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## What Is World-Class Forecasting?: A Perspective on 20 Years of Research

Over the past 20-plus years, researchers at the University of Tennessee have focused their attention to the question of “What is world-class forecasting?” This research has manifested itself in four distinct phases, covering a variety of research techniques. It is ongoing today. This paper will first describe the four phases we have referred to as “the forecasting benchmark studies” and will then summarize the key findings of this 20-plus years of research effort.

### THE FORECASTING BENCHMARK STUDIES

The forecasting benchmark studies have been conducted over four distinct phases, beginning in 1982. Phases one and two consisted of survey research and were reported in *Journal of Forecasting* articles (Mentzer and Cox 1984; Mentzer and Kahn 1995). Phase three consisted of in-depth analysis of 20 high-performing companies and was reported in a *Business Horizons* article (Mentzer, Bienstock and Kahn 1999). Phase four consists of an ongoing effort to better understand best forecasting practices through individual company sales forecasting audits, and this research has been documented in a recent *International Journal of Forecasting* article (Moon, Mentzer and Smith, 2003).

The Phase one survey was conducted in 1982. Data were collected from 157 companies, and the survey focused on the primary topic of forecasting research at the time, which was statistical technique. Phase two was a replication and expansion of phase one. In the phase two survey, conducted in 1992, data were collected from 208 companies, and the technique focus was expanded to include questions on forecasting systems and management approaches. One of the most interesting findings from phase two was that overall forecasting performance had not noticeably improved during the 10 years of technological innovation between 1982

and 1992. In phase three, in-depth interviews were conducted with forecasting personnel and forecasting “customers” at 20 high-performing companies across a variety of industries<sup>1</sup>. This research was undertaken to try and gain greater insights into why forecasting performance had not improved along with the advances in statistical sophistication and computer technology. The insights gained from these three phases of the research then led to phase four, the forecasting audits, which have to date been conducted at 25 individual companies since 1996.<sup>2</sup> Thus, the database from which we can now draw our conclusions about “world-class forecasting” consists of the practices, successes, and problems 410 companies have experienced. In the following section, a framework for examining forecasting excellence will be articulated, and insights about world-class practices will be discussed.

### DIMENSIONS OF FORECASTING

One of the outcomes of the benchmark studies has been a framework for analyzing forecasting practices at individual companies (Mentzer, Bienstock, and Kahn, 1999; Moon, Mentzer, and Smith 2003; Mentzer and Moon 2004). According to this framework, forecasting management can be thought of along four dimensions: functional integration, approach, systems, and performance measurement. The following sections will discuss what world-class forecasting consists of across each of these dimensions.

### FUNCTIONAL INTEGRATION

There are three themes articulated in the functional integration dimension, each of which is critical to effectively managing the forecasting process. The first involves a concept we term forecasting C<sup>3</sup>—communication, coordination, and collaboration. Communication encompasses all forms of written, verbal, and electronic

<sup>1</sup> Anheuser-Busch, Becton-Dickinson, Coca Cola, Colgate Palmolive, Federal Express, Kimberly Clark, Lykes Pasco, Nabisco, J.C. Penney, Pillsbury, Prosource, Reckitt Colman, Red Lobster, RJR Tobacco, Sandoz, Schering Plough, Sysco, Tropicana, Warner Lambert, and Westwood Squibb.

<sup>2</sup> AET Films, AlliedSignal, Alticor, Avery Dennison, Bacardi USA, Conagra, Continental Tire, Corning, Deere and Company, DuPont, Eastman Chemical, Ethicon, Exxon, Hershey Foods, Lucent Technologies, Michelin, Motorola PCS, Orbit Irrigation Products, Pharmavite, Philips Consumer Electronics, Sara Lee Intimate Apparel, Smith & Nephew, Union Pacific Railroad, Whirlpool, and Williamson-Dickie.

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communication between the functional business areas of the company—marketing, sales, production, finance, and logistics (including purchasing)—as well as with entities outside the company (primarily customers). Coordination is the extent to which there is a formal process in place, usually manifested through formal meetings, that provides structure to the sharing of information between two or more functional business areas. Collaboration is an orientation among functional areas toward the common goals of forecasting excellence. The second theme found in functional integration involves the way a company organizes itself around the forecasting function. Finally, the third theme is the extent to which different individuals in different areas of a company are accountable for their contribution to the forecasting process.

World-class forecasting companies achieve functional integration that stresses forecasting C<sup>3</sup>. In addition, these companies extend their commitment to functional integration to include external collaboration with key customers and suppliers. Whether this is done in a formal CPFR (collaborative planning, forecasting, and replenishment) context, or whether it is done more informally through regularly scheduled meetings with customers and suppliers, world-class companies enjoy the enhanced forecasting effectiveness that comes from open sharing of information across company boundaries.

Also, world-class companies structure forecasting as a separate functional area, coordinating the forecasting needs of all functional areas and, thereby, reducing the adversarial negotiation approach exhibited by many companies—i.e., a true consensus approach. As a separate functional group that is not accountable to sales, marketing, or operations executives, forecasting can be far more unbiased. This group is often responsible for orchestrating a sales and operations planning process, and coordinating the flow of information from people who have it (i.e., sales and marketing) to people who need it (i.e., production, logistics, purchasing, and finance). This independent forecasting group is also frequently responsible for maintenance of forecasting systems, which provide full access to information that impacts the forecasting process and outcomes (e.g., capacity constraints, promotions, and advertising campaigns). Also, in world-class forecasting companies, performance rewards are based on the multidimensional nature of these feedback

loops. For example, instead of rewarding on forecasting accuracy alone, rewards are based on division or corporate profitability goals, customer service goals such as improved fill rates, or supply chain goals such as reduced inventory levels.

### **APPROACH**

The dimension of approach encompasses what is forecast and how it is forecast. There are seven themes that cut across the various stages of sophistication in the approach dimension. First is the orientation of the forecast, ranging from plan-driven, to bottom-up, to top-down, to both top-down and bottom-up, with reconciliation. The second theme is the approach the company takes to conceptualizing historical demand. This ranges from a simple notion of “demand = historical shipments” to a full effort to document all demand, even if that involves orders not placed. The third theme consists of the extent to which companies differentiate between more and less important products or customers in their forecasting process. The fourth theme involves the use of a forecasting hierarchy. The fifth theme considers the level of technique sophistication exhibited by the forecasting company. The sixth theme is the relationship between forecasting and planning. Finally, the seventh theme involves the level of training and documentation of the forecasting process.

World-class companies recognize that top-down and bottom-up forecasting approaches often result in two different answers, and they “dig into the numbers” to reconcile and understand those differences. An example here helps to illustrate these insights. Let’s say that a consumer packaged goods (CPG) company first forecasts in a bottom-up approach. Each of this company’s major retail customers predicts that demand for the CPG company’s products will increase by five percent next year because of increased marketing activity at the retail level. However, a top-down forecast reveals that demand for this particular product will be relatively flat. The “best” forecast is probably somewhere in between. Not every retail customer will increase demand by five percent, but increased retail marketing support may increase overall demand to some degree. Therefore, a thoughtful reconciliation of the bottom-up and the top-down forecasts give the CPG company great insight into its marketplace and results in a more accurate and useful overall forecast.

World-class companies are also more involved in vendor-managed or co-managed inventory arrangements with key customers, as well as formal or informal CPFR arrangements. Forecasts for these customers are managed separately and then ultimately merged into forecasts for non-vendor-managed inventory (VMI), customer-managed inventory (CMI), or CPFR customers. Further, a full range of segmentation factors are considered in determining the level of forecasting sophistication and accuracy required for each product and for each customer. These include the factors of an ABC analysis, two-bin designations, dependent demand products, and make-to-order products.

In addition, world-class forecasting companies have a complete forecasting hierarchy in place, allowing anyone to forecast at the level at which they have information, and allowing all users to extract information from the forecast at the level at which they need it. For example, salespeople can *contribute* forecasts at the product line level (if that is the level at which they most commonly operate), and distribution planners can *use* forecasts at the stockkeeping unit (SKU) level, without the need for cumbersome manipulation of the data. In addition, world-class companies take full advantage of all the various statistical tools at their command, appropriately using a suite of time-series tools for more short-range, operational-level forecasts and using regression tools for mid- to long-range, strategic-level forecasts. With a full appreciation of the intricacies of the business environment comes a recognition that a certain amount of “game playing” will occur in any forecasting process. For instance, salespeople often under-forecast to obtain lower quotas, and distributors often over-forecast to cause greater quantities to be produced and held in inventory to be available for their use. World-class companies recognize these natural biases and appropriately modify forecasts generated by these groups, thus improving overall forecasting accuracy.

Finally, in the approach dimension, world-class companies recognize that the business plan and forecasts are intertwined and should be developed together, rather than allowing one to drive the other. This final point is only achieved through top management’s recognition of the importance of forecasting, both to the business plan and to operational planning.

## **Systems**

The dimension of systems encompasses computer and electronic communications hardware and software that support the forecasting process. There are five primary themes that cut across the systems dimension: (1) integration of forecasting systems with other corporate systems, (2) how reporting is handled, (3) how historical data are maintained, (4) how performance measures are handled in the systems, and (5) the level of investment in system infrastructure.

World-class companies along the systems dimension have taken the concept of integrated supply chain software as far as is technologically possible, so that all systems that both contribute to forecasts and use forecasts can do so automatically. These companies utilize information protocols that allow the exchange of forecasting data with both suppliers and key customers. Most of the world-class systems companies have implemented, and in many cases progressed beyond, electronic data interchange (EDI) relationships and moved into Web-based environments that promote the exchange of important forecasting data. They have also implemented sophisticated report-generation systems that allow authorized personnel to design ad-hoc reports, in real time, and either view or print customized or routine reports as needed.

Another world-class systems characteristic is the implementation of sophisticated data warehouse systems that allow forecasts to be updated in real time. Since many companies process order data in real time, the ideal way to give users the most up-to-date forecast data is to allow access to that historical data in real time as well. Also, these best-practices companies have integrated performance measures tightly into their systems, made them easily available to authorized users, and made them highly visible in reports. And finally, significant investment has been made by these high-performing companies in the infrastructure that allows timely and continuous upgrades and enhancements of forecasting functionality, which is needed to support excellence in forecasting management.

## **Performance Measurement**

The dimension of performance measurement addresses what metrics are used to measure forecasting effectiveness and the information

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gathered to explain that performance. World-class companies realize 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. It is interesting that this concept was explored in depth more than 25 years ago (Bowersox, Closs, Mentzer, and Sims 1979) but is still a characteristic of only a handful of companies in our database. This recognition leads to treating forecasting error not as an end result, but rather as a symptom of a problem to be investigated further. For instance, investigation of a forecasting error may indicate that point of sale (POS) demand was forecast accurately, but a lack of communication with production failed to alert the forecast system that the demand forecast was beyond the production capacity of the supply chain. The solution to the forecasting “error” in this case is an adjustment to the forecasting information system.

Finally, world-class companies have moved beyond measuring forecasting performance by unidimensional metrics of accuracy (e.g., mean absolute percentage error (MAPE), percentage error (PE)). Multi-dimensional metrics are used that tap accuracy, as well as measure the impact of the forecast on profitability, competitive strategy, supply chain costs, and customer service.

### **Conclusions**

World-class forecasting is a moving target. The two things that have been constant over the last 20 years of research into forecasting practices is that nothing is static, and no company is world-class over all dimensions. Every organization has opportunities to improve on their forecasting practices. The good news is that most companies are now recognizing that excellence in supply chain management requires excellence in understanding and managing demand. Clearly, continued work needs to be done to remain current in forecasting best practices, which provide the opportunity for companies to achieve such

excellence. The research team at the University of Tennessee is committed to engaging in this critical endeavor.

### **References**

Bowersox, Donald J., David J. Closs, John T. Mentzer, and Jeffrey R. Sims (1979), *Simulated Product Sales Forecasting*, (Michigan State University Bureau of Business Research: East Lansing, MI).

Mentzer, John T., Carol C. Bienstock, and Kenneth B. Kahn (1999), “Benchmarking Sales Forecasting Management,” *Business Horizons*, 42 (May-June), 48-56.

Mentzer, John T. and James E. Cox (1984), “Familiarity, Application, and Performance of Sales Forecasting Techniques,” *Journal of Forecasting*, 3, 27-36.

Mentzer, John T. and Kenneth B. Kahn (1995), “Forecasting Technique Familiarity, Satisfaction, Usage, and Application,” *Journal of Forecasting*, 14, 465-476.

Mentzer, John T. and Mark A. Moon (2004), *Sales Forecasting Management: A Demand Management Approach*, Thousand Oaks, CA: Sage Publications, Inc.

Moon, Mark A., John T. Mentzer, and Carlo D. Smith (2003), “Conducting a Sales Forecasting Audit,” *International Journal of Forecasting*, 19, 5-25.

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