Chapter II

Literature Review

Overview of Forecasting

Forecasting techniques can be categorized in two broad categories: quantitative and qualitative. The techniques in the quantitative category include mathematical models such as moving average, straight-line projection, exponential smoothing, regression, trend-line analysis, simulation, life-cycle analysis, decomposition, Box-Jenkins, expert systems, and neural network. The techniques in the qualitative category include subjective or intuitive models such as jury or executive opinion, sales force composite, and customer expectations (Kress, 1985; Mentzer & Kahn, 1995).

Along with qualitative and quantitative, forecasting models can be categorized as time-series, causal, and judgmental. A time-series model uses past data as the basis for estimating future results. The models that fall into this category include decomposition, moving average, exponential smoothing, and Box-Jenkins. The premise of a causal model is that a particular outcome is directly influenced by some other predictable factor. These techniques include regression models. Judgmental techniques are often called subjective because they rely on intuition, opinions, and probability to derive the forecast. These techniques include expert opinion, Delphi, sales force composite, customer expectations (customer surveys), and simulation (Kress, 1985; Wilson & Keating, 1994). The data in Table 2.1 presents forecasting techniques categorized by quantitative or qualitative.

Typically, the two forms of forecasting error measures used to judge forecasting performance are mean absolute deviation (MAD) and mean absolute percentage error (MAPE). For both MAD and MAPE, a lower absolute value is preferred to a higher absolute value. MAD is the difference between the actual sales and the forecast sales, absolute values are calculated over a period of time, and the mean is derived from these absolute differences. MAPE is used with large amounts of data, and forecasters may prefer to measure error in percentage (Wilson & Keating, 1994).

Table 2.1. Quantitative and Qualitative Techniques of Forecasting

Quantitative Forecasting Techniques:

- *Regression Analysis*: statically relates sales to one or more explanatory (independent) variables. Explanatory variables may be marketing decisions (price changes, for instance), competitive information, economic data, or any other variable related to sales.
- *Exponential smoothing* makes an exponentially smoothed weighted average of past sales, trends, and seasonality to derive a forecast.
- *Moving average* takes an average of a specified number of past observations to make a forecast. As new observations become available, they are used in the forecast and the oldest observations are dropped.
- *Box-Jenkins* uses the auto correlative structure of sales data to develop an autoregressive moving average forecast from past sales and forecast errors.
- *Trend line analysis* fits a line to the sales data by minimizing the squared error between the line and actual past sales values. This line is then projected into the future as the forecast.
- *Decomposition* breaks the sales data into seasonal, cyclical, trend and noise components and projects each into the future.
- *Straight-line projection* is a visual extrapolation of the past data, which is projected into the future as the forecast.
- *Life-cycle analysis* bases the forecast upon whether the product is judged to be in the introduction, growth, maturity, or decline stage of the life cycle.
- *Simulation* uses the computer to model the forces, which affect sales: customers, marketing plans, competitors, flow of goods, etc. The simulation model is a mathematical replication of the actual corporation.
- *Expert systems* use the knowledge of one or more forecasting experts to develop decision rules to arrive at a forecast.
- *Neural networks* look for patterns in previous history of sales and explanatory data to uncover relationships. These relationships are used to produce the forecast.

Qualitative Forecasting Techniques

- *Jury of executive opinion* consists of combining top executives' views concerning future sales.
- *Sales force composite* combines the individual forecasts of salespeople.
- *Customer expectations (customer surveys)* use customers' expectations as the basis for the forecast. The data are typically gathered by a customer survey by the sales force.
- *Delphi model* is similar to jury of executive opinion in taking advantage of the wisdom of experts. However, it has the additional advantage of anonymity among participants.
- *Naïve model* assumes that the next period will be identical to the present. The forecast is based on the most recent observation of data.

Three planning horizons for forecasting exist. The short-term forecast usually covers a period of less than three months. The medium-term forecast usually covers a period of three months to two years. And, the long-term forecast usually covers a period of more than two years. Generally, the short-term forecast is used for the daily operation and plans of a company. The long-term forecast is used more for strategic planning (Kress, 1985; DeLurgio & Bhame, 1991).

Finally, the distinction between the forecasting method and forecasting system is important. A forecasting method is a mathematical or subjective technique that forecasts some future value or event. While many statistical forecasting software packages are implementations of forecasting methods, they are not forecasting systems. A forecasting system is a computer-based system that collects and processes demand data for thousands of items, develops forecasts using forecasting methods, has an interactive management-user interface, maintains a database of demands, and has report file-writing capabilities. A forecasting system is much more complex than a forecasting method. The method is a part of the system (DeLurgio & Bhame, 1991).

Forecasting in the Hospitality Industry

Before the topic of forecasting in the foodservice industry is introduced, a brief discussion of forecasting within other segments of the hospitality industry will be presented.

Forecasting Research in the Lodging Industry

The accurate forecasting of hotel occupancy rates is important in virtually all areas of hotel operations. The purpose of a study conducted by Andrew, Cranage, & Lee (1990) was to determine whether time-series models gave accurate occupancy forecasts. The results of the study indicated that times-series models did give accurate forecasts. In addition, these models can be easily implemented through off-the-shelf software and hardware. This study helped to fill the gap in the academic hospitality literature regarding time-series models and hotel occupancy forecasts (Andrew, Cranage, & Lee, 1990).

Accurate reservation forecasting is of growing concern to the hotel industry. The need for improved accuracy is a direct result of intensifying competition and shrinking profit margins. Hotel room forecasting can be based on a number of different models and varying specifications (Schwartz & Hiemstra, 1997).

The trend of consumers waiting until the last minute to make reservations for lodging in order to take advantage of "sales pricing" has caused problems for lodging operators in forecasting demand. This has trickled over into other areas such as staffing, payroll, and, ultimately, customer service (Yesawich, 1993). However, lodging operators still feel that late reservations are better than no reservations when predicting arrivals and room revenues (Yesawich, 1993). Some lodging professionals are skeptical of industry forecasts that varying firms produce; thus, the operators tend to use personal judgment and past sales history when predicting revenues (Smith & Lesure, 1996). A forecasting technique that is gaining usage is the rooms-revenue-per-available-room (REVPAR). This technique provides an indication of how well a hotel is performing by combining the two most prominent hotel statistics, occupancy rate and average daily rate. REVPAR recognizes that lodging demand is influenced by price and provides hotels with a reliable method of forecasting hotel rooms revenue (Wood, 1994).

Forecasting Research in the Airline Industry

The nature of airline forecasting data is similar to hotel room reservations data as opposed to hotel and tourism forecasting data (Schwartz & Hiemstra, 1997). Lee (1990) conducted a study on airline reservation forecasting. The data from the study highlighted the uniqueness of the reservations data set.

Although the industry largely produces long-term forecasts for equipment planning, 95% of the forecasting is short-term (less than one year). Quite often, the top-down or industry-share approach is used as opposed to the bottom-up or market-aggregation approach (Biederman, 1993)

Another forecasting approach used in the airline industry is neural networks. Neural networks appear to enhance forecasting accuracy and go beyond the capabilities of conventional statistical analysis. Therefore, airline decision makers should benefit from using neural networks in forecasting airline passenger loads (Nam & Schaefer, 1995; Nam, Yi, & Prybutok, 1997).

Forecasting Research in the Tourism Industry

Witt & Witt (1995) conducted a comprehensive review of the tourism demand forecasting literature. They recognized the need for accurate tourism demand forecasts to assist managerial decision-making. The authors concluded that no single forecasting method performs consistently across different situations. These studies briefly touch on the need for forecasting research in the hospitality industry in general.

Most forecasting models for tourist arrivals were constructed under the assumption of only minor changes in the environment. The factors commonly used in tourism demand models include exchange rates, cost of living, income, seasonal fluctuation, and others (Sheldon & Var, 1985; Archer, 1987; Chan, Hui, & Yeun, 1999). Chan, Hui, & Yeun (1999) found that environmental changes, such as war or terrorism, presented several factors in predicting tourist flow. The findings of this study showed that, in terms of forecasting accuracy, the naive model was the best in handling unstable data (Chan, Hui, & Yeun, 1999). Witt, Witt, & Wilson (1994) observed that different forecasting techniques might perform differently in dealing with stable vs. unstable data.

Chu (1998) used seasonal and nonseasonal elements to forecast tourist arrivals in Singapore. Seasonality was a factor to consider in the forecasting of international quarterly tourist flows from the United States, Japan, United Kingdom, and New Zealand (Kulendran & King, 1997).

Qualitative techniques are generally used to forecast the long-term tourism environment. The Delphi approach is often used to accomplish this. In an alternative to the Delphi approach, Moutinho & Witt (1995) used a consensus approach. The consensus approach permits full discussion among the experts taking part in the exercise. Results showed that experts believed that science and technology would have major impacts on tourism development during the period up to 2030 (Moutinho & Witt, 1995).

Forecasting in Restaurants and Foodservice

Adoption of management science techniques, including forecasting, has not occurred extensively in the foodservice industry (Finley & Kim, 1986). However, the need for mathematical forecasting was recognized as early as 1960 (Gleiser, 1960). Since that time, limited applications of forecasting models have been reported (Cullen et al., 1978). Eisele (1981) discussed the need to improve forecasting techniques in college foodservice.

Miller (1990-1991) conducted a study of three foodservice venues in which she solicited the types of forecasting models that were used. Results of the study indicated that mathematical models were not widely used in college and university, health-care, or commercial foodservice. The most frequently used techniques are variations of the naive model. Respondents in all studies indicated that forecasting is an important concept and confirmed that additional training and improvement is needed. The majority of operations surveyed in both college and university foodservice and health-care foodservice maintain records necessary for forecasting. Therefore, data are available for employing forecasting models.

Forecasting is important because it contributes to better accountability, cost containment, productivity, profit, maximization, and customer and employee satisfaction. The findings reported by Miller (1990-1991) support the need for and significance of continued research in the area of restaurant and foodservice forecasting.

The impact of improved forecasting techniques on service production should be recognized. Forecasting affects not only material needs, i.e., food and labor, but also all costs, employee morale, and customer satisfaction. Mathematical models are reliable tools for improving forecast accuracy (Miller, 1990-1991).

Forecasting the appropriate amount of food to be purchased in the foodservice operation is an important decision that affects costs and the efficiency of the operations. Perishability of food makes prediction a unique problem in the foodservice operation (Miller & Shanklin, 1988). If the forecast is short, foodservice operations will run out of food. On the other hand, forecasting food in excess will cause an increase in food purchased and food produced, resulting in an increase in costs.

Foodservice operations require accurate purchasing forecasts. Accurate purchasing forecasts will assist in controlling the following: the amount of food purchased, the amount of personnel required to run the operation, and the amount of food waste on serving lines. Accuracy in the forecast is reflected in customer satisfaction, resource utilization, and profitability (Messersmith & Miller, 1992; Miller, McCahon, & Bloss, 1991; Miller, McCahon, & Miller, 1993; Sanchez & Miller, 1995).

Forecasting demand for goods and services is critical to effective and efficient hospitality management. In virtually every area of operations, reliable forecasts can provide a sound basis for managerial decision-making. Evidence exists that few foodservice operations currently use mathematical forecasting techniques (Miller & Repko, 1990; Repko & Miller, 1990). The limited amount of research in this area may be a contributing factor. Nevertheless, most foodservice and hotel managers apparently are interested in improving forecasting systems (Miller & Repko, 1990; Repko & Miller, 1990; Schmidgall, 1989).

Miller et al. (1991) developed and evaluated forecasting models to predict restaurant covers (dine-in guests). The demand for specific menu items could then be derived from the number of covers forecast. Data were collected from two restaurants located in mid-sized hotel properties. Results indicate that simple mathematical forecasts are practical tools that can be implemented in commercial foodservice operations. The methods are somewhat simplistic, and software and hardware are available for foodservice operators. Secondly, results indicate that simple mathematical models can be used to increase the efficiency and effectiveness of hospitality management (Miller et al., 1991). For example, a food and beverage manager can use a forecast of covers to optimize staffing and inventory levels. Controls such as these offer significant potential for cost savings and revenue enhancement (Miller et al., 1991).

Miller, McCahon and Miller (1993) expanded their earlier research (Miller et al., 1991) on forecasting restaurant covers to determine if there was a difference in selection of mathematical techniques based on short-term and long-term data sets. Results indicated that in both short-term and long-term studies, daily seasonality differences accounted for a large portion of the variance in the covers. Thus, seasonality should be taken into account when forecasting (Miller et al., 1993).

Forecasting is the first step in improved production planning, which can be a critical component in the current environment of increased competition. Forecasting is especially important in foodservice since perishability is a critical problem. Over and under production of food is a liability to the operation. It has an impact on personnel, materials, facilities management, customer satisfaction, and accountability costs. The purpose of a study conducted by Miller, McCahon, & Bloss (1991) was to develop, test, and evaluate mathematical time-series forecasting models using actual foodservice production data. The research developed and evaluated forecasting models using entrée demand data from a university dining hall. The results of this study indicated that mathematical models could improve production-forecast outcomes. In addition, these results indicated that the mathematical time-series forecasting models performed better for actual entrée data (Miller, McCahon, & Bloss, 1991). Miller, McCahon, & Miller (1991) determined that simple mathematical models (simple moving average and simple exponential smoothing) are effective in the school foodservice setting as well. The authors determined that school foodservice managers should seriously consider these techniques in an attempt to improve production demand forecasts.

The naive model (educated guess or intuitive estimate) continues to be the most-used method. In addition, the environment surrounding the foodservice industry has variables making forecasting a difficult tack. These variables include items such as customer behavior, seasonality, and location of the establishment, to name a few. Due to these variables, the human expert responsible for forecasting outperforms the mathematical model (Miller, Sanchez, & Sanchez, 1994). The Miller, Sanchez, & Sanchez (1994) study was the result of experimentation with an expert system model for foodservice (Sanchez, 1994). Sanchez (1994) developed an expert system model that forecasted various combinations of menu items. Sanchez, Miller, Sanchez & Brooks (1995) developed a knowledge-based system (expert system) to replicate the knowledge, experience, creativity, judgment, and intuition of the forecast expert in the process of forecasting food production. The performance of the expert system was comparable to that of the forecast expert; 81% acceptability was achieved. Nonexperts can use the expert system easily as well (Sanchez et al., 1995).

Lin, Vasser, & Miller (1992) provided a framework for building a strategic forecasting system that can help managers in a hospital foodservice setting select and use appropriate forecasting models for hospital foodservice. The authors determined that forecasting should not be viewed as a self-contained activity but, to be most effective, should be integrated into the overall planning of the health-care institution. For example, at the top management level, forecasts should be made in regard to all inpatient services; these projections will serve as the basis for projecting food production. This linkage should include information about cost, price, resources, and other factors in production as all of these components are interrelated and connected. Modifying this scenario to provide greater integration between the forecasting and planning aspects in both the foodservice department and hospital must incorporate planning (Lin et al., 1992).

Forecasting is a function that must be taught to hospitality managers through education and training. Miller, Miller, & Horsley (1993) conducted a study to determine the extent to which forecasting techniques are being taught in hospitality management programs, which forecasting techniques are being taught, how they are taught, and who is teaching them. This study was significant to the hospitality industry because it supported the literature, which suggests that forecasting is important and should be included in educational programs. In the study, 91% of the respondents indicated that forecasting was taught in their programs. The results also showed that mathematical techniques are being taught at both the undergraduate level and, to a greater extent, at the graduate level. This is important to the industry because the results suggest that graduates from many programs should be equipped to implement and manage forecasting techniques for more efficient and effective hospitality management. In addition, hospitality programs are using computers in the classroom; this indicates that graduates should be able to manage forecasting with the aid of computers (Miller, Miller, & Horsley, 1993).

Forecasting as a Part of the Management Process

Integrating Forecasting into Management Functions

There can certainly be no more important activity in the business organization than the effective development of sales forecasts and application of these forecasts to the organization's various functional needs. Closs, Oaks, & Wisdo (1989) argued that a sales forecast must incorporate 1) the correct use of forecasting techniques, 2) forecasting systems that effectively interact with the corporate management information system, and 3) recognition of the impact of forecasting management philosophy upon ultimate accuracy. A substantial gap still exists between applications and what is both desirable and obtainable. An examination of the forecasting and marketing literature suggests that a structure is needed for handling the issues that the practitioner must address (Makridakis & Wheelwright, 1977).

Various functional areas or departments may need on-going information on forecasts and forecasting accuracy, even though they are not allowed to make changes to forecasts. The departments that are most often allowed to review forecasts are marketing, finance, production, sales, and planning. Having access to the sales forecast information as well as the ability to disseminate the information is important (Mentzer & Schroeter, 1994).

Behavioral and organizational issues exist when integrating the forecasting system into a company. An important aspect of the behavior issue involves the interface between the preparer of forecasts and the users of forecasts. A need exists for a clear definition of tasks and priorities with regard to forecasting applications as well as a need for respect and understanding of each other's position (Makridakis & Wheelwright, 1977). An important aspect of the organizational issue involves differences among the needs of each department that uses the forecast (Makridakis & Wheelwright, 1977).

Because the sales forecast is the bonding tool that draws together the different line and support functions, all of the components of the organization must use the same forecast and assumptions. A business organization is an integrated group of activities, which requires coordination and common goals to result in profit for the company (Lawless, 1990).

Evidence has shown that, if there is not a sufficient degree of acceptance of the forecast and its validity, the different functional areas will in fact develop their own independent forecasts. This has the obvious effect of creating chaos, inefficiency, and substantial additional costs. The conflict and chaos created by the use of different sales forecasts can be detrimental to the organization's efforts and have a variety of undesirable side effects, including high inventory levels, inventory obsolescence, over utilized or underutilized plants, and unnecessary facilities. These are serious consequences potentially costing the business millions of dollars in excess capitalization due to ineffective sales forecasting (Lawless, 1990).

In order to enhance the use of a sales forecast, the forecast must have credibility. Communication of the forecast in business terms--not technical terms--also contributes to the acceptance. Both communication and process management call upon the interpersonal skills of the forecaster.

Determining forecast requirements provides each department an opportunity to assess its specific objectives and needs as they relate to the forecast and to consider the integration of the forecast into its activities. In order for the forecast to be effective, it must reflect the needs and functional processes of all functional constituents. A complete understanding of the manufacturing, distribution, sales, and marketing processes and constraints is a minimum (Lawless, 1990).

Corporate management involvement is essential since the forecast must reflect reasonable management goals and is used by a wide variety of functional areas within the company. Acceptance by management is critical in getting a forecast method accepted and applied consistently within the organization.

In order to be effective, the forecaster and forecast process must be sensitive to the corporate culture and to the professional agenda of the managers and users involved. The forecaster must exhibit qualities of leadership and establish a sound working relationship with the forecast users and participants. In communicating the forecast results to management, the forecaster must be capable of communicating the findings in language functional managers can understand and compatible with the corporate culture (Lawless, 1990).

Approaches and Methods to Forecasting

Steen (1992) studied the importance of team-based forecasting. Both Steen (1992) and Kahn & Mentzer (1994) concluded that team-based forecasting tends to improve forecast accuracy, and managers are more satisfied when forecasts are developed with inter-functional efforts.

According to Kahn & Mentzer (1994) and Mentzer & Kahn (1997), four general approaches to sales forecasting exist. The first approach is one in which each department develops and uses its own sales forecast(s). This is called the independent approach. The second approach has only one department responsible for developing the sales forecast(s). This is called the concentrated approach. The third approach has a forecast team comprised of representatives from multiple departments responsible for developing the sales forecast. This is called the consensus approach. Finally, the fourth approach has each department develop its own forecast, but a forecast team comprised of representatives from multiple departments is responsible for arriving at the final sales corporate forecast. This is called the negotiated approach. Approaches one and two are non-team-based approaches, while approaches three and four are team-based approaches (Kahn & Mentzer, 1994; Mentzer & Kahn, 1997).

According to Wright (1988), three broad classes of forecasting methods are available to the planner: statistical, judgmental, and econometric. Within the statistical category, widely used methods include smoothing, regression, and box-jenkins. Judgmental factors are incorporated into the forecast using techniques such as the Delphi and cross-impact methods. Finally, a wide range of econometric models using several hundred variables and large corporations to forecast the macroeconomic environment in which they operate use relationships.

Gordon, Morris, & Dangerfield (1997) suggested two general approaches to forecasting: top-down (TD) and bottom-up (BU) approaches. In the top-down approach, data are used to develop a forecast, which is then desegregated into individual units based on their historical fraction of sales. The bottom-up approach allows each unit to prepare a separate forecast, which is aggregated. Gordon et al., (1997) concluded that the bottom-up approach outperforms the top-down approach in improving forecast accuracy.

Forecasting Hardware and Software Systems

Mentzer & Gomes (1989) provided support for using Decision Support Systems (DSS) and addressed the following issues: techniques within the DSS, corporation needs and limitations, the forecast cost effectiveness, and the appropriate software system. Sales forecasting is an integral part of marketing DSS. The DSS contains tools to help the forecaster prepare better forecasts; tools are data, records of previous forecasting, and techniques. Forecasts assist marketing managers improve decision-making. In an organizational design context, forecasting should not be regarded as a self-contained activity, but should be integrated within the planning context of which it is a part (Mahmoud, Rice, & Malhotra, 1988).

When an organization has its own forecasting expertise (prepares its own forecasts) that expertise should not be separated into a self-contained department. Forecasting and planning functions should be combined. Involvement of the forecasters in planning enables them to select criteria for evaluating forecasting methods that are meaningful within the planning context (Wright, 1988).

Rubinstein & Liddle (1997) stressed that restaurant operators must go beyond the typical spreadsheet software that only allows for tallying of operator expenses and does not include the technology of a DSS. Several software packages are available to restaurant operators that incorporate inventory management, purchasing procedures, and sales data. These software packages assist restaurant operators in forecasting sales and production requirements.

One means of an automated system in supply chain management in the restaurant industry is electronic data interchange (EDI). In short, EDI is the computer-to-computer exchange of business transactions between companies. EDI is seen as a means to facilitate sales forecasting efforts by providing information that would pertain to a channel member's demand for the products and/or services offered by the supply channel member. In turn, the supply channel member, upon receiving this information, would respond with an update to production and/or distribution schedules in order to meet this demand (Jain, 1994).

Kahn & Mentzer (1996) believe that EDI would provide accuracy, accessibility, and speed, thus lowering costs of sales forecasting information and leading to more efficient and effective business planning. The Efficient Foodservice Response movement--a system of food purchasing, distribution, and handling--is projected to generate more than $14 billion in cost savings through the food supply system. Almost half of the savings are expected to be derived from electronic data interchange (Matsumoto, 1997). Efficient Foodservice Response (EFR) is similar to technology-based supply chain initiatives used in supermarkets and other retail industries and is expected to help decrease waste from the foodservice supply channel, ultimately providing better value to customers (Nation's Restaurant News, 1996). The goal of the EFR program is for manufacturers, brokers, distributors, and restaurant operators to begin new practices, which will lower total cost in the foodservice supply channels (Nation's Restaurant News, 1996).

Another system to manage sales forecasting in commercial restaurants is the Point- of-Sales (POS) System. The POS system operates on the property level, with the capacity to be interfaced with regional and corporate systems to provide efficiency in the collection and transfer of sales data, inventory management, recipe maintenance, payroll, and many other functions. Hand-held server terminals, which are actually POS systems, allow servers to accurately enter orders that are linked to restaurant databases containing inventory and sales information. This technology in hardware and software is increasing customer service while decreasing inaccuracies in restaurant forecasting (Durocher, 1997).

While many industries spend 4% of gross sales on technology, the foodservice industry spends approximately 2% on technology. More recently, restaurant companies are seeing an increase in technology budgets allowing companies to invest more in technology. Successful implementation of hardware and software in the highly competitive restaurant business requires precision and careful analysis. Every restaurant, whether a high-volume independent or multi-unit chain company, has its own characteristics and consequently needs technology matched carefully to its unique blend of needs and services (Nation's Restaurant News, 1997). Through comprehensive analysis of sales information, management can predict business volume with factors such as weather, season, and time of day, which are vital ingredients to success (Computing Canada, 1980).

Allnoch (1997) believes that the challenge for restaurants is to establish accurate inventory targets for dry goods, packaged items, and food items, while maintaining acceptable levels of customer service. Allnoch (1997) suggests that restaurant companies incorporate a strategy that uses an inventory planning system with statistical process control capabilities to help users manage inventory, forecast product demand, and deliver the right amount of product in a timely, efficient manner. In a very competitive market, restaurant corporations must focus on gaining incremental sales and profits from existing equipment and restaurant units. Several proposed capacity management ideas depend on accurate forecasting (Sill, 1991)

The process used to budget and control costs in a foodservice business begins with the sales forecast. The small foodservice operator uses the same factors a large company uses when forecasting sales. These include past history, competition, and management goals. All forecasting methods have some element of uncertainty. Small foodservice operators tend to use the bottom-up approach to budgeting and forecasting. The larger chains use both the bottom-up aggregate approach to forecasting by collecting sales forecasts from each unit and region, as well as the top-down approach to forecasting using corporate sales forecasting and distributing them to each division and unit (Chandler & Trone, 1982).

Measuring the Performance of Forecasts

Gardner (1990) believed that metrics measures are of little interest to managers concerned with whether forecasting will improve decision-making. The major conclusion of this research is that differences in forecast accuracy can be substantial when measured in terms meaningful to managers (Gardner, 1990). The impact of forecasting should be presented to management in the form of a tradeoff curve between inventory investment and customer service. Tradeoff curves between aggregate inventory investment and customer service are widely used as analytical tools in inventory management. Alternative forecasting models should be evaluated by comparing the position of their tradeoff curve to improve customer service and reduce inventory investment (Gardner, 1990). Tradeoff curves based on alternative forecasting models should have applications in other operational decision problems. In staffing problems, tradeoff curves could be developed to show managers how forecasting affects measures such as the number of personnel required, overtime/undertime, and customer waiting time. In production scheduling, tradeoff curves should be helpful in finding a good balance between production setups and the number of late jobs (Gardner, 1990).

Accuracy in Forecasting

Accuracy of forecasts improves when the source of error is identified and corrected (Jarrett, 1990). The sales forecast is critically important in business because it is often the starting point for all operations or planning. Errors in forecasts have costs, which often are very high. These costs have direct effects on budgeting, planning, production, and perhaps prices. Despite the errors, forecasts must be conducted in order to make plans for the future (Jarrett, 1990).

Even though it was acknowledged that current performance fell short of desired levels, accuracy and evidence/substantiation were viewed as the most important elements for successful sales forecasting (Lowenhar, 1984). Many of the weaknesses of the sales forecasting system appeared to be related to organizational and structural problems.

Due to lack of assigned areas of responsibility, the consensus forecasting approach worked to dilute forecasting responsibility. A lack of integration and agreement on control mechanisms across all sales forecasting activities and an absence of an agreed-upon mechanism to systematically gather sales force input into the forecasting process existed. (Lowenhar, 1984)

Other studies on forecast accuracy determined that executive assessments have an acceptable level of accuracy (Sparkes & McHugh, 1984), and multiple regression followed by survey and opinion polling were judged most accurate (Wilson & Daubeck, 1989). Naive models were judged to be least accurate, and a strong association existed between importance and accuracy (Wilson & Daubeck, 1989).

Combining forecasts to improve accuracy has been of interest to sales and market-forecast researchers for the past two decades. One of the underlying justifications for the concept of combining forecasts is the view that all forecasting methods are imperfect since no model can completely capture reality. The best forecasting method is usually defined as the method giving the smallest error. Based on the research, a combination approach is best whenever possible (Flores & White, 1988). Finally, Schnaars (1984) identified the following variables as potential factors affecting forecast accuracy: time horizon, data availability, level of aggregation (the micro or macro level), type of product, and stability of the data series.

Satisfaction in the Forecasting Process - Mentzer

The purpose of the Mentzer & Cox (1984a) article was to report the results of a survey to investigate the use, performance, and satisfaction of forecasting managers with current sales forecasting techniques. Respondents who were familiar with a technique were asked to state their degree of satisfaction. The majority of respondents were satisfied with regression analysis, exponential smoothing, moving average, trend analysis, classical decomposition, simulation, and jury of executive opinion. Accuracy was relatively high for aggregate short-range forecasts but decreased as forecast level moved toward product detail. Accuracy also decreased with longer time horizons. Performance is apparently measured in terms of accuracy, ease of use, low cost, and credibility was used as secondary criteria. (Mentzer & Cox, 1984a)

The purpose of Mentzer & Kahn's (1995) research was to report the results of a ten-year retrospective study of sales forecasting practices using the same, and in a few cases, slightly modified measures from the Mentzer & Cox (1984a) study. The Mentzer & Kahn (1995) study concentrated on the original four objectives in determining whether sales forecasting practices of the early 1990's parallel sales forecasting practices of the early 1980's. A benefit of this study was the establishment of an updated baseline for sales forecasting practices, which included the important dimension of satisfaction (Mentzer & Kahn, 1995).

Respondents in Mentzer & Kahn's (1995) study were less satisfied with the jury of executive opinion and moving average than in the Mentzer & Cox (1984a) study. The overall degree of forecast accuracy in the Mentzer & Kahn (1995) study was almost equivalent with Mentzer & Cox (1984a). As previously mentioned, research on sales forecasting practices since 1984 has overlooked the satisfaction issue. Future research should encompass this issue when examining sales forecasting practices (Mentzer & Kahn, 1995).

Background of Sales Forecasting Benchmarking Model

Benchmarking as a Tool

Benchmarking is a diagnostic tool designed to compare a company's performance against that of its peers. Because businesses are focused on financial performance and measurable results, benchmarking is a valuable tool for generating positive program results (Foley & Saunders, 1999). In supply chain management, the word benchmarking refers to the process of comparing yourself to the best, learning, and then improving continuously (Purchasing, 1999).

In recent years, many management teams have looked towards benchmarking and business process reengineering to aid them in their quest to improve the performance of their organizations. However, such initiatives focus on business processes, which make little or no contribution to strategic objectives. Peppard (1999) found that benchmarking should be a part of the strategic process within an organization, not an afterthought from which to judge performance. Becoming proficient in benchmarking is an important process for improving other areas, such as customer satisfaction and strategic planning (Peppard, 1999; Stork, 1999).

Development of Model Dimensions

In 1984, Mentzer & Cox (1984a) researched the forecasting process. The purposes this study was the following: 1) to investigate the use, performance, and satisfaction of forecasting managers with current (relevant to the 1980's) forecasting practices, 2) to determine the degree of satisfaction of managers with different forecasting techniques, 3) to determine which forecasting techniques were most commonly used for different time horizons and forecasting levels, and 4) to survey managers to determine certain managerial aspects of forecasting. The researchers concluded that regression, subjective, exponential smoothing, and moving average were fairly well known and widely used techniques. In addition, accuracy was relatively high for short-range forecasts but decreased with longer time horizons.

Noteworthy findings in the Mentzer & Kahn (1995) study included the following: 1) accuracy is a top criterion for evaluating sales forecasting effectiveness, and 2) managers should consider other issues associated with forecasting (including forecasting environment, data collected, computer systems used, and administration of the forecasting process).

The Mentzer & Cox (1984a) and Mentzer & Kahn (1995) studies concentrated on corporate sales forecasting practices with a primary focus on specific techniques. The study conducted by Mentzer, Kahn, & Bienstock (1996) incorporated the entire sales forecasting process. Mentzer et al. (1996) developed a four-dimensional descriptive model for sales forecasting benchmarking. These dimensions included functional integration, approach, systems, and performance measurement. Each dimension has four hierarchical stages in which companies can be characterized. Stage 1 is the least evolved stage and Stage 4 is the most evolved. This model incorporated the managerial aspects of the sales forecasting process.

The Functional Integration Dimension

Functional Integration refers to collaboration, communication, and coordination, which are three key concepts in forecasting. Communication encompasses all forms of written, verbal, and electronic communication between the functional business areas--marketing, sales, production, finance, and logistics (including purchasing). Coordination is the formal structure and required meetings between two or more functional business areas. Collaboration is an orientation among functional areas toward common goal setting and working together.

Stage 1 - Functional Integration. In Stage 1, each functional area has its own forecast for its own purposes (the independent approach discussed by Kahn & Mentzer (1994)). These disparate goals for forecasting cause communication breakdowns among functional areas, resulting in a lack of any coordinated or collaborative sales forecasting efforts between functional areas. Forecasting and effectiveness are low in this stage (Mentzer et al., 1996; Mentzer et al., 1999).

Stage 2 - Functional Integration. In Stage 2, there is a recognition of the need for coordinated sales forecasts through formal meetings between functional areas, with the forecasting function housed in a specific functional area (the concentrated approach in Mentzer & Kahn (1994)). The challenge in this stage is that the location of forecasting may give way to a functional area bias. For example, if located in the production or logistics functional areas, the forecasts may take on an operational nature. If located in the marketing or sales functional area, the forecast may take on a marketing orientation. Coordination is accomplished through "consensus forecast" meetings; however, a lack of collaboration or setting of common goals existed (Mentzer et al., 1996; Mentzer et al., 1999).

Stage 3 - Functional Integration. In Stage 3, a more consensus forecasting approach is used. More effective communication and coordination between functional areas exists. Frequently, a manager who is present understands the role of sales forecasting in business planning and is knowledgeable regarding the company's sales forecasting process. More effective negotiation between the various functional areas to reach a consensus forecast as well as recognition of forecasting goals amongst functional areas is achieved (depending on the degree of negotiation as opposed to consensus, the negotiation or consensus approach determined by Mentzer & Kahn (1994)) (Mentzer et al., 1996; Mentzer et al., 1999).

Stage 4 - Functional Integration. In Stage 4, communication, coordination, and collaboration are achieved. Forecasting is structured as a separate functional area, and forecasting needs are coordinated reducing the negotiation exhibited in Stage 3. This stage is a true consensus approach. In addition, this stage has systems that provide full access to information that may impact the forecasting process and outcomes (Mentzer et al., 1996; Mentzer et al., 1999).

In Table 2.2 are listed the characteristics of companies within the four stages of the functional integration dimension as determined by Mentzer et al. (1996) and Mentzer et al. (1999).

The Approach Dimension

Approach refers to what is forecasted and how it is forecasted (within the company).

Stage 1 – Approach. In Stage 1, forecasting approaches are driven by the business/profit plan (i.e., top-down forecasts). Concentration is on the profit plan with little recognition of the impact of economic factors, marketing efforts, or stage in the product life cycle. Forecasting is seen as a tactical function with little impact on the development of the business plan. Forecasting techniques are usually some sort of naive, subjective, and/or statistical approach with little understanding of how the techniques work (i.e., a "black box" approach) (Mentzer et al., 1996; Mentzer et al., 1999).

Table 2.2. Functional Integration: Stage Characteristics (Mentzer et al., 1996; 1999)

Stage 1

- Major disconnects between marketing, finance, sales, production, logistics, and forecasting
- Each area has its own forecasting effort
- No accountability between areas for forecast accuracy

Stage 2

- Coordination (formal meetings) between marketing, finance, sales, production, logistics, and forecasting
- Forecasting located in a certain area — typically operations oriented (located in logistics or production) or marketing oriented (located in marketing or sales) — which dictates forecasts to other areas
- Planned consensus meetings, but with meeting dominated by operations, finance, or marketing--i.e., no real consensus
- Performance rewards for forecasting personnel based only on performance contribution to the department in which forecasting is housed

Stage 3

- Communication and coordination between marketing, finance, sales, production, logistics, and forecasting
- Existence of a forecasting champion
- Recognition that marketing is a capacity unconstrained forecast and operations is a capacity constrained forecast
- Consensus and negotiation process to reconcile marketing and operations forecasts
- Performance rewards for improved forecasting accuracy for all personnel involved in the consensus process

Stage 4

- Functional integration (collaboration, communication, and coordination) between marketing, finance, sales, production, logistics, and forecasting
- Existence of forecasting as a separate functional area
- Needs of all areas recognized and met by reconciled marketing and operations forecast (finance: annual dollar forecast; sales: quarterly dollar sales territory based forecasts; marketing: annual dollar product based forecasts; production: production cycle unit SKU forecasts; logistics: order cycle unit SKUL forecasts)
- Consensus process recognizes feedback loops (i.e., constrained capacity information is provided to sales, marketing, and advertising; sales, promotions, and advertising can drive demand; etc.)
- Multidimensional performance rewards for all personnel involved in the consensus process

Stage 2 – Approach. In Stage 2, there is a bottom-up approach to forecasting demand, where demand is determined by what is recorded in invoices and corporate reports. Time-series forecasting techniques are used, more for the simplicity of the techniques rather than the appropriateness of the technique. Recognition of the interrelationship between the business plan and sales forecasting exists. More emphasis placed on some documentation of the forecasting process and some statistical training for personnel, but little emphasis is placed on helping personnel understand business environments (Mentzer et al., 1996; Mentzer et al., 1999).

Stage 3 – Approach. In Stage 3, Recognition of top-down and bottom-up forecasting exists; however, little is done to reconcile the two approaches. Point-of-sale (POS) demand and supply chain timing/inventory information is used to forecast demand. Recognition that regression-based forecasting works better for longer-range forecasts at higher levels in the corporation exists. In addition, time-series forecasts work on shorter-range forecasts and experienced business qualitative input is an important component of all forecasts. Increased awareness of the relationships in which the business is involved exists, thus allowing the forecasts to drive the business plan (Mentzer et al., 1996; Mentzer et al., 1999).

Stage 4 – Approach. In Stage 4, Companies recognize that top-down and bottom-up forecasting are not two independent processes, rather they are interdependent. If a change in one approach exists, the forecast is reconciled in the other approach. There is an emphasis on vendor-managed inventory. Subjective modifications are made to the generated forecasts based on an understanding of the business. These modifications greatly increase the forecast's accuracy. An understanding exists that the business plan and the forecasts are intertwined and should be developed together. Top management recognizes the importance of forecasting both to the business plan and to operational planning (Mentzer et al., 1996; Mentzer et al., 1999).

The characteristics of companies within the four stages of the approach dimension as determined by Mentzer et al. (1996) and Mentzer et al. (1999) are shown in Table 2.3.

Table 2.3. Approach: Stage Characteristics (Mentzer et al., 1996; 1999)

Stage 1

- Plan driven, top-down forecasting approach (failure to recognize the interaction between forecasting, marketing, and the business plan)
- Forecast shipments only
- Treat all forecasted products the same
- Naïve and/or simple statistic approach to forecasting often with little understanding of the techniques used or the environment ("Black Box Forecasting")
- Failure to see the role of forecasting in developing the business plan (forecasting viewed solely as a tactical function)
- No training of forecasting personnel in techniques or understanding of business environment--no documentation of the forecasting process

Stage 2

- Bottom-up, SKUL-based forecasting approach
- Forecast self-reported demand (demand recognized by the organization) or adjusted demand (invoice-keyed demand)
- Recognize that marketing/promotion efforts and seasonality can drive demand
- Recognize the relationship between forecasting and the business plan, but the plan still takes precedence over the forecasts
- Limited training in statistics with no training in understanding the business environment—limited documentation of the forecasting process

Stage 3

- Both top-down and bottom-up forecasting approach
- Forecast POS (point of sale) demand and back this information up the supply chain and/or utilize key customer demand information ("uncommitted commitments")
- Use ABC analysis or some other categorization for forecasting accuracy importance
- Identification of categories of products that do not need to be forecast (i.e., two-bin items, dependent-demand items, make-to-order items)
- Use of regression-based models for higher level (corporate to product line) forecasts and time-series models for operation (product to SKUL) forecasts
- Recognize the importance of subjective input from marketing, sales, and operations to the forecast
- Forecasting drives the business plan
- Training in quantitative analysis/statistics and understanding of the business environment—a strong manager/advocate of the forecasting process

Stage 4

- Top-down and bottom-up forecasting approach with reconciliation
- Vendor-managed inventory factored out of the forecasting process
- Full forecasting segmentation of products (ABC, two-bin, dependent-demand, make-to-order, product value, seasonality, customer service sensitivity, promotion driven, life-cycle stage, shelf life, raw material lead time, production lead time
- Understand the "game playing" inherent in the sales force and the distribution channel (motivation for sales to underforecast and for distribution to overforecast)
- Develop forecasts and business plan simultaneously, with periodic reconciliation of both (for instance, consideration of capacity constraints as part of long-range plan and forecasts)
- On-going training in quantitative analysis/statistics and understanding of the business environment—top management support of the forecasting process

The Systems Dimension

Systems refer to computer and electronic communications hardware and software utilized to develop, analyze, and distribute forecasts.

Stage 1 – Systems. In Stage 1, a number of separate information systems which are not interconnected, a situation referred to as "islands of analysis" resulting in information being transferred from one functional area to another via printed reports. This information must be manually input to the receiving functions computer system, resulting in the same data being input over and over again using these isolated systems. Data error and lost productivity are results of this stage. Few individuals outside of the MIS department understand the functionality of the system, and no forecast metrics are captured or reported (Mentzer et al., 1996; Mentzer et al., 1999).

Stage 2 – Systems. In Stage 2, electronic links among functional areas that help generate and/or use the forecasts exists, eliminating the need for manual transfer and input of information. On-screen reports of forecasting performance metrics are available as well as periodic printed reports. The reports are often large and contain extraneous information (Mentzer et al., 1996; Mentzer et al., 1999).

Stage 3 – Systems. In Stage 3, a client-server system architecture with improved system user interface exists. These interfaces allow changes and subjective input to be easily entered and communicated to all functional areas. A common ownership of information (data warehouse) exists. Reports can be customized and are available on-screen or printed on demand (Mentzer et al., 1996, Mentzer et al., 1999).

Stage 4 – Systems. In Stage 4, an open architecture allows EDI linkage. This can be a based on POS (point-of-sales) demand forecast. Considerable savings exist in supply-chain inventories through added EDI information (Kahn & Mentzer, 1996; Mentzer et al., 1996; Mentzer et al., 1999).

Listed in Table 2.4 are the characteristics of companies within the four stages of the systems dimension as determined by Mentzer et al. (1996) and Mentzer et al. (1999).

Table 2.4. Systems: Stage Characteristics (Mentzer et al., 1996; 1999)

Stage 1
- Corporate MIS, forecasting software, and DPR (Distribution Requirement Planning) systems are not linked electronically
- Printed reports, manual transfer of data from one system to another, lack of coordination between information in different systems
- Few people understand the systems and their interaction (all systems knowledge held in MIS)
- "Islands of analysis" exists
- Lack of performance metrics in any of the systems or reports

Stage 2
- Electronic links between marketing, finance, forecasting, manufacturing, logistics, and sales systems
- On-screen reports available
- Measures of performance available in reports
- Reports periodically generated

Stage 3
- Client-server architecture that allows changes to be made easily and communicated to other systems
- Improved system-user interfaces to allow subjective input
- Common ownership of data bases and information systems
- Measures of performance available in reports and in the system
- Reports generated on demand and performance measures available on line

Stage 4
- Open-systems architecture so all affected areas can provide electronic input to the forecasting process
- EDI linkages with major customers and suppliers to allow forecasting by key customer and supply-chain staging of forecasts (i.e., Real-time POS forecasts to plan key customer demand ahead of supply-chain cycle)

The Performance Measurement Dimension

Performance Measurement refers to the metric used to measure forecasting effectiveness and any information gathered to explain performance.

Stage 1 - Performance Measurement. In Stage 1, there are no systems or understanding of the forecasting process to even measure accuracy. Forecasts are developed and used; however, no measures of accuracy exist, and accuracy is not tied to performance evaluation. Typical performance evaluation criteria are based on meeting the business plan or reconciliation of the forecast to the business plan (Mentzer et al., 1996, Mentzer et al., 1999).

Stage 2 - Performance Measurement. In Stage 2, some measure of forecast accuracy (generally mean absolute percent error--MAPE) is used as the sole metric of forecasting performance. Limited understanding of the forecasting process in this stage may cause some to incorrectly use the MAPE metric, possibly inflating the accuracy measure. In this stage, recognition exists of the impact of such external factors as economic condition, weather, and competitive actions on demand and, thus, forecast accuracy (Mentzer et al., 1996; Mentzer et al., 1999).

Stage 3 - Performance Measurement. In Stage 3, MAPE is still used as a measure of forecast accuracy, and concerns are shifted to measuring the impact of forecast accuracy on marketing and supply chain activities. The actual reporting of accuracy measures within this stage becomes more sophisticated including graphical presentation of accuracy and the ability to look at accuracy from various levels of the product (from unit demand to corporate dollar demand) (Mentzer et al., 1996; Mentzer et al., 1999).

Stage 4 - Performance Measurement. In Stage 4, the realization exists that forecasting error is partially a function of incorrect forecasts and partially a function of the inability of the supply chain to deliver the products when and where they are demanded. Thus, forecast error is not treated as an end result, but a problem to be investigated and controlled. Finally, multidimensional metrics are used to measure accuracy (as opposed to uni-dimensional metric of accuracy; e.g., MAPE) as well as the impact of the forecast on profitability, competitive strategy, supply-chain costs, and customer service (Mentzer et al., 1996, Mentzer et al., 1999).

Listed in Table 2.5 are the characteristics of companies within the four stages of the performance measurement dimension as determined by Mentzer et al. (1996).

Chapter Summary

An overview of forecasting management was presented in Chapter II. A discussion of forecasting in the hospitality industry was presented. The review of literature provided an in-depth look into research conducted in the area of restaurant and foodservice forecasting. The literature review also presented the management aspects of the forecasting process. A background to the sales forecasting model was presented, including discussion on integrating forecasting into management functions, forecasting approaches and forecasting techniques, forecasting hardware and software systems, measuring the performance of forecast measurements, forecasting accuracy, and management satisfaction of forecasting.

Table 2.5. Performance Measurement: Stage Characteristics (Mentzer et al., 1996; 1999)

Stage 1

- Accuracy not measured
- Forecasting performance evaluation not tied to any measure of accuracy (often tied to meeting plan, reconciliation with plan, etc.)

Stage 2

- Accuracy measured primarily as Mean Absolute Percent Error, but sometimes measured inaccurately (e.g., forecast, rather than demand, used in the denominator of the calculation)
- Forecasting performance evaluation based upon accuracy, with no consideration for the implications of accurate forecasts on operations
- Recognition of the impact upon demand of external factors (e.g., economic conditions, competitive actions, etc.)

Stage 3

- Accuracy still measured as Mean Absolute Percent Error, but more concern given to measurement of the supply-chain impact of forecast accuracy (i.e., lower acceptable accuracy for low-value noncompetitive products, recognition of capacity constraints in the supply chain and their impact on forecasting and performance, etc.)
- Graphical and collective reporting of forecast accuracy (throughout the product hierarchy)
- Forecasting performance evaluation still based upon accuracy, but there is a growing recognition that accuracy has an effect upon inventory levels, customer service, and achieving the marketing and financial plans

Stage 4

- Realization that exogenous factors affect forecast accuracy and that unfulfilled demand is partially a function of forecasting error and partially a function of operator error
- Forecasting error treated as an indication of the need for a problem search (for instance, POS demand was forecast accurately, but plant capacity prevented production of the forecast amount)
- Multidimensional metrics of forecasting performance--forecasting performance evaluation tied to the impact of accuracy on achievement of corporate goals (e.g., profitability, supply chain costs, customer service)