Service and Asset Management
Part One in a Five-Part Series

OPTIMAL SERVICE-PARTS MANAGEMENT

LESSONS FROM THE CAT LOGISTICS BEST-IN-CLASS PROCESSES FOR DEMAND PLANNING

THE BEST-RUN BUSINESSES RUN SAP™

CONTENT

EXECUTIVE SUMMARY

OPERATING AT A NEW LEVEL OF FLEXIBILITY AND RESPONSIVENESS

Today's service-parts organizations, such as those in the aerospace and defense, automotive, agricultural, heavy equipment, and industrial machinery and components industries and segments, are pursuing the service-parts and spare-parts markets for revenue and profit growth. Increasing customer demands and a dynamic marketplace are forcing these organizations to operate at a new level of flexibility and responsiveness, in order to efficiently address customer requirements and attain desirable profit margins.

Ultimately, to reduce costs and improve service effectiveness, service-parts organizations must shift from being reactive to being proactive service providers. They must effectively address a range of issues related to service levels, inventory investment, transportation, fulfillment, and value-added services. By combining best-in-class processes and planning techniques supported by an appropriate IT infrastructure, organizations of all sizes can gain efficiencies and boost the success of their service-parts management businesses.

This paper is the first in a five-part series that describes the best-in-class processes of Cat Logistics Services Inc. (Cat Logistics), a wholly owned subsidiary of Caterpillar Inc., and the paper focuses on demand planning. Cat Logistics has leveraged its decades of experience managing large, multitiered networks and supporting the service-parts logistics needs of global companies to develop best-in-class processes that are applicable across a range of industries.

INTRODUCTION

ADDRESSING AND MANAGING DEMAND-PLANNING ISSUES

According to an Aberdeen Group study, 67% of OEM companies surveyed say service-parts inventory optimization is "extremely important"; 24% say it is "very important."

The Convergence of People and Parts in the Service Chain, Aberdeen Group

Organizations – including those in the aerospace and defense, automotive, agricultural, heavy equipment, and industrial machinery and components industries and segments, to name a few – are pursuing the service-parts and spare-parts markets for revenue and profit growth, which is a complex challenge for companies serving demanding customers in a dynamic marketplace. Although service-parts sales generate high margins and contribute significantly toward profits, organizations must address and manage a number of issues to be successful, such as the following:

- **Service levels** – How long will a customer wait for a specific part before going to a competitor? What level of service will increase the likelihood of the customer placing repeat orders for the original product?
- **Inventory investment** – How much inventory is needed, and where should it be placed to satisfy the service-level requirements? While this is a fairly straightforward decision for fast-moving parts, it is quite challenging for slow-moving parts, which make up a majority of parts serviced.
- **Transportation** – What are the various transportation modes available to meet customer requirements, and what are the associated timings and costs?
- **Fulfillment centers** – How many fulfillment centers are needed, and where should they be located?
- **Value-added services** – Which value-added services, in addition to the normal services provided, can the organization offer to differentiate itself from the competition?

Increased customer service demands are dictating new approaches to service-parts management that require commitments to inventory availability and delivery dates. This trend requires a new level of flexibility and responsiveness; organizations need to make decisions more quickly, and the flow of work through the organization has to be efficient and focused on the proper priorities.

Cat Logistics knows firsthand that well-executed logistics can have a profound impact on a company. For more than 80 years, its parent company, Caterpillar Inc., has been building the world's infrastructure and, in partnership with its worldwide dealer network, has been driving positive and sustainable change on every continent. In 1987 Cat Logistics was formed as a wholly owned subsidiary of Caterpillar Inc. in order to provide world-class logistics solutions to other companies. Today Cat Logistics serves more than 65 client companies – including its parent, Caterpillar Inc. – in an array of market sectors worldwide.

Cat Logistics understands that shareholder value is directly linked to rapidly evolving supply chain management process improvements that enhance customer service and help achieve higher revenue and margins while reducing costs. The company's culture revolves around a large-volume and high-velocity business, a commitment to total customer satisfaction, and a continual pursuit of process efficiencies. These considerations have driven the company to an integrated problem-solving approach – one that involves first identifying a problem, then rolling up the sleeves to analyze the root cause, and finally implementing a sustainable solution that improves the overall business. Cat Logistics accomplishes progress by working toward a practical reality under an operating philosophy that drives results. Integral to this concept is its staying connected to its dealers and responding to customer demands as quickly as possible. A key factor is a highly integrated service-parts planning and management solution that helps Caterpillar drive success from its parts and service – and ultimately realize additional sales of its equipment.

According to industry standards, by investing in integrated solutions to address inventory planning, manufacturers can realize inventory reduction of 30% to 50%, sales lift of 10% (with increased availability), and productivity increases of 30% to 40%.

This paper is part one in a five-part series that describes Cat Logistics' combined know-how and best-in-class processes gained from decades of experience managing large, multitiered networks and supporting the service-parts logistics needs of global companies with diverse product lines. The series is organized around the operational processes illustrated in Figure 1, and this paper focuses specifically on demand planning. The key operational processes listed in the figure form the foundation of an effective service-parts planning and management system.

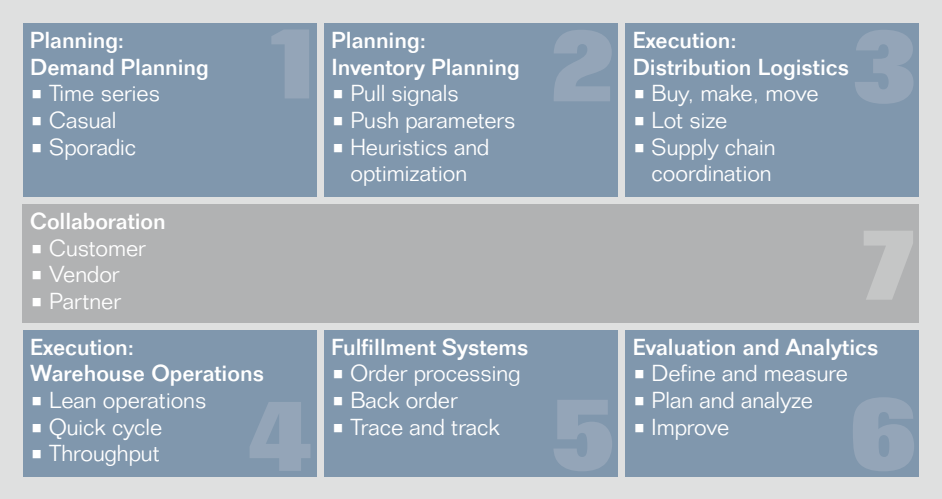

Figure 1: Operational Processes for Service-Parts Logistics

MULTIECHELON, OR BILL-OF-DISTRIBUTION, NETWORK

PROTECTING AGAINST DEMAND FLUCTUATIONS

Cat Logistics runs a bill-of-distribution (BOD) model in which facility master, or "parent," points are responsible for replenishing "child" points. At the highest-level parent, where inventory comes in from the supplier (that is, the BOD entry point), Cat Logistics forecasts demand and calculates forecast variation across the entire network. Then it calculates safety stock for the entry point to ensure that the network is protected against demand fluctuations over the supplier's lead time.

A key component in Cat Logistics' success is its ability to assign each part number to a unique BOD. The BOD defines the warehouse or facility hierarchy per part number, which forms the basis for most planning and distribution decisions, such as forecasting (aggregation and disaggregation), distribution requirements planning (DRP), and deployment. This arrangement allows the utmost flexibility in determining how child points are replenished from parent points and in defining where parts enter the network (a single entry point or multiple entry points), which can be changed over time to meet business requirements. As BODs change over time, planning functions – including demand management, requirements planning, and deployment – automatically consider the appropriate BOD for optimal planning of the network. In fact, it's possible to plan for future BOD changes: using the effective date of a planned BOD change, the system makes plans based on which BOD is in effect for the period being planned.

Assume that a global organization like Cat Logistics has the following fulfillment centers, as shown in Figure 2: A1, E1, and AP1 are the masters in their associated regions – Americas, Europe, and Asia Pacific, respectively. If there is one worldwide supplier for part number 1A1 and that part number is not used in Europe, a BOD (such as the one illustrated in Figure 3) can be defined for planning and execution purposes.

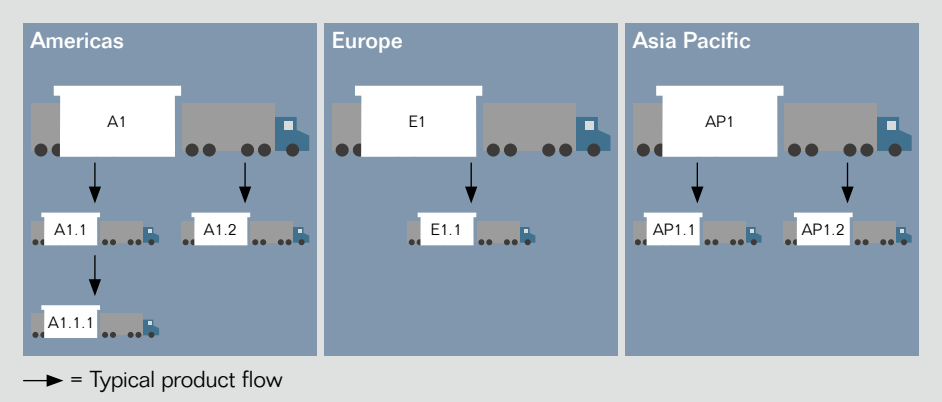

Figure 2: Fulfillment Centers

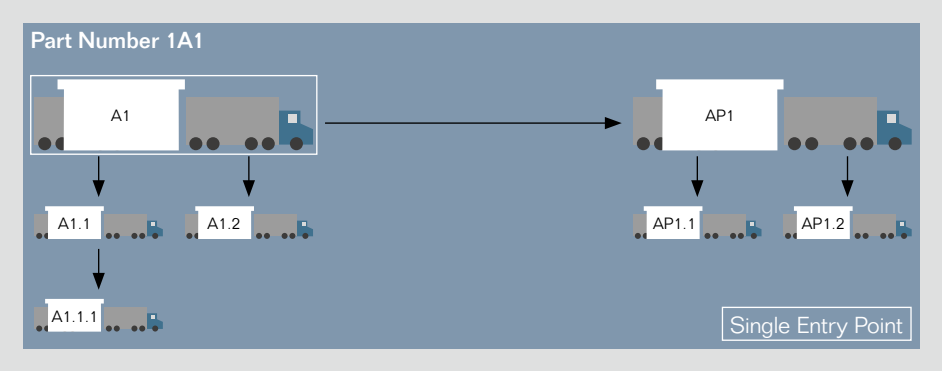

Figure 3: Bill of Distribution

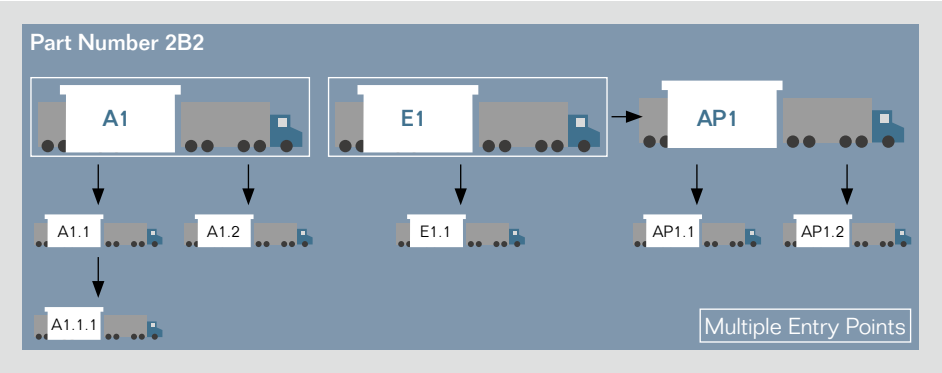

Figure 4: Part Entering Network at Multiple Entry Points

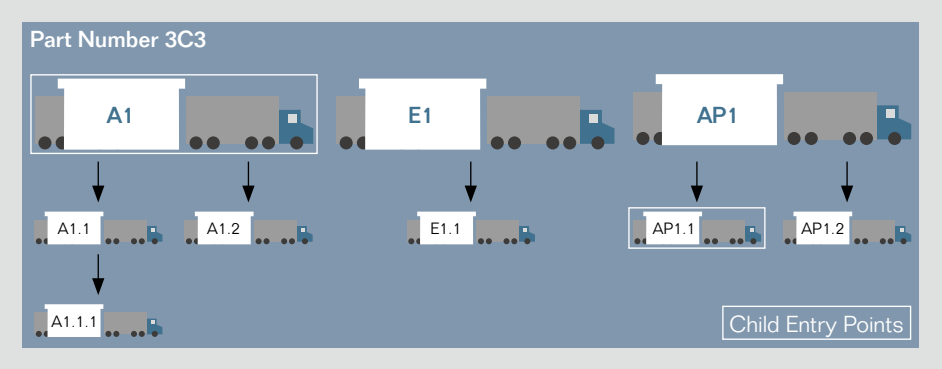

Figure 5: Network Correctly Planning and Distributing Material for Entry Point

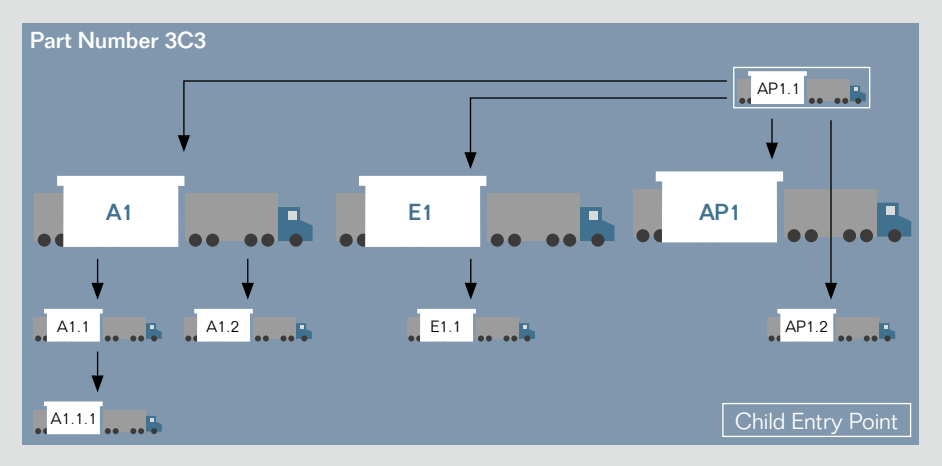

Figure 6: Overall Bill of Distribution

For part number 2B2, the organization has suppliers in both the Americas and Europe, so the part enters the network at multiple entry points: A1 and E1 (see Figure 4). If a supplier is located close to a facility that is typically a child point, this facility can be designated as an entry point and the network will correctly plan and distribute material for this entry point (see Figure 5). The overall BOD is represented in Figure 6, where AP1.1 is the entry point.

Without this flexibility, a number of inefficiencies are introduced, including additional transportation and handling costs, additional inventory, and longer lead times for fulfillment. The organization would need additional amounts of safety stock to compensate for these longer lead times. For example, when Cat Logistics managed clients without being able to assign a part number to a unique BOD, product supplied from Japan had to be shipped to the United States, then to Singapore, and then back to Japan. This inefficiency resulted in incredible waste.

As organizations expand globally, it is quite common for a BOD to change over the life of a part. In the example illustrated in Figures 7, 8, and 9, an organization began manufacturing in one region (Americas, Figure 7), but because its sales growth justified manufacturing in another region (Asia Pacific), it now has two suppliers. The organization can quickly modify the BOD so that each region can be supported by the local supplier (see Figure 8). As demand shifts along with other business requirements over the years and manufacturing is no longer justified in

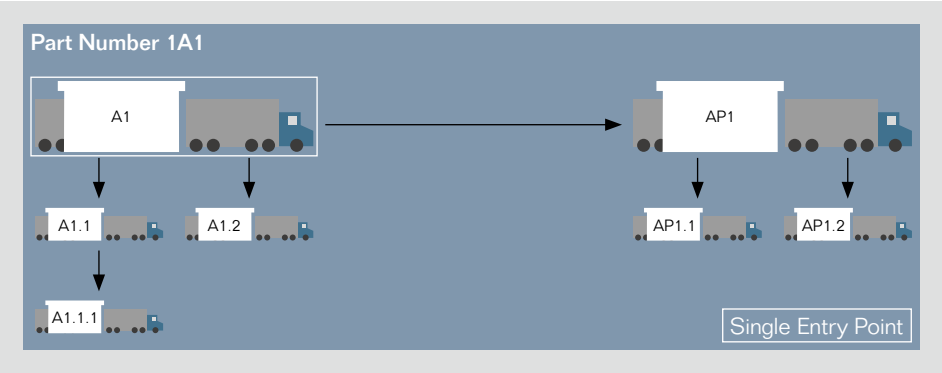

Figure 7: Organization Manufacturing in Another Region with Two Suppliers

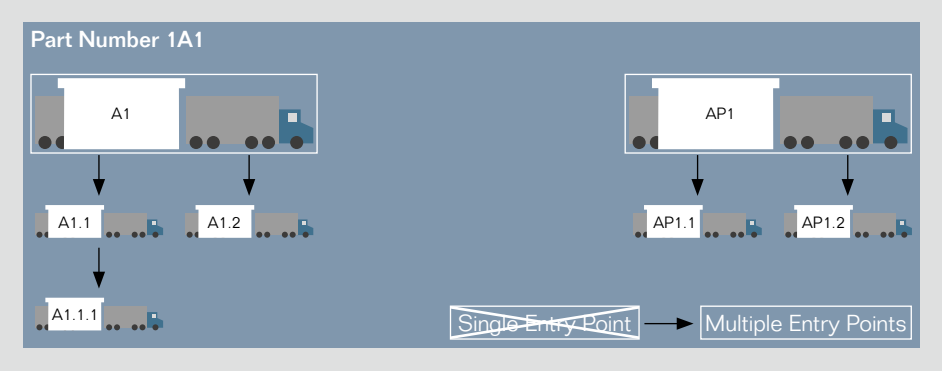

Figure 8: Modifying Bill of Distribution, So Regions Can Be Supported by Local Suppliers

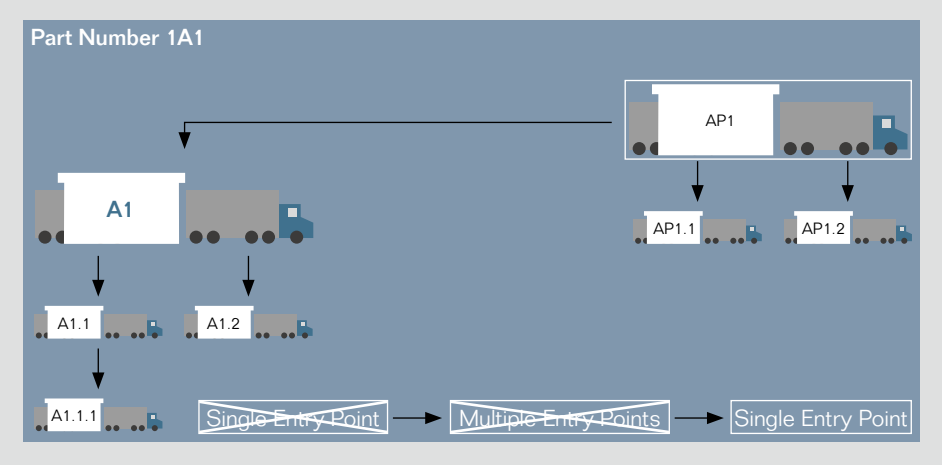

Figure 9: Modifying Bill of Distribution Again, to Reflect the Current Situation

the Americas, the company could again modify the BOD to reflect the current situation (see Figure 9).

In general, Cat Logistics has found that the ability to operate a flexible, multiechelon network can improve service levels by as much as 4% to 6% (assuming existing levels of 90% and more) while reducing inventory by 20% to 30%, materials staff by 30% to 50%, and transportation costs by 15% to 30%. As will be discussed in the second paper in this series, the BOD can also influence inventory planning decisions, particularly in relation to the placement of slow-moving inventory in the network.

DEMAND PLANNING
GENERATING A MARKET-DEMAND FORECAST

To satisfy original equipment manufacturer (OEM) customers, parts manufacturers are continually innovating and offering customer-specific product enhancements, leading to an increase in the number of aftermarket service parts. In fact, all service-parts operations must carry and distribute a disproportionate amount of low-volume items – and the number they must carry is rapidly growing because of shorter product lifecycles. Yet organizations must still meet service requirements and must do so economically by controlling the amount of inventory needed to meet these requirements.

Demand planning is the process through which an organization generates a forecast of market demand for its products on a regular basis. This allows the organization to calculate a historically based statistical forecast for each point (that is, part number and warehouse combination) in the BOD. Some key output variables include demand in pieces, demand in customer orders, pieces per customer order, standard (forecast) deviation, and pieces per deviation.

Here are some of the ways in which Cat Logistics meets service requirements:

- Capturing and managing demand
- Using a variety of forecasting methodologies
- Choosing the right forecasting methodology
- Separating known demand from variable demand
- Using future-dated orders
- Forecasting for new and end-of-life parts

Capturing and Managing Demand

Two keys to the forecasting process are utilizing the detail data captured during the demand generation process and effectively managing the demand purification process. Demand generation refers to the customer orders placed during the forecasting period. Cat Logistics uses the individual sales orders as input into the forecast process. Although some organizations accumulate their individual orders (typically related to pieces) into weekly or monthly totals for forecasting, this consolidation of demand loses the granularity of the individual order and pieces-per-order variations.

> Increasing customer demands and a dynamic marketplace are forcing organizations to operate at a new level of flexibility and responsiveness, in order to efficiently address customer requirements and attain desirable profit margins.

One example of a systematic process that uses the detail data and can have a positive impact on the forecast is to properly align the demand for successor product planning or supersessions. By rolling the demand to the bottom of the chain prior to the forecast, organizations can ensure the actual sales orders are modified appropriately, thereby minimizing forecast error. However, organizations must ensure the original customer order is not changed, in case the supersession is "broken" and the original item needs to be reforecast. For example, if a customer orders item 1A1, which has been replaced by item 1A1x (bottom of the chain), the organization should roll the demand for item 1A1 into item 1A1x for the forecast, so the forecasting algorithm can apply accurate demand for the bottom-of-the-chain item. For data-integrity purposes, the sales order needs to remain intact, with 1A1 as the item ordered. That way, if the supersession is broken (that is, 1A1 is no longer replaced by 1A1x), then the organization can reforecast 1A1 and 1A1x with their associated demand histories.

Cat Logistics also needs to be able to easily realign historical data to reflect the current supply chain situation, such as network changes (distribution centers added or removed) or changes in dealer or customer profiles. Perhaps more important, the detailed historical data can allow Cat Logistics to execute its transactional simulation process, to evaluate the impact of proactive changes in the supply chain on service levels, inventory, operations, and transportation.

An organization may inadvertently add demand data to the forecasting algorithms even when the demand might not be repeatable and shouldn't be included in the forecast. This, in turn, impacts

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forecasting accuracy. By being aware of and identifying customer demand, organizations can exclude one-time-only data, such as promotional or warranty demand, or can scale back appropriately. If the process excludes promotional or warranty demand or both, then it is likely that another process is handling the demand to ensure the organization acquires and distributes material as required. Prior to the actual forecast, the organization highlights outliers – that is, sales orders that fall outside defined statistical boundaries – so it can manage them accordingly.

Forecasting Methodologies and Application

Providing services to a variety of industries has allowed Cat Logistics to experience a wide array of supply chain models, some of which have required new forecasting methodologies to be developed while others have required enhancements to existing methodologies.

The following examples illustrate how Cat Logistics' external client requirements have resulted in forecasting changes that have led to improvements. One client experienced large sales-order variations, which is common when selling to dealers and distributors. This situation prompted Cat Logistics to enhance the Poisson methodology to what it refers to as "compound Poisson." This modified methodology relies on the philosophy of forecasting entries and average quantity versus pure demand per period. So instead of simply considering how many pieces will be sold in a period, Cat Logistics considers the timing and size of the order. This methodology is most useful when dealing with lumpy demand patterns, when a company needs to effectively forecast arrivals (sales orders) and quantities.

Over the past 10 years, Cat Logistics has enhanced its seasonal definition; as a result, for the same level of inventory, clients have realized a significant service improvement. This was due largely to the development of mathematical algorithms for recognizing seasonal patterns, based on past demand.

Relying on individuals to determine when an item is and is not seasonal typically leads to too many or too few items being classified as seasonal. The timing is also rarely optimal. By having the system analyze demand patterns, Cat Logistics improves accuracy and timeliness significantly. This allows the company to proactively smooth seasonal item schedules so its suppliers can respond effectively to the increase in demand. And by minimizing disruption within fulfillment centers through control over receiving influx, Cat Logistics can move material through the supply chain more effectively and be ready for customer orders.

Regardless of the situation, organizations need to employ a number of forecast methodologies – for example, Poisson, exponential smoothing, and declining growth rate – and apply the ones that are most effective for the parts provided. It is quite possible that an organization will apply different methodologies to different parts at different levels in the supply chain. For example, an organization can apply a trend model to a part number at one warehouse and classify the same part number as seasonal at another warehouse. Ultimately, these methodologies help ensure the right amount of inventory at the right locations.

Because of changes in business models, technology, and customer demands over time, the relevant forecast model for any given part at any given time is likely to change. More important than using a variety of forecasting methodologies is deciding which one to use. Organizations need a solid methodology to help them transition between different forecast methodologies and, in addition to their theoretical evaluation, should consider the factors that can improve performance as they select a different forecasting model. Although a single methodology helps ensure consistency, it may not help a company perform to its full potential and respond appropriately to changing market conditions.

Increased customer service demands are dictating new approaches to service-parts management that require commitments to inventory availability and delivery dates. This trend requires a new level of flexibility and responsiveness.

For example, although Croston's method for intermittent demand forecasting is sound, Cat Logistics experienced issues using this method because it is not always practical to apply, especially when a new item with low usage is involved. Cat Logistics incorporated Croston's method in its "demand-trip,"

or forecast-adjustment, technique. If Cat Logistics sees a significant change in a forecast two or three months in a row, it assumes that a key factor has changed and resets the forecast accordingly. Cat Logistics also developed other criteria around Croston's, such as how to transfer from one forecast model to another.

In addition to the above forecasting methodologies, Cat Logistics employs a demand-trip technique that controls how reactive a particular forecasting methodology may be to only upward or only downward demand. This technique is especially valuable in that it allows Cat Logistics to apply human judgment to how its forecasting methodologies will react. For example, if business is expected to decline in the near future (which is, of course, not reflected in recent demand), Cat Logistics could set demand-trip parameters to cause the forecasting methodology to respond more quickly to downward demand than to upward demand.

Although all forecasting methodologies offer different ways to determine how to plan for future demand, the demand-trip technique provides flexibility to control how forecast methodologies respond in a changing business climate.

Fixed-Demand Requirements

Cat Logistics has found that it can use the concept of fixed demand to manage situations that the planning system cannot accommodate because the information is not part of historical demand data, such as in the case of new-part introductions, initial dealer orders, or promotions. In these situations, the organization places fixed demand to manually inform the planning system of a future need. By judiciously using fixed demand, organizations can control the planning system with nonforecastable types of requirements. With this technique, organizations using an integrated system – that is, enterprise resource planning (ERP), planning, and deployment – can achieve proper planning by adding their knowledge to the system.

Cat Logistics has also found that it can use fixed demand to adjust demand and react to market intelligence or exceptional situations. For instance, an increase in business is not always reflected in historical demand; sometimes, on the basis of various market signals, organizations know they will have to adjust demand in reaction to an anticipated increase in activity. To respond to those situations, organizations can perform analyses to determine which items they believe will be in demand (for example, competitive, high-volume, or critical parts). The organizations would then place fixed orders in the system to adjust DRP to reflect the new market intelligence. In this way, the future plans are more responsive to the actual market situation and not just a reflection of the historical information. Once an organization places orders against these items, an override function within the system can respond to ensure that the right quantity was ordered. This demand becomes part of the DRP algorithm, for which the organization can specify start and stop dates.

Future-Dated Orders

Since all forecasts contain errors, Cat Logistics has found that the best way to improve forecasts is by reducing the amount of actual forecasting involved. By separating out the nonvariable future demand and only forecasting the unknown, organizations can improve the reliability of their forecasts. Organizations can achieve this by working collaboratively with customers to agree upon future-dated orders, for which a customer provides ample notification of a needed part, allowing the organization to preclude it from the forecast. For example, if a customer is planning an equipment overhaul in six months and knows which major components it will need, the organization can plan for the event by ordering the parts and then sending them through the pipeline when needed. With mutually beneficial incentives in place to meet inventory and service levels, organizations are likely to encourage and improve demand signals from customers.

New-Part Introduction and End-of-Life Parts

The new-part introduction process is very important to an organization, as it can have an immediate impact on customer perceptions of a new product. However, forecasting for new parts can be a difficult task, particularly for items, such as electronics, that have a short lifecycle. Market intelligence can provide important information, such as where the original product will be sold (globally or regionally), whether or not

there will be a ramp-up period, and supplier capacity data (that is, if the supplier can meet production and aftermarket requirements). All of these events can significantly impact the decision of where and how much inventory should be placed in the network.

Cat Logistics uses market intelligence, as well as historical data from similar items, to determine the initial requirements. The company considers the type of application (mining, forestry, marine, or demolition and scrap, for example) and environmental conditions that might affect the machines (for instance, hot, cold, dusty, or remote), along with calculated acceleration curves from parts with the same or similar attributes. The result is a best-match initial forecast.

From a service-parts standpoint, an end-of-life item is one that has fulfilled its service policy. The service policy incorporates various attributes, a key one being the criticality of the part to machine uptime. An organization needs to review the item in question to determine if it should continue to be supported or discontinued, which means it will no longer have schedules placed on the supplier.

Cat Logistics pays particular attention to end-of-life parts and monitors their usage to properly plan inventory and reduce the risk of obsolescence. Cat Logistics' analytical method for planning for end-of-life parts is to evaluate a part's usage once the service policy has expired, which is a minimum of 10 years after the part is no longer used in production. Cat Logistics will take into consideration the type of product the part goes on and existing field populations, and it may still service the part even if demand is not very high.

To predict the forecast behavior of these end-of-life parts, Cat Logistics uses decay curves. To convert the demand from the old part to the new superseding part, in order to increase the likelihood of using the oldest inventory, Cat Logistics also employs extensive supersession and substitution-part chains that are parameter controlled and date controlled. With increased scrutiny and monitoring of end-of-life parts, Cat Logistics has continuously reduced stocking levels and obsolescence of Caterpillar service parts.

CONCLUSION

SHIFTING FROM REACTIVE TO PROACTIVE

Organizations must meet service requirements and must do so economically by controlling the amount of inventory needed to meet these requirements.

The quality of service that organizations deliver can be a key competitive differentiator. And the quality and timeliness of that service delivery is directly impacted by the availability of parts that are needed to successfully conclude that service. To reduce costs and improve service effectiveness, organizations must shift from being reactive to being proactive service providers. By combining best-in-class processes and planning techniques supported by an appropriate IT infrastructure, organizations of all sizes can gain efficiencies and boost the success of their service-parts management businesses.

Be sure to read the next paper in this series, titled *Optimal Service-Parts Management: Lessons from the Cat Logistics Best-in-Class Processes for Inventory Planning*, to gain insight into best-in-class inventory planning processes from Cat Logistics.

To learn about how the SAP® Service and Asset Management solution can help you improve service-parts management, call your SAP representative today or visit us on the Web at www.sap.com/solutions/sam.

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