2, can additional strengths, weaknesses, and opportunities be determined with further ratio analyses?	*Phase 3:* Data ratio analyses	Able to identify target areas between units and within units

Implications for Practice

Restaurant analytics that effectively measure input and output variables between and within multiple units promote a data-rich organizational culture. For the small multi-unit organization that was the focus of this study, this is certainly the case. The next step is to build on the findings reported here using multi-year data. The goal continues to be the enhancement of operational productivity/efficiency and, ultimately, profit optimization through the application of research diagnostics and targeted analysis.

For multiple operating units, when the operating environment consists of similar operating units using similar technologies and delivery platforms, productivity/efficiency assessment using the same efficiency frontiers and applying multidimensional polygon analysis may become more useful. The proposed model provides restaurant operators the opportunity to identify the impact of different operating expense variables and their impact on the overall profitability. The use of the polygon analysis in itself makes complex sensitivity analysis of certain operating variables to profit outcomes a much easier process.

When the DEA analysis indicates a need to improve a specific unit's sales, the restaurant operators can take this information and begin discussions on how to generate additional revenue. For example, the restaurant's operators may determine whether they want to increase revenues in low demand periods through promotions/packaging/product offerings or during high demand periods with higher yield sales through price increases, or both. The within-unit analysis allows practitioners to compare results from a short timeframe (a month) with results from a longer period (a quarter, a year, multiple years) in order to identify trends. This comparison would signal operators to make changes to improve or continue the identified trend. Results that indicate problems with labor management also allow practitioners to make corrections that will improve productivity. Industry benchmark comparisons can also assist operators with making positive corrections to improve performance. Other practical implications are based on the inputs and outputs selected for the analysis.

In this case, to optimize profitability, it behooves restaurant operators to analyze the productivity/efficiency of each operational unit against an idealized level (frontier) of efficiency and conduct targeted within-unit research analysis. DEA is particularly well suited to doing just that and, in concert with multidimensional polygon analysis, offers a rare opportunity to implement such profit-optimization techniques across multi-unit restaurant operations that are readily accessible and visual in nature.

Annex 1
Theoretical Underpinnings

The expanding role of large amounts of data and analytics in today's business environment suggests that more advanced measurement, diagnostics, and modeling of restaurant input/output and operating margin variables requires an expanded focus within the hospitality industry. Additionally, the increased expectations of investors and corporate executives seeking to sustain accretive financial performance is driving operators and researchers alike to consider developing more sophisticated yet practical data analytics processes at both the operating and executive levels of an organization.

Example of relevant, current studies with similar analyses include, Sigala (2004) used DEA in a benchmarking study in the lodging sector; Taylor, Reynolds, and Brown (2009) applied DEA in a study of menu engineering; and Choi, Roh and Yoon (2007) used DEA to examine productivity in a chain restaurant, albeit one that differs from the one we investigated for this study. Other applications of DEA to the foodservice industry include Joo, Billington, and Stoeberl (2012), who explored labor management in restaurants; Reynolds and Thomson (2007), who assessed a three-phase DEA approach in a restaurant setting; and Reynolds and Taylor (2011), who integrated DEA with a structural equation model.

The restaurant analytics literature has centered mostly on traditional revenue management components such as meal duration management, pricing, reservation activities, menu engineering, table mix, and process control changes (Anderson, C.andXiaoqing, X. 2010; Kimes, 2004). Common variable measurement practices and data analytics used in restaurants today are somewhat customer-centric, focusing on loyalty, market segmentation, social media, and top-line-oriented strategic pricing approaches (Yanjin and Yang, 2000). Nevertheless, other hospitality researchers approach restaurant analytics from a revenue/profit-optimization perspective, heavily emphasizing the importance of demand-based forecasting processes and dynamic pricing models (Cross, Higbie, and Cross, 2009) or with a primary emphasis on the importance of cost-margin analysis (Pavesic, 1983).

Regarding the restaurant industry, in particular, Reynolds and Biel (2007) introduced DEA as a holistic productivity metric designed to measure productivity and efficiency across a chain of 336 restaurants. In their paper, they called for further exploration of productivity and efficiency analytics pertaining to both traditional and newly emerging factors. Using DEA methodology, they found employee satisfaction a highly volatile input for optimizing operational capacity (output).

Noting the importance of managing changes in production resources and production systems and their impact on service delivery, service productivity as a function revolves around how effectively input resources into the service (production) process are transformed into outputs in the form of services (internal efficiency), how well the quality of the service process and its outcome is perceived (external efficiency or effectiveness), and how effectively the capacity of the service process is utilized. Given the key role of labor management it is essential that restaurant operators manage labor costs in a manner that facilitates the goals of minimizing dining duration and maximizing customer throughput during variable customer demand periods. There exists a fine balance between understaffing and overstaffing service and production personnel. Adequate staffing is necessary to achieve customer satisfaction levels without impinging on financial returns. The negative impact of understaffing on the quality of customers' experiences is likely to result in lost business and associated revenue. Overstaffing on the other hand, while not likely to interfere with duration management strategies and customer satisfaction, will result in unnecessary labor costs that counteract the profit impact of any efforts to increase revenue (Reynolds and McClusky, 2013)

Methodological Approach

When evaluating labor cost, although all attributes of labor cost are of the same scale (dollars), the dollar amounts are too large. Therefore, normalization calculations were necessary to create a more manageable factor to compare between multiple operating units with dissimilar concepts. Normalization is a straightforward process and was calculated as follows: for each labor factor, a range was defined such that all values of the labor factor were included. Predetermined minimum and maximum values were obtained from the restaurant's financial statements. For each factor, these were the highest and lowest labor cost dollar figures. For example, if the lowest unit-labor cost of back of the house labor was $612,540 and the highest was $2,201,451, then the labor cost range was: $2,201,451–$612,540 or $1,588,911. Finally, to normalize the labor cost factor's value, the researchers used a predetermined scaled range [N_0, N_1]. The scaled ranges were N_0=0 and N_1=10. For factors such as labor cost where a lower value is associated with better performance, Zij, the normalized value of factor i of labor cost j is given by the following equation:

$Zij = (Max- Vij) / Ri * (N_1 – N_0) + N_0$

Where, Vij denotes the value of factor I of labor cost j (e.g., the labor cost of back of the house). Max denotes the upper boundary of the labor cost factor range. Min denotes the lower boundary of the labor cost factor range. Ri = Max – Min denotes the labor cost factor range. Therefore, the actual formula was:

*(2,201,451-873,825)/ (2,201,451-612,540) * (10-0) + 0 = 8.36.*

For the subject operating unit example, consider the labor cost of back of house ranges between $612,540 and $2,201,451, and the labor cost of back house unit 2 is $873,825. On a 0 to 10 scaled range, the labor cost of back of the house in unit 2 is 8.36. The researchers set 10 scales to measure the idealness of cost and profit. 8.0-10.0 is ideal and under 5.0 is unsatisfactory. The cost numbers of unit 1 are 0, which means that the labor costs in unit 1 are the largest.

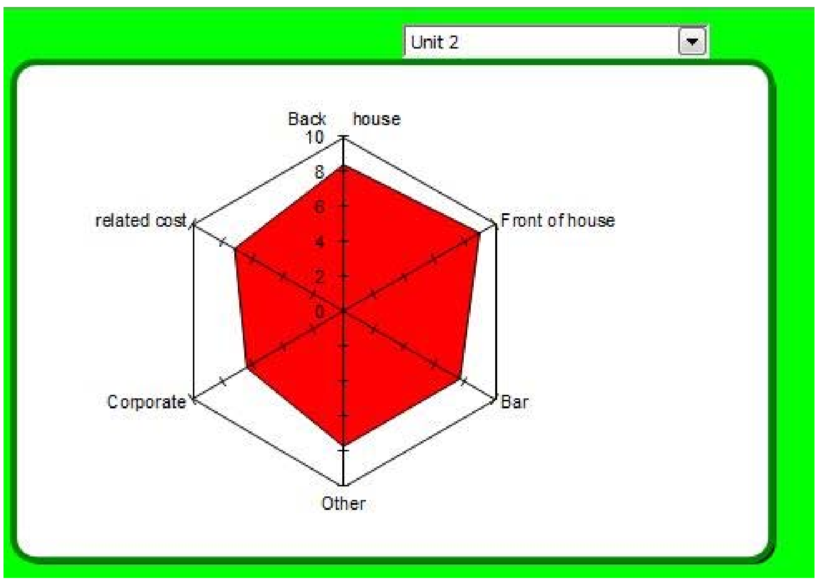
Annex 1, Table 1: Multi-unit labor cost normalization calculation

	Back of House	Front of House	Bar	Other	Corporate	Related Cost	Total Labor
Unit 1	$2201451	$1445096	$461138	$1496316	$457514	$1821794	$7883309
Unit 2	$873825	$485466	$169128	$570857	$219903	$829057	$3148236
Unit 3	$612540	$375561	$90897	$286525	$85826	$434792	$1886141
Unit 4	$717375	$495356	$81376	$387634	$93538	$477667	$2252946
Unit 5	$1047639	$675163	$113920	$479935	$180847	$645723	$3143227
Normalized the Cost							
Max	$2201451.00	$1445096.00	$461138.00	$1496316.00	$457514.00	$1821794.00	
Min	$612540.00	$375561.00	$81376.00	$286525.00	$85826.00	$434792.00	
							profit
Unit 1	0.00	0.00	0.00	0.00	0.00	0.00	10.00
Unit 2	8.36	8.97	7.69	7.65	6.39	7.16	2.20
Unit 3	10.00	10.00	9.75	10.00	10.00	10.00	0.00
Unit 4	9.34	8.88	10.00	9.16	9.79	9.69	0.22
Unit 5	7.26	7.20	9.14	8.40	7.44	8.48	2.14

In order to explain how to build the multidimensional operating efficiency profiles, consider the following simple example: Given that various costs of multiple restaurant units have a set of attributes, one can constructed attribute axis plots based on the attribute levels, as shown in Figure 1.

Operating Expense Factor (Attribute)	**Level**
Back of House Labor	BOH (%)
Front of House Labor	FOL (%)
Bar Labor	BL (%)
Other Expenses	OE (%)
Related Costs	RC (%)
Corporate Expense	CE (%)

Annex 1, Figure 1: Operating Efficiency Polygon Radar Chart



Source: Cohen, Mesika, and Schwartz (1998).

In the example in the present study, the six operating expense attributes are expressed in normalized values on a scale of 0-10, given 0 as least efficient and 10 as most efficient operating level. One would assume that lower unit-level labor costs have a favorable impact on unit-level profitability. In order to effectively measure the attributes or factors that compose the key labor cost profiles of each unit, normalization is necessary to deal effectively with the different scales.

Normalization of these labor cost values enables the polygon tool to illustrate performance levels across multiple units against an ideal factor profile. Once all attributes are translated to a standard scale; the shape and size of the polygon becomes more meaningful. For example, an asymmetric polygon indicates that, compared to other labor cost attributes, one or more factors have a peculiar level—either significantly higher or significantly lower. In the symmetric profile, all attributes have similarly normalized values (Cohen, Mesika, and Schwartz, 1998).

Annex 2

The following table includes the benchmarks for operating expense variables used in the study. These benchmarks were obtained from the National Restaurant Association.

Annex 2, Table 1: National Restaurant Association-Benchmark Operating Expense Variables

Attribute	Lower Quartile	Median	Upper Quartile
COGS			
Food	30.8%	35.0%	42.0%
Beverage	25.9%	30.0%	34.8%
Combined	30.2%	33.9%	39.0%
Operating Expenses	6.0%	15.0%	28.2%
Labor Cost	28.3%	34.7%	41.4%

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