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Menu Analysis: A Review of Techniques and Approaches

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Abstract
This review discusses menu analysis models in depth to identify the models strengths and weaknesses in attempt to discover opportunities to enhance existing models and evolve menu analysis toward a comprehensive analytical model.

Keywords
Food Science, Menu Planning, Modeling

Menu Analysis: A Review of Techniques and Approaches

By James J. Taylor and Denise M. Brown

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Introduction

The menu drives purchasing and production decisions in all restaurant operations. Menu analysis models enable restaurateurs to systematically evaluate individual menu items by comparing each menu item to other menu items based on pre-selected criteria. Historically menu analysis models have included food cost, contribution margin and popularity or product mix. As many definitions of menu engineering and analysis exist as there are techniques. For example, LeBruto, Quain, and Ashley (1995) defined menu engineering as a methodology to classify a menu item by contribution margin and popularity. Cohen, Mesika, and Schwartz (1998) suggested menu sales mix analysis (often referred to as menu engineering) as a suitable managerial tool. Atkinson and Jones (1994) considered menu sales mix analysis a generic term that included approaches attempting to improve menu performance. These early definitions were expanded into a number of models to assess and manipulate (engineer) menus.

Before the advent of elaborate point of sale (POS) systems, cashiers tallied the sales of specific menu items for management to evaluate. (Kotschevar, 1994) Management developed a popularity index by determining the percentage of each menu item sold in a given period in comparison to the total of all menu items sold during that same period. Only specific predetermined menu items were chosen for evaluation.

Popularity indexes reflected the popularity of menu items but did not consider any cost information. Since popularity indexes represented simple percentages, comparison of percentages from one period to another was difficult. Often only a selection of the menu items was tallied during a specific production or service period. Total sales of menu items may have varied across these periods resulting in unequal comparisons based on differing menu item choices.

In an early attempt to improve on simple popularity indexes, Hurst's menu score was another menu analysis method frequently used prior to the implementation of POS systems. The Hurst menu score was obtained from the popularity percentage of a menu item based on similar menu items multiplied by the gross profit of the selected menu item. The popularity percentage was calculated by taking the total count of patrons choosing a menu item and dividing it into a total count of similar menu items being studied within a category of menu items, for example entrees. The resulting total became the menu score. (Kotschevar, 1994.)

Efforts to model the role and significance of menu composition using a matrix approach were devised to improve on these early methods of menu analysis. Miller (1987) was the first to develop a matrix model which focused on food cost and product mix to analyze menu item profitability without consideration of production costs. Kasavana and Smith (1982) used the Boston Consulting Group Portfolio Analysis as the basis for the Menu Engineering matrix approach to menu analysis. They incorporated contribution margin defined as the difference between the sales price of an item and the cost of food product to produce that item. This approach focused on flow-through dollars rather than on food cost percentages. Kasavana and Smith (1982) considered high gross profit and low food cost as mutually exclusive. Pavesic (1983) modified matrix models by both Miller (1987) and Kasavana and Smith (1982) by using food cost and weighted average contribution margin, which included popularity and contribution margin. Pavesic did not treat food cost percentage and gross profit as mutually exclusive components and used weighted gross profit/contribution margin to replace the individual menu item gross profit used by Kasavana and Smith (1982.) In doing so, Pavesic included popularity as an indirect third variable. To obtain the weighted gross profit, individual gross profit of each menu item was multiplied by the number sold. Pavesic's Cost/Margin model included an option of adding a "supplemental cost" to food cost. This theoretically could be used for a labor component or for packaging costs of carry-out food.

Hayes and Huffman (1985), LeBruto, Quain, and Ashley (1995), Cohen, Mesika and Schwartz (1998), and Horton (2001) have all attempted to include labor costs in menu analysis approaches. Hayes and Huffman developed an individual profit and loss statement for all menu components in an attempt to allocate all costs including labor and fixed costs to individual menu items. LeBruto, Quain, and Ashley were the first to consider categorical data to measure labor costs by segmenting the Menu Engineering matrix from four into eight quadrants to reflect high and low labor items. Cohen, Mesika, and Schwartz (1998) introduced a multidimensional approach that considered food cost, price, labor cost, popularity, and contribution margin to evaluate menu effectiveness. Attributing labor to specific menu items is inexact at best. Since multiple tasks are taking place in a restaurant operation at the same time where several different menu items are prepared simultaneously, allocating exact labor expenses becomes complex.

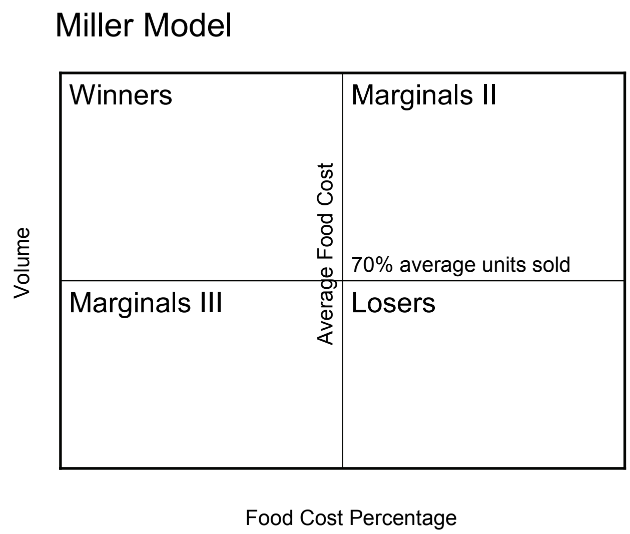
Bayou and Bennett (1992) proposed that fixed costs such as rent, utilities, and insurance should be excluded from the evaluation of menu items. Bayou and Bennett developed a profitability analysis model to evaluate the financial strength of menu items in an attempt to allocate variable costs such as labor. Horton (2001) segmented the menu prior to the analysis and evaluation of the menu into categories of comparable items for comparison. He modified the Kasavana and Smith model to include pure variable labor costs. Horton defined pure variable labor costs as those labor costs that could be calculated in the production of a menu item. However, Horton did not consider other production costs in the preparation process into his labor calculation such as the time it takes to cook a batch sauce in a pasta dish.

The Miller Model

The first model, the Menu Analysis model (MAM), was developed by Miller who attempted to identify menu items that were both popular and low in food cost. He introduced a four quadrant matrix for analyzing menus. Quadrants were segmented based on the product mix and food cost of the menu. The average food cost axis is defined as the line of division between high and low quadrants. An illustration of the Miller menu analysis model is depicted in Figure 1. Originally, Miller did not define a method to calculate the division line between high volume and low volume (defined as popularity). Later modifications of the MAM redefined the division axis to match the Kasavana and Smith model discussed next. Miller segmented high/low volume using the 70/30 percent mark with 30 percent defined as high volume and the remainder defined as low volume.

The division of the food cost axis between high and low was determined based on the average food cost of all menu items included in the analysis. Menu items falling into the quadrant named Winners, the most desirable quadrant, are high in popularity and low in food cost. Menu items located in the quadrant labeled Marginals II are high in both food cost and popularity. Retooling Marginals II recipes to decrease food cost or increasing the sales price can bring a Marginals II item into the Winners quadrant. Marginals II items may also be discarded if recipe modifications are not feasible or practical. Menu items classified into the Marginals III quadrant are low in food cost but lower in popularity as compared to the items in the Winners quadrant. Restructuring the menu placement of these items and adjusting advertising may increase the visibility of Marginals III menu items and popularity moving these menu items into the Winners quadrant. Finally, menu items grouped into the quadrant labeled Losers are high in food cost and low in popularity. Generally Losers menu items should be discarded from the menu. Following a menu analysis with the MAM and subsequent menu changes, a reanalysis of the menu is appropriate.

Figure 1: The Miller Matrix



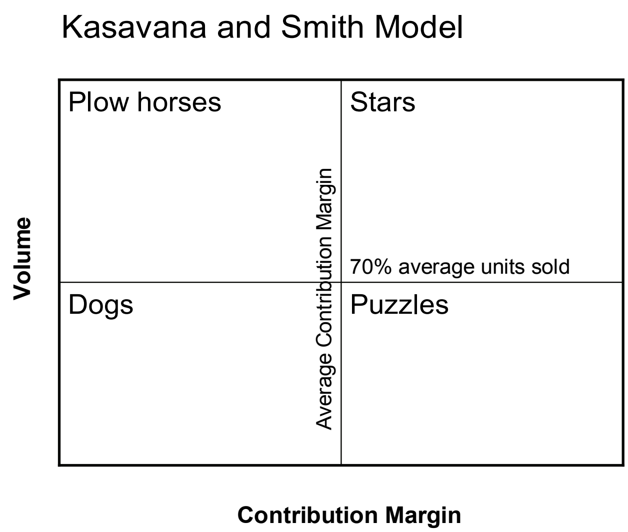
Model

Since menu items are categorized into quadrants based on average food cost and popularity, any retooling of the menu will cause menu items to shift relative to the original analysis. Some previously suitable menu items will fall into less desirable regions. No ideal distribution of Winners, Marginals II, Marginals III, or Losers was reported in the literature, however Miller suggested that 60% of the menu items in the Winners and Marginals III, the low food cost categories, was an appropriate goal.

Kasavana and Smith Model

A modification to the MAM was developed by Kasavana and Smith in 1982, depicted in Figure 2. Food cost on the x-axis was replaced with individual menu item contribution margin and average contribution margin replaced average food cost as the axis between quadrants. Contribution margin was defined as sales price subtracted from direct costs. Because contribution margin only consists of sales price less food cost in this analysis, contribution margin should be considered gross profit as defined by Generally Accepted Accounting Principals (GAAP). LeBruto, Quain, and Ashley addressed the impact of this misrepresentation of gross profit as contribution margin. When using contribution margin (gross profit) instead of food cost, the quadrants shift locations in the matrix relative to the MAM. The ideal menu item location in the Kasavana and Smith model is in the upper right quadrant instead of the upper left quadrant in the Miller model. This shift conceptually occurs because the higher the contribution margin of the menu item the more profitable the menu item. Conversely, in the Miller model the lower the relative food cost the more profitable the menu item. Average contribution margin, the x-axis in the Kasavana and Smith model, was calculated by taking the total weighted contribution margin (gross profit) and dividing it by the total number of units sold. The total weighted contribution margin (gross profit) was calculated by summing of the total contribution margin (gross profit) for each menu item and dividing the contribution margin by the total number of menu items sold. Total contribution margin (gross profit) for each menu item is calculated by multiplying individual menu item contribution margin (gross profit) by the number of units sold. The objective in using contribution margin (gross profit) to replace food cost was a shift in emphasis from raw costs to the profitability potential of a menu item.

Figure 2: The Kasavana and Smith Model



An inherent danger of minimizing food cost, however, was pointed out by Pavesic. A menu item designed from the perspective of achieving the lowest overall food cost percentage may cause an operation to sacrifice total sales revenues, Low cost items are generally low priced items and typically have low contribution margins (gross profit). Food cost does not focus management attention on maximizing sales per guest or on flow through dollars that cover other costs and eventually result in net income.

Kasavana and Smith renamed the quadrants in the revised model which became known as the Menu Engineering Model (MEM). The premise with the MEM is similar to the MAM with a goal to increase the profitability potential of the menu. The Winners quadrant was renamed Stars; the most desirable quadrant. These menu items have a high contribution margin (gross profit) with a high sales volume. The quadrant named Marginals II by Miller was renamed Plowhorses. These menu items have a high sales volume but a low contribution margin. The quadrant Marginals III by Miller was renamed Puzzles. These menu items have a high contribution margin (gross profit) but a low sales volume. The quadrant named Losers by Miller was renamed Dogs. These menu items exhibit a low contribution margin (gross profit) and a low sales volume. Menu decisions relative to the recipe and advertising changes based on quadrant categories are similar to those discussed with the MAM.

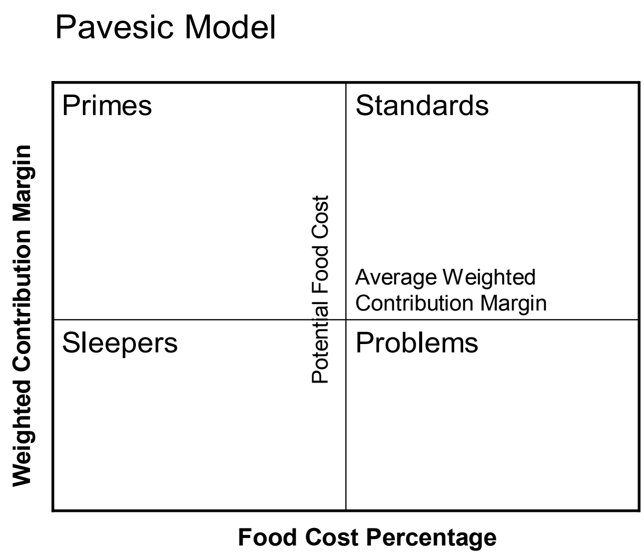
The primary limitation of both the MAM and the MEM relates to sales volume. Below an established minimum sales level, a menu item with a favorable contribution margin cannot generate sufficient profit to cover the total costs since contribution margin is not weighted by sales volume. (Bayou and Bennett, 1992; Dearden, 1978.) A second limitation is an inherent danger of using contribution margin in an effort to increase sales. This strategy may favor higher priced menu items that eventually decrease demand and total operational profitability.

Pavesic Model

In an attempt to overcome the shortcomings of using either food cost or contribution margin (gross profit) in menu analysis, Pavesic incorporated a weighted average contribution margin (gross profit), also called "profit factor," and food cost into the Cost Margin Analysis Model (CMAM). The profit factor variable combines contribution margin (gross profit) and sales volume previously addressed in the MEM. According to Hayes and Huffman and Pavesic, CMAM encompasses the three key elements of sales volume (popularity, food cost percentage, and dollar contribution margin). Including these three elements provides an unbiased perspective for making menu-pricing and positioning decisions.

In the CMAM the x and y-axis quadrants were renamed Figure 3. The CMAM model contribution margin is again defined as sales less food cost. The y-axis values are redefined as the weighted dollar contribution margin and the x-axis was renamed the potential food cost percentage. The weighted contribution margin accounts for the popularity of the menu item and the contribution margin (gross profit) by multiplying the contribution margin (gross profit) by the number of items sold. The average weighted contribution margin is the point of dissection on the y-axis from the high quadrant to the low quadrant. It is calculated by summing individual contribution margins for all menu items together and dividing that total by the total number of menu items sold. The potential food cost along the x-axis is used to segment the high and low food cost quadrants. Potential food cost is calculated by dividing weighted (total) food cost into the weighted (total) food sales as described with previous models. Mathematically, potential food cost is actually a weighted average food cost and is often called standard food cost by other authors. (Miller and Pavesic, 1996.)

Figure 3: The Pavesic Model



The quadrant named Primes contains those menu items with a low food cost and a high weighted contribution margin (gross profit). Primes are equivalent to the Winners in MAM and the Stars in MEM. The quadrant labeled Sleepers identifies menu items with a low food cost and a low weighted contribution margin. The decision process relative to recipe or menu changes mirrors the quadrant labeled Marginals III in the MAM and the Puzzles in the MEM. The quadrant with a high food cost and a high weighted contribution margin is labeled Standards. The menu item decision making process is comparable to the Marginals II in the MAM and the Plowhorses in the MEM. Finally, the quadrant with the high food cost and low weighted contribution margin called the Problems in the Pavesic model compares to the Losers in the MAM and the Dogs in the MEM.

The three models discussed are compared in a decision matrix (Table 1). Quadrant labels and menu decisions of the three models are included in the figure. The CMAM and MAM quadrants have similar meanings and locations in the matrix. As previously discussed, the MEM quadrants are transposed in location relative to the other two models. All three models focus on measures that include food cost and sales volume in varying degrees. However, none of the models effectively include other costs of production, most notably absent are labor costs. When labor is subsequently incorporated analysis, menu items previously grouped into the desirable quadrants in any of the three models may become less desirable and possibly undesirable from a profitability perspective. Likewise, menu items that group into less desirable quadrants without consideration of labor costs may move into a more profitable classification when labor costs are included. A similar argument can be made for the popularity factors such as menu design, marketing efforts, customer satisfaction, dining ambience, and other factors that are difficult to quantify. Since many other factors are more qualitative and often difficult to measure they are frequently excluded in menu analysis models.

Table 1:

Model	Author	Corresponding Quadrant			
Menu Analysis	Miller	Winners	Marginals II	Marginals III	Losers
Menu Engineering	Kasavana and Smith	Stars	Plowhorses	Puzzles	Dogs
Cost/Margin Analysis	Pavesic	Primes	Standards	Sleepers	Problems
Decisions(s)					
Option 1		Keep menu item as is	Reduce costs by retooling recipe	Promote menu item by advertising and/or menu placement	Delete menu item
Option 2			Increase price	Decrease price	
Option 3			Do nothing	Do nothing	
Option 4			Delete menu item	Delete menu item	

Hayes & Huffman Model

As an alternative to the matrix model format, Hayes and Huffman developed a method of menu analysis that focused on meeting net profit goals by creating profit and loss statements for each menu item. Their goal was to account for fixed and variable costs to overcome flaws of the three aforementioned matrix menu analysis models. Variable costs were included to assess the profitability of each menu item. To simplify cost allocation, fixed costs are divided evenly by the number of menu items. The profit and loss method relied on allocation of both fixed and variable costs. However, the allocation method to assign variable costs was not explained. The basic formula used by the Hayes and Huffman model was as follows:

Sales of menu item – (cost of food + fixed costs + variable costs) = net profit for menu item.

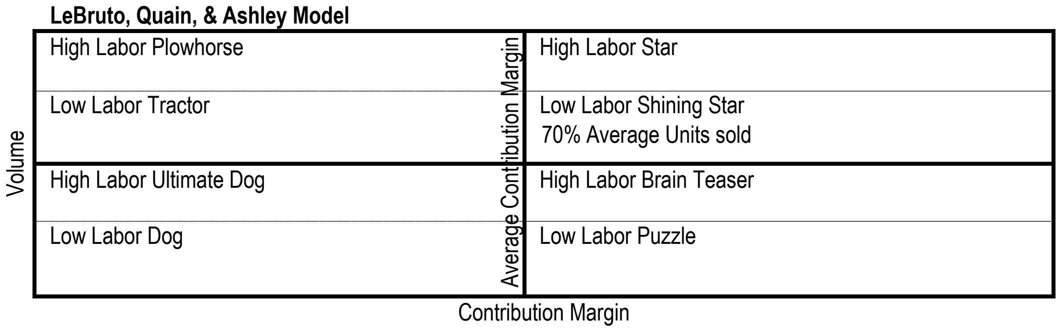
In this formula sales were determined as the total sales of a menu item for a predetermined time period such as a month. Fixed costs in the formula were calculated by dividing total fixed costs from the operation by the total number of menu items. The same amounts of fixed costs were allocated to each menu item regardless of any other considerations. Variable costs in the formula were allocated based on an assigned average variable cost for the entire operation established at 35 percent.

Additionally, Hayes and Huffman argued that the matrix approach and use of averages to segment menu items into groups was undesirable since minor modifications to the menu could cause menu items to change ranking. An endless evaluation process would result. They argued that every menu item must stand on its own from a profitability perspective regardless based upon each menu item compared with other items on the menu. If an individual menu item met organizational financial goals, then it remained on the menu. Conversely, if the menu item did not achieve an adequate theoretical return the menu item was discarded.

LeBruto, Quain and Ashley Model

In an effort to incorporate variable labor costs, LeBruto, Quain, and Ashley modified the MEM. They proposed that errors in the analysis of menu engineering data could result from ignoring the profit factors while relying solely on the placement of menu items in the MEM. Additionally they acknowledged Looft's (1989) observation about the difficulty in determining labor costs on a menu item basis. As an alternative to separating labor into fixed and variable components and subsequently attempting to allocate specific labor costs to each menu item, LeBruto, Quain, and Ashley took the Kasavana and Smith model and subdivided each quadrant into high and low labor quadrants. The resulting matrix model contained resulting in a total of eight sectors. Labor was separated in half into high and low segments with the menu items falling equally into each category Figure 4. They recommend that labor assignment of the menu items be made by either a food service professional or through employing a jury of execution, a technique used in qualitative forecasting. The sectors of the quadrants were renamed to reflect the labor component.

Figure 4: LeButo, Quain and Ashley Model



Cohen, Mesika, and Schwartz Model

To solve limitations of two dimensional matrix menu analyses, Cohen, Mesika, and Schwartz developed a multidimensional approach. They included food cost, price, labor cost, popularity, and contribution margin into the menu analysis by incorporating a multifactor dish approach combined with normalizing the input data. Normalization of data to a scalar variable ranging from 0 to 10 combined with analyses of the five menu variables created a polygon dish. The menu variables were evaluated by three ranges. The ideal range was defined as 8 to 10, the acceptable range was defined as between 4 to 8 and the unacceptable range was defined as between 0 to 4. Menu items could be either evaluated independently or compared to other menu items based on the item distribution within the polygon dish. Labor cost was included as a factor in the multidimensional analysis similar to by Hayes and Huffman, Bayou and Bennett, and LeBruto, Quain, and Ashley. Although labor was a factor in this model, Cohen, Mesika, and Schwartz provided no explanation of how the labor cost was measured or calculated. As with others who developed menu analysis approaches, Cohen, Mesika, and Schwartz did not specify how the variables including labor would be calculated nor did they consider other factors of production. Incorporating labor as well as other costs into the menu analysis has been difficult.

Bayou and Bennett Model

Bayou and Bennett argued that the previous menu analysis models for the most part lacked one or more of three essential ingredients: analysis by menu groups, analysis by meal periods, and not differentiating between the short run (special order pricing) and long run (make or buy items) profitability analysis. They argued that allocation of costs was not as simple as evenly assigning costs to all menu items. Simplification was especially pragmatic when various menu items were sold in different categories at different meal time periods. Although Bayou and Bennett disagreed with the methodology of the Hayes and Huffman, conceptually they agreed that labor factors must be considered in the analysis. Bayou and Bennett stated that cost allocation was essential in any analysis of menu items however; they did not propose a solution to the allocation problem in the Profitability Analysis Model (PAM). They proposed first to subdivide the menu into simple parts. Meal periods were assigned as breakfast, lunch or dinner. Product groups were assigned as appetizers, entrées, and desserts. Finally, the menu items in each group were analyzed. The PAM included direct fixed costs in the individual menu item analysis but excluded other fixed costs that Bayou and Bennett defined as common fixed costs from the primary analysis. They defined direct fixed cost as those cost that can be directly attributed to a meal period. In their study, direct costs consisted of full and part-time labor. They concluded that advertising and utilities directed to a specific meal period could also be included. They further defined common fixed costs as those costs remaining regardless of meal period. Examples of common fixed costs included non-shift specific labor, utilities, advertising, and total maintenance costs.

Horton Model

Horton proposed another approach to include labor into the matrix analysis. Horton again modified the MEM by including estimated labor into the contribution margin (gross profit). Horton measured labor cost by multiplying active labor the time to prepare a menu item by the hourly labor cost of the production employee performing the task. For example, the time it takes a cook to place a hamburger on the grill, remove it after cooking and prepare the set-up of bun and assorted accompaniments is multiplied by the dollar hourly rate for that employee. Horton did not include any of the other preparation costs associated with the hamburger preparation such as ordering the products, prepping the hamburger, or prepping accompaniments. Horton compared the menu of an independent restaurant analyzed twice using the Kasavana and Smith model, once with the contribution margin inclusive of labor and a second time with contribution margin exclusive of labor. The inclusion of labor in the contribution margin calculation changed classifications of six of the 52 menu items analyzed. Four menu items dropped in classification while two improved. Horton concluded that labor may be an important factor to include in future studies.

Alternative Approaches to Menu Analysis

Although these models are useful, more sophisticated approaches to menu engineering are warranted in response to slim profit margins and increased competition. As an alternative approach to assign exact labor dollars to an individual menu items must be considered. Managers must be able to evaluate menu items based on labor attributes assessing all of the steps in the food flow, from the ordering and receiving of ingredients to the final production and plating. Identification and quantification of these labor attributes or factors could be used to develop a model that compares and examines menu items using a multi-dimensional approach. Such a model could assess the relative strength of each menu item in terms of profitability.

In a full-service restaurant approximately thirty to thirty-five percent of every dollar earned is spent on labor. The majority of labor costs are associated with kitchen or production staff. Evaluating labor productivity is common in food service operations. Restaurant operations generally measure or track labor productivity as a percentage of sales and do not formally consider other cost/productivity factors such as utilities, equipment efficiencies, pre- or partially prepared goods for production, and training in organizational productivity analysis. Brown and Hoover (191) recommended institutional food service organizations utilize total factor productivity or multi-factor productivity as a means of more effectively measuring labor, materials, and more specifically production costs. They suggested a singular focus on labor productivity may result in poorer overall productivity and decreased profitability. In the general business literature there has been a shift from labor productivity to total factor productivity, multi-factor productivity and DEA. (Reynolds, 2004.)

Although much of the menu analysis research has emphasized the importance of including labor, minimal success has been reported. The actual dollar costs of labor are extremely difficult to precisely calculate and assign to single menu item throughout the entire production process. One individual may prepare many items simultaneously therefore making it difficult to differentiate labor among menu items. Since menu items have been compared based on a function of food cost and consumption using menu engineering approaches rather than cumulative dollar values of all costs, an efficiency comparison approach should be considered. Similar difficulties in cost assignment exists relative to the costs of inventorying, ordering, receiving and stocking the items are difficult to allocate. (Kiefer and Kelly, 1994.) Menu items affect labor and other production costs from a number of perspectives. Variables such as intensiveness of production, complexity of individual recipes, number of ingredients, form of ingredients, and the number of independent ingredients are all relevant to a comprehensive analysis. To accurately evaluate the effectiveness of a menu and individual menu items, a number of factors too difficult to obtain in a quantitative or precise measure should be included using a qualitative and/or categorical level measure.

Data Envelopment Analysis (DEA) has the capability to incorporate both quantitative and qualitative factors. DEA has already been used to measure gross national product, modified to evaluate firm level performance and its methodologies could be adapted to examine menu efficiency. Although not presently applied to menu engineering and analysis, DEA could be a suitable technique can incorporate multiple complex sets of factors impacting menu profitability.

A more comprehensive menu analysis model that builds on the strengths of matrix approaches while permitting a comparison of categorical menu items together by incorporating food cost, popularity, contribution margin and a well defined labor component is the next step in the evolution of a comprehensive menu analysis model. Finally to address the dilemma of accurately reflecting labor components, DEA analysis could be used to rank and measure efficiency of menu items relative to labor by evaluating qualitatively measure components of labor; eliminating the labor allocation problem that previous models have encountered. The resulting use of a qualitative menu analysis approach could provide an operational decision maker with a systematic assessment of menu items to identify the most efficient menu items. Assessment of the efficiency of all other menu items is also possible. Furthermore, a

DEA based menu analysis model can pinpoint specific components such as labor functions or food costs that require adjustments to improve efficiency.

In addition to capturing and assessing labor costs, DEA could be used to evaluate other variables such as popularity, customer satisfaction, and marketing. Production costs are as important to the menu analysis as are the factors that affect menu item popularity. There has been a great deal of research on the consumer behavior aspect of menu pricing and menu design and how these affect the popularity of individual menu items. Numerous authors (Carmin and Norkus, 1990; Kiefer and Kelly, 1994; Kreul, 1982; Miller, 1996; and Orkin, 1978) have all examined how menu pricing affects menu item popularity. Menu design has been researched by Doerfler (1978), Stoner (1988), and Miner (1996.) Popularity can also include point-of-sale advertisement such as table tents and/or server recommendations and external marketing activities that could include direct advertisement. The popularity side of the menu item analysis has yet to be introduced into any menu analysis model. A comprehensive model will need to consider how menu design and marketing affect menu item effectiveness. However, the first step toward a fully comprehensive menu analysis is evaluating the impact of labor costs on individual menu items. Once a qualitative approach is identified for labor, other qualitative factors or variables may be added and a comprehensive menu analysis model can be derived.

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