Demand Planning and Sales Forecasting: A Supply Chain Essential

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Effective demand planning and sales forecasting across the supply chain can bring a host of benefits. Specifically, it can help improve labor productivity, reduce head count, cut inventories, speed up product flows, and increase revenues and profits. This article views this critical supply chain activity from a number of instructive perspectives. And it offers a structure for linking business plans and sales forecasts both horizontally and vertically within the organization and collaboratively among the supply chain partners.

Demand planning and sales forecasting (DP&SF) is a critical consideration for manufacturers, distributors, retailers, and other supply chain members. It is a central activity for many mid- to senior-level executives who manage their companies' supply chain activities as well as those specialists responsible for developing and monitoring sales to forecasts, schedules, and budgets.

Yet despite the importance of demand planning and sales forecasting, a lack of communications within the company's functional areas and across trading partners often leads to separate and disjointed forecasts. To compensate for these uncoordinated forecasts and the related negative impacts on customer service, companies often resort to building excess inventories and fixed assets. And they turn to expensive premium freight.

What are the specific challenges faced by practitioners seeking to implement an effective DP&SF process? The answers are embodied in these kinds of questions:

- How can customers be integrated with other supply chain members to realize supply chain efficiencies?
- What role does the sharing of business plans and schedules play in demand planning and sales forecasting?
- What information technologies enable the realization of DP&SF goals?
- How do Vendor or Supplier Managed Inventories (VMI/SMI) relate to demand

planning and sales forecasting?

- How do channel members share the cost of inaccurate forecasts in terms of buybacks, reverse logistics of returns, ineffective promotional campaigns, and the costs of improved DP&SF?
- What metrics should be used to monitor improvement of the forecasting process?
- How can top management be sold on the ROI opportunities from these techniques and processes?

This article addresses these issues, while providing direction on obtaining the necessary resources to implement a successful DP&SF process that has real business value and high ROI potential. Importantly, it includes instructive first-hand perspectives from supply chain professionals who are deeply familiar with this process.

Needed: A Structured Approach to DP&SF

Demand planning and sales forecasting is receiving much attention in the literature as well as in educational programs and conferences. The topic is most often addressed as:

- An approach focused upon the use of statistical forecasting tools.
- An operations planning and budgeting process.
- An approach in which trading partners share production and operations schedules, data on sales activity, and/or information on inventory levels through VMI collaborative practices.
- An overall business planning and market forecasting approach.
- A behavioral approach requiring a forecasting champion and consensus team actions.[1]
- A step-by-step process flow to link and reconcile supply chain member forecasts.[2]

Advocates often make the argument for their particular approach to DP&SF without adequately identifying the linkages to the other perspectives. What's needed is a structured approach to identifying those linkages that gives forecasters and planners direction on when to use the alternative techniques.

In response to that need, the University of Wisconsin-Madison has conducted research to help stakeholders decide what forecasting approaches should be used to achieve improved supply chain results both within the organization and among the trading partners. The research also included a secondary search of the literature on DP&SF and interviews with leading company practitioners. This research was augmented with information from a recent UW-Madison seminar on best practices in demand planning and sales forecasting.

The research led to the development of a top-management event flowchart integrating the various decision levels of DP&SF. That flowchart, shown in Exhibit 1, illustrates how forecasting at five alternative business levels must be mutually supportive and reconciled to keep everyone moving in concert. The broad business perspective suggested by

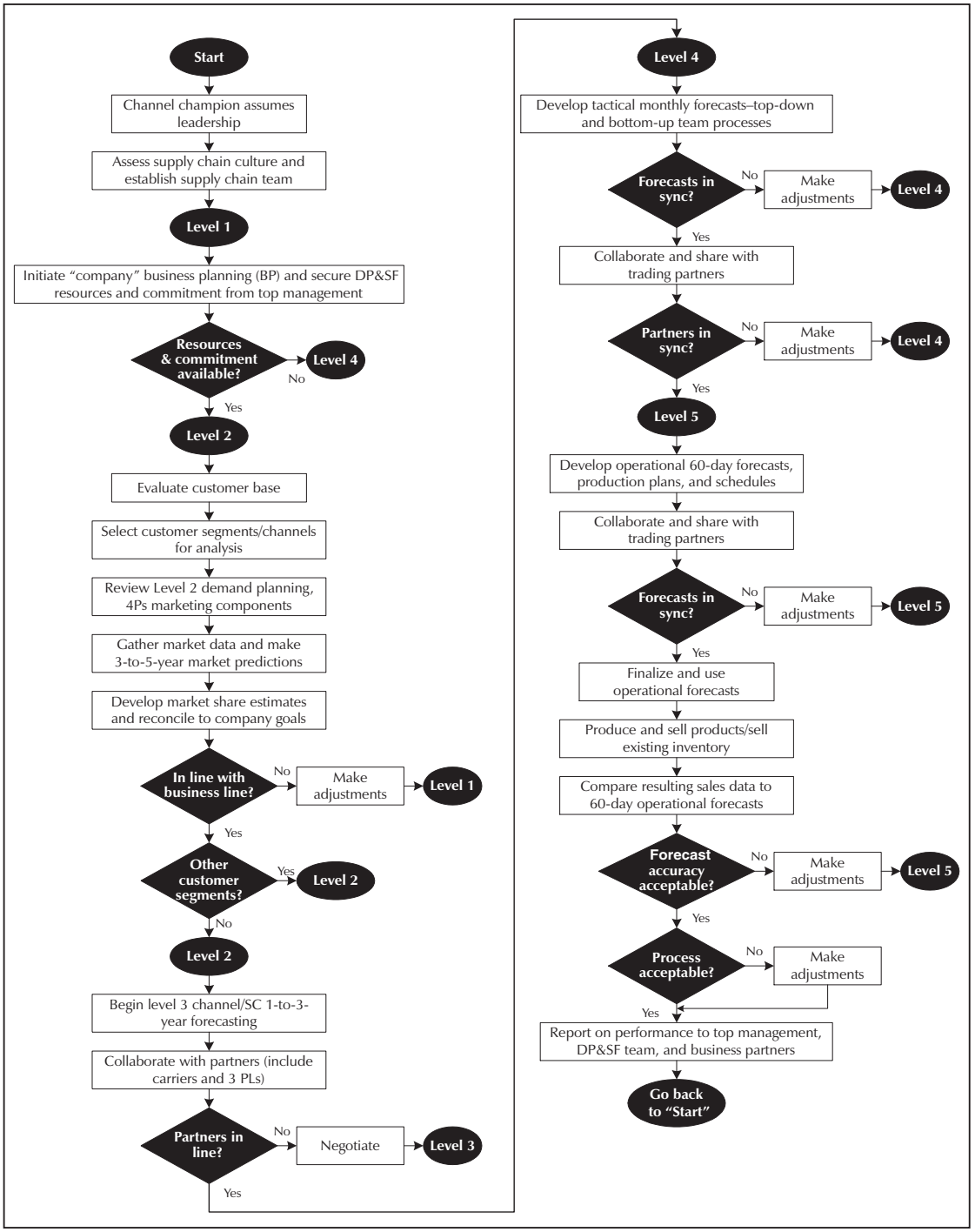

Exhibit 1. Event flowchart for demand planning and sales forecasting

the flowchart is critical because business plans and budgets drive the commitment of resources for supply chain activities.

To aid management and forecasters in deciding where to forecast and allocate resources, we then developed the DP&SF matrix shown in Exhibit 2. This aid identifies the key considerations in selecting the appropriate forecasting levels. The ideal is to adopt

Decision-Making Levels	**Level 1**
Selection Factors	**Strategic Planning**
Forecast and planning horizon	3 to 10 years
Business Purpose and Context for Forecasting	• Corporate vision and mission • Growth target trend • Enterprisewide • Top-level management is ultimately responsible
Forecast Measures	• Sale–gross and net • No. of customers, suppliers (increase/decrease) • Overall customer satisfaction
Customer Considerations	• Broad look at changing customer base • Technology used with major customers • What can be done to improve relationships?
Product/Market	• Decisions about entering new markets or leaving current ones • Life cycle–new product intros, discontinuations, modifications
Competition Influences	• Organizations in any industry that compete for same sales dollar
Analytical Tools and Database Considerations	• Category sales trends • Enterprisewide historical data • Econometric analysis • GIS analysis • Decision-support simulation
IT Systems Support	• Understand current system and future needs • Use of business planning information
Champion	• Lead executive available? • Executive as committee chair
Team Representation	• Top management executive committee • Outside consultants

Exhibit 2. DP&SF selection factors (continued on pages 130 and 131)

Level 2	Level 3
Macro/Market	**Channel/Supply Chain**
3 to 5 years	1 to 3 years
• Market share and penetration • Country and/or global markets analyses • Product and marketing managers responsible	• SCM mission/vision • Focus on each channel and channel partners' responsibilities • Take into account environmental changes
• Dollars • Pounds, gallons, etc. • Units • Variance analysis of actual to forecast	• Sales • ROI • Profit contribution • Service levels • Inventory turns • Operating costs
• Broad/generic levels of forecasts • Marketing channels • Customer segments	• Analysis of relationships with customers • Contract stipulations with customers
• Introduce product worldwide (if global)	• Changes to channel structure to enhance individual market presence and category profitability
• Organizations within the same markets	• "Systems" of companies, i.e., entire supply chains • Category management positions
• Macro information • Consumer and economic indices • Gap analysis • Judgmental surveys • Correlation analysis	• Customer and product level historical data • Regression analyses • Supply chain management software • Simulation, optimization
• Level of information sharing among business units, impact on forecast accuracy	• Determine integrity of channel partners' data • Reconcile forecasting methods
• Consensus team leader for marketing and sales • Product line managers	• Channel leader—supplier, customer, your company
• Cross-functional team including major customers and channel partners • In-house consensus team • Industry experts	• Cross-functional consensus team • Inter-organizational teams

Exhibit 2. Continued

Level 4	Level 5
Tactical and VMI/SMI	**Demand Operational**
2 to 12 months	1 week to 2 months
• Short-term objectives by product line and division • Channel member cooperation critical	• SKU projections • Focus on actual demand • Need to be reactive and flexible
• Units • Sales dollars • Pounds • Inventory levels/turns • Ton-mile, unit-miles	• Units • SKUs • Shipments • Variance analysis of actual to forecast
• Pareto analysis of customers and business relationships • VMI/SMI?	• Individual customer levels of interactions • Transactional shipment/sales analyses
• Focus on specific market areas • Promotions, unique market characteristics • Forecast demand at DC level	• Within markets—focus on individual customers and product line changes
• Direct competitors by product line • Impact of other divisions of same company	• SKU competition
• Strategic demand data • Recent historical data • Carrier information • POS/POU data • Forecasting tools • Optimization	• Short-term forecasting tools • Operating schedules • DRP/MRP outputs • POS/POU data • ASNs and other EDI
• Implement specific systems improvements • Determine integrity of detailed forecasting data	• Appropriate forecasting software • Partner feedback regarding system effectiveness
• Consensus team leader • Functional leaders	• Consensus team leader • Plant-level leaders • Functional leaders
• Cross-functional consensus team • Functional teams	• Cross-functional consensus team • Inter-organizational teams

Exhibit 2. Continued

the process approach shown in the flowchart. But the reality is that many companies initially have difficulty following such an integrated process flow. For them, the selection matrix becomes a more practical way of determining the starting point for making business decisions.

Five levels of DP&SF are addressed in the matrix: strategic planning, macro/market, channel/supply chain, tactical (VMI), and operational. The vertical topics in the first column identify areas to be considered in selecting and implementing each of these approaches. The cells within the matrix illustrate specific selection and implementation considerations for the topic and forecasting approach. Exhibit 2 thus provides a road map for helping companies implement the flowchart as they progress through the various stages of demand planning and sales forecasting.

The three real-world perspectives presented below highlight different components of the DP&SF process in action. First, Dean Jenson discusses how consensus decision making is an integral part of DP&SF at Rayovac. Note that the selection factors "Champion" and "Team Representation" in Exhibit 2 call for consensus decision making both among functional areas of the company and with trading partners. Consensus decision making based upon effective and diligent communications among supply chain parties is essential to sound DP&SF.

Next, Thomas A. Kozak and Eric Jones of Panduit, a leader in the electrical equipment industry, present their views on the evolution of Vendor or Supplier Managed Inventory within the context of DP&SF at the tactical and operational levels (Levels 4 and 5 of the matrix).

Finally, Eric Stellwagen of Business Forecast Systems presents sound advice on using forecasting tools particularly well suited for Levels 4 and 5.

Case Study: At Rayovac, Consensus Forecasting Starts with the Customer

The following observations are from Dean Jenson, supply chain manager for Rayovac Corporation.

An article appearing in *The Journal of Business Forecasting: Methods & Systems* by John Mentzer et al. made a strong case for adopting a consensus approach to forecasting and appointing a forecasting champion to help integrate and reconcile the process.[3] As an example of this approach, Rayovac has built processes using consensus decision-making teams. These teams bridge the gaps between top management's setting of Level 1 Key Result Goals (for example, the company will double its size within five years) and Level 5, where manufacturing develops short-term, two-month, and next week's production schedules.

Rayovac believes that the best information to drive a forecast starts with the customer. To that end, a team is implementing a process to build a forecast from the bottom up by getting consensus from sales, marketing, finance, and the supply chain group responsible for

forecasting, inventory management, scheduling, warehousing, and transportation. Within the process, controls are incorporated to meet corporate Key Results Measures, or KRMs.

This process is especially critical during annual planning. The annual planning process is a cross between bottom-up and top-down forecasting. It starts with top-down corporate Key Results Measures (such as growth, turns, and service levels), which are compared to the bottom-up forecast developed through consensus teams. If the bottom-up forecast does not meet the KRMs, meetings are held to align the two. The output is a realistic annual plan and forecast that are aligned for the first month. During the year, monthly consensus meetings are held to update the bottom-up forecast and compare it to the annual plan. Inevitably, the updated consensus forecast will deviate from the plan. During the consensus meetings, actions are taken to bring the forecast and plan into alignment.

Consensus forecasting forms the backbone of the bottom-up forecast. Four major domestic U.S. and international sales channels—consumer (food, drug, hardware, auto), mass merchandisers, industrial MRO, and OEM micro power—align the forecasting process with key customer forecasts. This provides the focal point for each channel's plans and forecasts. Prior to implementing consensus decision making, each functional area expended significant time and resources developing its own forecast—often without the tools or information to do the job properly. The result was multiple forecasts, second guessing, and general confusion when information was not relayed across the supply chain.

Rayovac found the following ingredients to be key in successfully implementing a consensus forecast process:

1. *Use the forecast to drive the business, not just to report accuracy*. For sales, the forecast will be used as a means of increasing customer-service levels; for marketing, measuring the effectiveness of trade and advertising programs; for finance, projecting and tracking returns to financial plans; and for the supply chain, driving production scheduling, inventory deployment, and capacity planning.
2. *Get people committed to one process*. Eliminate confusion over who should talk to whom. Get consensus on the forecast across all functional areas.
3. *Identify a forecast champion* who has the support of upper management. That individual must think cross functionally, possess clout within the organization, and demonstrate leadership skills.
4. *Utilize the right tools*. These include:
   - ► Forecasting software to initiate quantitative forecasts and to accommodate management overrides.
   - ► Supply chain software to track performance and connect to Enterprise Resource Planning (ERP) systems.
   - ► Communication software to download and upload forecast information across functional areas in an easy-to-use manner.

   Designing Rayovac's consensus model was a cross-functional effort. This required staff

from each functional area to be in the same room, understand the needs of the other areas, and negotiate alternatives to arrive at an optimal process.

The monthly process to develop a Level 5 operational consensus forecast has specific steps for each week.

Week 1: The Supply Chain group uses forecast models to build and maintain three forecasts: (1) a quantitative forecast with history filtered to add or remove non-recurring events; (2) a consensus forecast, which includes qualitative overrides, that drives the business; and (3) an annual operating plan based on key result measures. This forecast is completed at the beginning of the year. It is used as a barometer of how the consensus forecast is attaining Key Results Measures.

Data for the baseline forecast are sourced from customer point-of-sale (POS) information, warehouse pulls, orders, or invoices for product shipped. The forecasting software tests multiple variations of forecast models and selects the "best" model based on sample data. Models are maintained for the top customers that represent 80 percent of the business. The remaining customers are grouped into "all other" by sales channels. The forecast is for consumer package sales, and the forecasting software contains conversion factors for dollars and manufacturing units. Forecasts are automatically developed at three levels of a product hierarchy—SKU, product group, and product family. The forecast analyst reconciles any differences. Accuracy is tracked for the 30-, 60-, and 90-day forecasts.

Week 2: Sales and supply chain management review the information and enter overrides to the consensus forecast. The main level of engagement is the customer/product family/month level. For unique promotions or new customers, SKU level detail becomes the main level of engagement. For Vendor Managed Inventory customers, inter-organizational teams work at lower levels of the product hierarchy using tools to analyze POS data and inventory activity EDI 852 transactions used to transmit POS information.

Week 3: Consensus team meetings are held. Teams are organized around the four major sales channels and include leaders from each functional area such as sales, marketing, finance, and supply chain, which includes manufacturing, distribution, and transportation plus purchasing as a recipient of detailed forecasts. During the meeting, the teams review KRMs, forecast accuracy, and the consensus forecast updates made in Week 2. If there are differences between consensus forecast and plan, the teams discuss tools available to change customer demand or prepare a revised plan for management. This is an interactive process that provides ample early warning to adjust expectations (either up or down). If changes to the forecast are appropriate, overrides are entered at the customer/SKU level. This process ensures team ownership of and accountability for the forecast.

Week 4: The supply chain group disaggregates the company forecast to distribution center levels and pushes the forecast into the ERP system. During this process, inventory levels and production schedules are optimized. The plans are shared with purchasing to assist upstream suppliers. Pushing the forecast through an ERP system keeps all func-

tional areas marching in the same direction. In the future, information will be passed on to other partners in the supply chain, including carriers and logistics services providers.

At Rayovac, consensus forecasting is the responsibility of the cross-functional team, not one function. Each team has a scorecard of service levels and forecast accuracy for customers in its channel. Inventory turns for the entire company also are reported. The team shares the risks and lives by the consensus forecast. If actuals come in significantly greater than forecast, service levels will suffer. If actuals come in significantly lower than forecast, inventory turns suffer. Forecast error will never be completely eliminated. However, processes are in place to minimize the number of surprises during a month, which smoothes production scheduling and inventory planning. In combination with higher service levels, this directly affects ROA and ensures continuing support for consensus forecasting.

Industry Trend: The Evolution of Vendor Managed Inventory

The flowchart and matrix depicted in Exhibits 1 and 2 respectively identify collaborative planning and forecasting as a means to realize corporate and supply chain goals. VMI has received much attention in the last few years as a critical means of improving the planning and forecasting process. Essentially, VMI addresses the questions of how to use shared sales and inventory data among supply chain partners and who is responsible for supply chain sales and inventory levels.

Thomas A. Kozak and Eric Jones of Panduit Corporation, an electrical and communications component manufacturer, have been working on various VMI approaches to customer fulfillment. As they discuss below, Panduit has observed VMI evolve in three stages, enabled by advances in information technology. (Kozak has since become president of Pan-Pro LLC, a Panduit subsidiary specializing in VMI consulting.)

VMI I—Legacy Vendor Managed Inventory

In the late 1980s, Wal-Mart and Kmart, two retailing giants committed to reducing supply chain cost, fostered the implementation of a "best practice" termed the Continuous Replenishment Process. CRP was really the beginning of Vendor Managed Inventory. It used forecasting technologies and electronic data interchange (EDI) to minimize inventory at the retailer's existing distribution centers by exploiting the supplier's flexible manufacturing capabilities. The combination of electronic communications and a substantial reduction in the overall replenishment cycle time produced dramatic results. Both the retailer and the supplier benefited from faster turnaround and lower costs. The ultimate end-consumer benefited from a better selection at lower prices.

CRP, though a significant breakthrough, was not without a number of limitations. For one thing, the system was driven by inaccurate forecasts. For another, the replenishment

method was static, based on fixed order point/order quantity (OP/OQ), and assumed a fixed order cycle, typically weekly. This led to unnecessary inventory during slow periods and service interruptions and stock-outs during peak demand. Finally, CRP did not produce an order. Instead, it suggested an order, which meant that purchasing still incurred the costs of administering order fulfillment.

VMI II—The Concept in Transition

VMI's effectiveness improved in the next stage as retailers and manufacturers implemented data interchange tools. Replenishment became driven by customer demand. Forecast methods were used only to find the most optimal replenishment path. "Pull replenishment" presented a dynamic alternative to reorder point systems; fitting inventory management to actual demand resulted in improved service levels at the lowest total cost. Automatic order entry and billing was integrated into dynamic inventory management. This eliminated routine, repetitive purchasing activities and all associated costs.

In 1994, the National Association of Electrical Distributors (NAED) adopted a standard format called EDIPro. This format eliminated the need for a middleman to translate necessary data between enterprises in the electrical industry. Programming was done once and then reused with each additional VMI partner in turn. New levels of profitability and competition were now possible.

VMI II is having a profound impact on business. Two significant outcomes of VMI II implementation have flowed from the standardization of the communications interface:

- *A Spotlight on Performance.* With the communications improved and standardized, process execution takes on new importance. To illustrate, it does no good to be able to generate and place orders at nearly the speed of light if the product is not consistently available within the stated leadtime. For this reason, the true pioneers continue to reengineer their businesses both in the back rooms and in the systems that support them. By driving out time, waste, errors, and complexity from their internal operations, the alliance partners are exploiting the VMI communications infrastructure to achieve new levels of profitability.
- *Service Level and Forecasting Limitations Identified.* The second outcome is more far reaching. Essentially those companies that have restructured their businesses while implementing VMI alliances are discovering the limitations of traditional service-level management and forecasting techniques. This realization, combined with even higher customer expectation levels, is moving the industry to a new, third generation of vendor managed inventory—VMI III.

VMI III—The Future Is Near

Predicting the future can be hazardous. But certain developments and trends are pointing to a new level of VMI that will greatly enhance supply chain efficiency.

Among the most important to watch for are these:

Automated In-Transit Management. Multinational corporations have been using mixed-mode transportation in their cross-continent replenishment for years. Typically, they use ocean containers for the majority of their shipments, while relying on airfreight to cover demand patterns outside of the statistically probable or to respond to problems resulting from human error. As with any process, if the decision points and the decision criteria can be defined, the routing can be automated. Note that some companies with the right type of product (small, lightweight, and high dollar density) are routing all shipments by air to eliminate both the long cycle times associated with ocean shipments and the related warehousing costs in brick, mortar, systems, and personnel in the receiving continent.

Demand Balancing. The second-generation VMI process is being modified to automatically detect daily demand patterns that are outside of the statistically probable. The likelihood of an imminent stock-out condition then is automatically and continuously evaluated. An air shipment of the minimum required quantity is initiated automatically if shipments already in the pipeline are insufficient to meet demand.

SKU-Level Inventory Management. State-of-the-art inventory systems allow distributors and their trading partners to make finer cuts when segmenting their inventory. And this, in turn, lets them manage products on the basis of very specific demand patterns. Because of the limitation of older computer systems, similar types of products had to be managed identically—even though they had very different demand patterns. But today, segments can be based on the product's velocity or variability. For example, a brand of cat food that comes in six flavors might be managed to achieve a single in-stock and service level, even though two of the flavors account for 80 percent of the sales. With systems capable of managing down to the SKU level, items can be segmented in several classes based on sales. High-velocity items can be managed under high service levels, and low-velocity items under low service levels. Overall service levels will stay constant or increase, while the required inventory decreases.

End-Customer VMI. With VMI III, the supply chain management process will move further down the chain to the distributor's large customers. The distributor could offer VMI to his large customers, perhaps OEMs. In some sectors, a more traditional replenishment method could be used. In either case, the power of the concept is evident: higher service levels for a given (in many cases, lower) inventory investment. With both the supplier/distributor and the distributor/end-customer links automated, routine repetitive labor is removed and additional inventory may be pulled out of the channel.

Materials Requirements. IT implementations will combine VMI replenishment techniques with planning schedule data derived from the end-customer's MRP systems. Essentially, these systems will replenish based on demand "pull" data combined with data derived from the forecast. This process links the planning schedule data with longer-term forecasting data in a process similar to the familiar "projected available balance" MRP

logic. The result will be less inventory at the distributor and JIT delivery to the customer's work stations.

Automated Receiving. Automated receiving removes barriers to the ultimate in VMI implementation, thereby improving end-customer service and taking costs out of the distributor's organization. By combining the bar-coded Serialized Shipping Container Code (SSCC-18)—the "license plate" on the shipping container—with shipment information electronically preloaded into the receiver's computer, the receiving process is completely reengineered. This facilitates the shift to employing the best carrier for each specific situation—parcel, air, LTL, truckload, or ocean container.

The combination of the SSCC-18 bar code and the advance shipment information via EDI can effectively eliminate presorting by suppler, sorting by purchase order, manual receiving, and, for qualified suppliers, the incoming inspection and count activities. This system radically reduces the labor associated with putaway and cross docking. All it takes is a simple, reliable bar code scan at whatever level is appropriate for the shipment method—carton, pallet, truck, package. This system can literally instruct the receiving personnel to stage certain material for immediate re-shipment and to store other material in the warehouse. And by moving VMI II's receiving information from the shipment to the carton (the "license plate") level, the VMI partners can really understand the carrier-specific shipment in transit times. That information supports and encourages further sophistication and cost reduction within the framework of the VMI III replenishment process.

The future of VMI III is not that far off. In fact, all of the VMI III projections above, with the exception of the planning schedule data, can be achieved within the standard VMI transaction sets defined within EDIPro. The ANSI 830 planning schedule transaction, moreover, now is going through the standardization process and soon will be added to EDIPro as well.

Technology Update: The Tools for Better Demand Planning

Eric Stellwagen, vice president of Business Forecast Systems Inc., presents the following guidelines for using today's information technology for DP&SF.

The increasing pressure on corporations to improve their forecasting has spawned a growing demand for easy-to-use forecasting software. Forecasts drive demand planning. The more accurate your forecasts, the better your planning—it is that simple. Improving the accuracy of your forecasts results in decreased stockouts and lower inventories. Thus, the forecast's contribution to the company's bottom line is—or should be—measured in dollars.

Three Forecasting Approaches

Most companies follow one of three approaches to generating their forecasts: judgmental, simplistic, or statistical.

Judgmental Approaches. The advantage most frequently cited for judgmental approaches is that they allow the forecaster to incorporate domain knowledge. This knowledge can come from many sources, including experience with similar products, feedback from sales staff, customer surveys, and focus groups. Another advantage is that judgmental approaches do not require statistical expertise or historical data.

The problem with judgmental forecasting, however, is that it is subjective. Company politics, sales goals, and wishful thinking often bias forecasts. Fine-tuning and improving a system that is based on a judgmental forecast is extremely difficult. Judgmental forecasting also is expensive because of the high cost of human time. If forecasts are needed for hundreds or thousands of SKUs, judgmental forecasting is simply not possible.

Simplistic Models. Many corporations implement, or use software that implements, simple quantitative algorithms to prepare the forecasts. These include methods such as moving averages, same-as-last-year, percentage growth, best-fit line, and others. These methods are appealing because they are easy to implement, easy to understand, and quick to execute. They are commonly found in older demand-management systems, often with an automatic algorithm for selecting which model to use based on the historical fit.

These simplistic approaches should be avoided. If you are going to use a data-based approach to forecasting, superior algorithms now available can capture a wider array of behaviors that will generate more accurate forecasts. A new generation of forecasting software automates these more sophisticated algorithms, making them accessible to all.

Statistical Approaches. Statistical forecasting models fall into two broad categories, univariate and multivariate. Univariate methods (also referred to as time-series methods) work with the past history of what you are forecasting—for example, the monthly demand history of a given SKU for the last four years. They capture patterns such as the level, trend, and seasonal patterns and extrapolate them forward. Examples of time-series methods include exponential smoothing models, Box-Jenkins models, and Croston's intermittent demand model.

Multivariate approaches combine time-series approaches with the ability to include explanatory variables such as promotional schedules, price information, and economic indicators. Examples of multivariate methods include dynamic regression models, event models, and neural networks.

Statistical forecasting methods virtually always outperform the simplistic models in terms of forecast accuracy. One reason for this is that the simplistic models often are special cases of the more general statistical models. It is harder to evaluate the performance of statistical models vs. judgmental approaches, except in particular cases. In our experience, most corporations that adopt statistical methods realize fairly significant gains in forecast accuracy. Statistical methods also allow the forecasting process to be automated and provide confidence intervals that can be used to set stocking levels and assess risks of various inventory and production levels.

Forecasting Software

Most forecasting software falls into one of the following four categories:

1. *Spreadsheets* are often used to generate forecasts—they shouldn't be. Although it is easy to implement simplistic forecasting models on a spreadsheet, these models should be avoided (see discussion above). Spreadsheets and relational databases can provide convenient environments to store historical data, monitor forecast accuracy, and generate reports. In addition, most forecasting packages are designed to interface with these products.
2. *Broad-based statistics packages* are designed for statisticians. They offer a wide range of analytical tools. Forecasting is almost always available, usually as an optional module at extra cost. These packages assume a strong quantitative background on the user's part and require that all model-building and validation decisions are made by the user. Examples of popular general statistical packages include SAS and SPSS.
3. *Business forecasting packages* are designed for business people. They tend to incorporate the forecasting methods best suited to corporate data such as exponential smoothing, Box-Jenkins, Croston's intermittent demand model, event models, and dynamic regression. They offer a high degree of automation in terms of model selection and validation, allowing the non-specialist to use the packages effectively. Most offer the ability to judgmentally override the statistical forecasts. Some even offer the capability to define and reconcile hierarchical forecasts. Examples of popular business forecasting packages include Forecast Pro and Autocast.
4. *Forecasting engines* are designed to generate large numbers of forecasts automatically. Most forecasting engines can operate either independently or integrated with some type of planning system (ERP, MRP, supply chain, and so forth). Though similar to business forecasting packages in terms of functionality, they are designed to handle large-scale jobs. Both of the business forecasting packages identified above offer "batch editions" (forecasting engines).

Some planning systems, particularly those encompassing supply chain management, include built-in forecasting capabilities. Some are based on simple methods, others on statistical models. The good ones feature an array of statistical models, automatic model selection, hierarchical forecasting, forecast adjustment, forecast performance monitoring, and the ability to maintain multiple forecast scenarios. There are scores of these systems available. They run the gamut from fairly simple demand management packages costing less than $10,000 to all-inclusive corporatewide solutions priced at millions of dollars. Examples of economically priced demand-management systems with integrated forecasting include OptiPlan and Demand Solutions. Examples of higher-cost all-inclusive forecasting and planning systems include i2 Technologies, Logility, and Manugistics.

Making Improved DP&SF Happen

Regardless of where you start in the demand planning and sales forecasting process—or where you ultimately want to end up—you need resources. Top management must be sold on the expected ROI in order to commit those resources necessary to achieve the desired business and supply chain results. The resources needed to institute DP&SF as a business-improvement process include the following:

- ► People, both within the organization and among the trading partners:
  - How many people and person-hours devoted to DP&SF?
  - Number of teams?
  - Functional commitments?
  - DP&SF champion?
- ► Systems:
  - Dollar requirements?
  - Degree of systems implementation?
  - Required outside software and consulting assistance?
- ► Operating materials, supplies, and communications systems.

In addition to committing the necessary resources, management must put ground rules, policies, and procedures in place. Project activities and time estimates are essential. Meeting schedules need to be planned. Strategies for managing product lines, locations, categories, and SKUs must be developed.

Performance measures also must be set in such key areas as cost savings, sales impact, gross margin impact, capital and operating expenditures, inventory turns and reductions, and ROI. Measurements also need to be developed on the number of accounts on Vendor Managed Inventory and running CRP. How well the trading partners are sharing information needs to be measured, too.

Finally, for a successful implementation, the causal forces affecting DP&SF results must be examined. These include such issues as Pareto ABC effects, SKU differences, functional differences/similarities, product lines and divisional differences, business unit differences, carrier and third-party provider impact, new product introductions, product promotions, and manufacturing/engineering changes.

Through the research findings and the first-hand experiences, this article has sought to give readers direction in structuring, organizing, and implementing demand planning and sales forecasting for supply chain management—in short, to make DP&SF happen. The research findings, in particular, underscore the technical side of DP&SF as well as the important "people" side of this critical supply chain management process.

At a recent University of Wisconsin-Madison seminar of best practices in DP&SF attendees identified four opportunity areas to improve the impact, accuracy, and timeliness of DP&SF. These action areas are cited to give readers direction in getting started. The seminar attendees agreed that companies need to develop:

1. *Consensus decision making* across functional boundaries both within the firm and externally with allied trading partners.
2. *Integrated and reconciled forecasts* among stakeholders.
3. *Effective use of information technologies and forecasting tools* as the enablers for realizing potential gains from shared information.
4. *Top management buy-in* of the first three action areas to minimize conflicts and inefficiencies in DP&SF. This commitment will save supply chain resources and ultimately yield competitive advantage.

Notes

1. Chase, Jr., Charles W., "Getting People to Use Your Forecasts," *The Journal of Business Forecasting: Methods & Systems,* Spring 1998.
2. Stack, Jack, "A Passion for Forecasting," *Inc.,* November 1997.
3. Mentzer, John T., Mark A. Moon, John L. Kent, and Carlo D. Smith, "The Need for a Forecasting Champion," *The Journal of Business Forecasting: Methods & Systems,* Fall 1997.

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