What You Need to Know About Forecasting and Planning Service Parts

Service parts forecasting and demand planning present some unique challenges; these challenges require specialized tools to be handled effectively and successfully. Not all tools are equal. In this paper you will learn why service parts forecasting is different, the common tools used to deal with it, and a new methodology that yields superior results.

Service (spare) parts and related aftermarket services account for 8% of the gross domestic product (GDP) in the U.S., with U.S. consumers and businesses spending more than $700 billion each year on parts and services for previously purchased assets, such as automobiles, aircraft, and industrial machinery. On a world-wide basis, expenditures on such aftermarket parts and services total more than $1.5 trillion annually and account for 20-30% of revenues and about 40% of profits for most manufacturers of durable goods.

For companies that manufacture, distribute, or hold large inventories of service parts, the demand planning challenges are strikingly similar. They must manage their parts inventory requirements to meet the repair and maintenance needs of products whose useful lives could span decades. Because of the prevalence of time-based service agreements, they often need to meet high service levels to help ensure zero downtime. They must also contend with the inevitable problems of maintaining inventories of expensive, slow-moving parts that are subject to obsolescence. And, they may need to do all of this in a multi-location environment that includes central distribution centers, regional warehouses, and branch offices, each with different stocking strategies and requirements.

By their very nature, service parts are generally more complex than their counterparts used in the production of finished goods items. First, service parts are sold by themselves, not as part of a manufactured product. This tends to result in lower usage rates and much more volatility in their demand patterns. Long lead times and difficulty in specifying when and where the part will be needed next can make their supply chains more complex. For these reasons, many companies must tie up cash in extra safety stock to ensure that service levels are maintained at a competitively high level. In addition, unlike their production counterparts, service parts must be stocked throughout the entire life of the product, meaning that inventory planners need to manage significantly more SKUs on the service part side of the business. All of these factors make the forecasting and demand planning of service parts especially challenging.

Demand planning is particularly difficult for service parts operations where demand is intermittent, or slow-moving. A significantly large percentage of the items in service parts inventories, often as high as 70%, exhibit this characteristic. As we will explain, intermittent demand is very hard to forecast, and until recently there was no accurate method of forecasting this type of demand.

However, accurate forecasting of parts with intermittent demand is critical for determining the proper amount of safety stock, and ultimately the amount of inventory you put on the shelf at each stocking location. Not having the right part at the right time at the right location can be an expensive proposition resulting in unacceptable downtime, lost revenue, and reduced customer service levels.

The Intermittent Demand Problem
Intermittent demand is present where demand history contains a large percentage of zero values, interspersed with spikes of non-zero demand that occur randomly. Figure 1 below plots the
demand over 36 months for three intermittent part items (shown in red, blue and green). Only in month 32 was there non-zero demand for all three items. Many months had no demand at all, and when demand did appear, its level varied erratically:

![Monthly Demand for 3 Intermittent Part Items](image)

**Figure 1: Examples of Monthly Demand for Intermittently Demanded Parts**

For items like these, there is no apparent structure or pattern to the data, a phenomenon that most traditional forecasting methods don’t manage well. The reason these methods are inadequate is that they ignore the special role of zero values when analyzing demand, as well as other key characteristics of intermittent data. Traditional methods identify recognizable patterns in the demand data, such as trend and seasonality, but when these regular patterns are not detected, the methods tend to simply “smooth over” what they interpret as outlier or anomalous values.

A number of vendors claim to offer solutions to the intermittent demand forecasting problem that use traditional forecasting methods, or variations of them. While conventional statistical forecasting methods can produce credible forecasts of the average demand per period when demand is intermittent, they cannot produce accurate estimates of the entire distribution of possible lead time demand values (i.e., total demand over a lead time). Too often, what they do produce are misleading inputs to inventory control models—with costly consequences.

For each intermittently demanded item, the importance of having accurate forecasts of the entire distribution of all possible lead time demand values cannot be overstated—not just a single number thought to be the average or most likely demand per period. These forecasts are key inputs to inventory control models that recommend correct procedures for inventory management, such as the timing and size of replenishment orders (reorder points and order quantities). They are particularly essential in service parts environments, where they are needed to accurately estimate optimal service level inventory requirements for satisfying total lead time demand (e.g., the minimum inventory and safety stock necessary to satisfy a 95 or 99 percent likelihood of not stocking out of an item).

**Problems with Traditional Approaches to Intermittent Demand Forecasting**

The most common approach to forecasting intermittent demand is “gut feel.” This judgmental approach is not feasible when you are dealing with thousands or tens of thousands of items, and only provides a single-number estimate of demand. In addition, this method can unintentionally but incorrectly predict trends in demand, based on expectations, resulting in under-stocking or over-stocking inventory. We have even heard anecdotal evidence from an aerospace executive that his
company’s forecasts tended to be too high or too low depending on the mood of his planners the day they made the forecasts.

*Exponential Smoothing* is the most commonly used statistical approach, but it is inadequate for the specialized problem of demand for service parts. Exponential Smoothing is designed to estimate average demand, not inventory service levels. To get forecasts of inventory needs, advocates of exponential smoothing assume that the probability distribution of lead time demand values will resemble a “normal” bell-shaped curve. However, where there is intermittent demand, the actual demand distributions don’t look anything like a bell-shaped curve.

*Croston’s Method* is a variant of exponential smoothing that copes better with the unusual patterns of intermittent, slow-moving items. While Smart Software has found that Croston’s method is more accurate than simple exponential smoothing for forecasting the average demand per period, our latest research found that it is actually less accurate at forecasting inventory needs.

*Poisson Models* recognize that demand is more or less random. In this sense, it roughly matches the pattern of demand for service parts. However, Poisson Models have two serious weaknesses when applied to service parts forecasting. First, while distributions of lead time demand are not bell-shaped, neither are they Poisson-shaped. Second, Poisson Models ignore the fact that demand in one time period very often tracks or correlates with demand in the previous period.

Finally, *Reliability Models* assume that demand for service parts can be predicted from the physical wear-and-tear of working parts. This approach imposes a tremendous data cost on the forecaster, as well as the entire service organization – especially when thousands of items are being used. To predict demand one would have to keep a tally of how many parts are in service, how many hours of operation each part has endured, and how much wear occurred during those hours. Furthermore, these data are worthless without a reliability model relating part use to the need for replacement.

**The Smart Way to Forecast Intermittent Demand**

Over the past eight years, experience with a patented forecasting technology pioneered by Smart Software -- the *Smart-Willemain* method -- suggests that the age-old problem of accurately forecasting intermittent demand has been solved. Smart Software has integrated this new technology into its flagship product SmartForecasts® Enterprise, an enterprise-wide demand forecasting, planning, and inventory optimization system. Users of this software are experiencing nearly 100 percent accuracy in forecasting inventory requirements, millions of dollars in inventory savings, and greatly improved customer service levels.

The new method was developed with the help of a National Science Foundation (NSF) competitive grant awarded to develop a new and more accurate method of forecasting intermittent demand. Smart Software’s research was aided by a team of researchers at Rensselaer Polytechnic Institute, in Troy, New York, under the direction of Dr. Thomas Willemain, a professor in the Department of Decision Sciences and Engineering Systems.

The NSF study examined 28,000 commercial data series that included inventory items from nine companies in the U.S. and Europe, representing the aircraft, high tech, electronics components, marine equipment and other capital equipment industries. The research produced a new forecasting method, based on bootstrapping, that provides fast, realistic forecasts of intermittent product demand over a fixed lead time.

*Bootstrapping* is a statistical method that accurately forecasts both average demand per period and customer service level inventory requirements. It does this by using samples of historical demand data to create thousands of realistic scenarios that show the evolution of cumulative
demand over a lead time. It is an empirically-based method that makes no assumptions about the data and does not assign any predetermined shape or pattern to the forecast results.

Because the Smart-Willemain method gives a forecast of the entire distribution of lead time demand and not just a single-number estimate, it can provide the type of planning information that service/spare parts organizations require for their intermittently demanded items—fast, reliable safety stock and inventory stocking level solutions for any desired customer service level.

The ability to obtain accurate inventory and safety stock estimates is crucial in helping organizations balance parts inventories and reduce associated carrying costs, while maintaining or improving service levels. By achieving optimal inventory solutions, parts operations are able to improve cash flow and more efficiently deploy corporate inventory, financial, and personnel assets, while delivering better service to their customers. These kinds of results are being realized by scores of organizations around the world using SmartForecasts with its intermittent demand technology to forecast demand for their service parts.

To give you an idea of the types of displays and reports that SmartForecasts produces while automatically forecasting service parts requirements, we have presented Figures 2 and 3 below. Figure 2 shows the bootstrapping method in action, generating a graph of the distribution of cumulative lead time demand (in green) for a service part (Part #6) that has a lead time of 3 months and exhibits intermittent demand. Notice the very asymmetric (not bell-shaped) nature of the demand distribution:

![Figure 2: Distribution of Lead Time Demand for a Service Part Exhibiting Intermittent Demand](image)

The audit report in Figure 3 shows the following forecast results for Part #6 based on its lead time demand distribution: average lead time demand (3 units), maximum possible lead time demand (30 units), 95% service level inventory recommendation (10 units), and associated amount of safety stock (7 units). Similar results are presented for the other items forecasted in this service parts group:
A number of our customers are using SmartForecasts to streamline and optimize their service parts operations. The experiences of Prevost Parts and SKF Vehicle Service Market may be of particular interest.

Prevost Parts, the parts division of Canadian bus manufacturer Prevost Car, uses SmartForecasts to more effectively distribute parts to the North American motor coach and transit bus markets. To serve its clients, the company maintains seven North American locations with over 25,000 active parts, 70 percent of which exhibit intermittent demand. Prevost selected SmartForecasts over SAP’s demand planning system and several other best-of-breed applications, in good part because of Smart’s unique solution to the intermittent demand forecasting problem. In just 3 months following SmartForecasts’ implementation, the company’s backorders and lost sales decreased 65% and 59%, respectively, and fill rates increased from 93 to 96%. As Prevost Parts’ logistics director commented, “We need to have the right parts in the right place to support our customers. SmartForecasts helps us to not only improve our inventory allocation but also significantly reduce transportation and inventory costs.”

SKF Vehicle Service Market (SKF-VSM) is the North American automotive aftermarket arm of SKF, a $6.3 billion, publicly traded corporation headquartered in Gothenburg, Sweden. SKF-VSM maintains six distribution centers in North America and stocks approximately 60,000 unique parts, the majority of which exhibit intermittent, slow-moving demand. Within 6 months of implementing SmartForecasts, the company was able to reduce the net value of its inventory by over a million dollars. The full benefit was seen in 2005 when SKF-VSM was able to reduce its inventory holdings by an impressive 16% while still maintaining targeted 95% customer service levels. As SKF-VSM’s manager of aftermarket supply chain planning noted, “SmartForecasts drives our relationship with suppliers. We [now] have a much better understanding of what our future demand will be, and that reduces a lot of the costly expediting that we had to do in the past.”
To read more about the success of Prevost Parts, SKF-VSM and some of our other customers, we invite you to visit our web site at www.smartcorp.com/success_stories.asp.

For more information about SmartForecasts and Smart Software and how they can help your organization improve its parts forecasting and inventory planning, please call 1-800-762-7899 or email info@smartcorp.com. We look forward to hearing from you.

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