SPEED TO MARKET

A Newsletter for
Job Shops–Niche Manufacturers–Focused Distribution Systems
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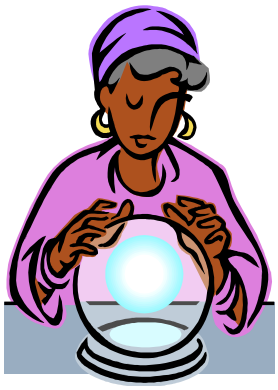
Forecasting in a Job Shop?



Demand forecasting has traditionally been associated with mass production, build-to-stock businesses that make standard products and fill orders from finished goods inventories. Part art, part science, forecasting can be a complex endeavor. Algorithms and stocking level strategies often incorporate seasonal trends and computer simulations to predict demand patterns for a wide variety of products. Examples of papers written in this area include *Evaluating Forecasting Algorithms and Stocking Level Strategies Using Discrete-Even Simulation*[i] and *A New Adaptive Method for Extrapolative Forecasting Algorithms*.[ii]

Lean manufacturing can be dramatically effective in mass production environments because quick changeovers and flexible manufacturing enable smaller lot sizes to be produced more quickly, at the same per unit cost as longer runs. This results in less inventory on the shelf, reduces the cost to carry, increases inventory turns, shortens the forecasting horizon, and enables forecasting to be more accurate. It's a lot easier to forecast demand for the next month than it is to forecast for the next six months.

In a mass production environment, a forecast is generally configured in terms of the number of SKU's (stock keeping units) expected to be sold during a given period. This enables manufacturing to purchase materials and build ahead to have these items ready for sale when orders are booked. But job shops are different. There are no standard units to forecast and demand is unpredictable. At first blush, it would seem that forecasting would offer little value, even if it could be accomplished. This may or may not be the case. Let's take a look at how forecasting might work in a job shop, and whether or not it can be valuable.

What are we forecasting in a job shop? The first question to ask is: "Exactly what are we attempting to forecast if everything is made to order and there are no standard units of production?" The answer is we are trying to forecast demand in terms of the approaching workload on the shop. Why? Because having an accurate picture of the volume of work expected to hit the floor at a given time enables us to prepare to process it more effectively. This is true whether it's a demand peak or a valley.

The second question is: “How valuable would it be for you to know what your workload will be two or three weeks from now?” If you see this as being valuable, then it makes sense to try and forecast demand. If not, you can choose to roll with the punches.

Note: Recall the October Speed to Market Newsletter article, ***Variations on a Job Shop Theme***, where we examined differences among job shops, and the need to take these variations into account when seeking to improve performance and profitability? Forecasting is an excellent example. It may work in some shops and not others. For example, there may be a lot of ‘static” between quoting activity and the actual receipt of orders. Time between quote and order may be too long, or surges in demand may not be an issue. In some shops, it might make more sense to forecast when work will hit the engineering department rather than the floor. The point is, the approach to forecasting described in this article is not a “one size fits all” tool. It has to be considered within the specifics of your business.

Forecasting Logic: The basic idea is to extrapolate the workload in hours from the volume of quotes completed, factored by the shop’s historical win rate, and then profiled by work center. In other words, the dollar volume of quotes completed in a given week can be converted into hours. When this number is multiplied by the historical win rate, the result is a projection of the volume of work (in hours) that will hit the shop floor in a coming period. If you build a profile of how work is typically allocated among work centers based on historical data, this will give you a pretty good idea of the anticipated workload by work center. Knowing this in advance gives you more options for managing capacity, scheduling production, and solving problems before they become crises.

The following information is required:

- The amount quoted during a week in dollars
- The hit rate…dollars won divided by dollars quoted historically (prior 6-12 months average)
- The hours represented by these dollars. This number is calculated by dividing the expected value of quotes won by the quote rate.
- How these hours will be distributed across work centers
- The time between quoting and receiving orders
- The time from order entry and release to the floor or to the first step in the production process

The following table is a profile from a general purpose machine shop that illustrates how work is distributed by work center. This profile was built by analyzing 2000 orders processed in this shop over the past 12 months. You can see CNC mills process 38% of the work, all the way down to the saw which is the least utilized piece of equipment.

Work Centers	Saw	CNC Lathe	CNC Mill	Manual Lathe	Manual Mill	Surface Grind	ID Grind	OD Grind	Jig Grind	EDM	Bench
% Load	0.4%	12.2%	38.0%	2.4%	5.1%	16.4%	1.5%	9.2%	8.8%	5.2%	0.8%

Building a Forecasting Model The following model is based on an Excel® spreadsheet that automatically converts the dollars quoted into hours by work center. You can see that $200,000 quoted at a 15% hit rate yields 600 hours of work quoted at $50 per hour. These 600 hours are then allocated over work centers by historical utilization.

Dollars Quoted		$ 200,000									
Hit Rate		15%									
Forecast Volume		$ 30,000									
Quote Rate		$ 50									
Forecast Hours		600									
Work Centers	Saw	CNC Lathe	CNC Mill	Manual Lathe	Manual Mill	Surface Grind	ID Grind	OD Grind	Jig Grind	EDM	Bench
% Load	0.40%	12.20%	38.00%	2.40%	5.10%	16.40%	1.50%	9.20%	8.80%	5.20%	0.80%
Forecast Load	2.4	73.2	228	14.4	30.6	98.4	9	55.2	52.8	31.2	4.8

Here is another example. Dollars quoted were increased to $300,000, the hit rate to 18%, and the quote rate reduced to $45 per hour. The net result is that total hours have increased from 600 to 1200 with a similar increase in the load on work centers.

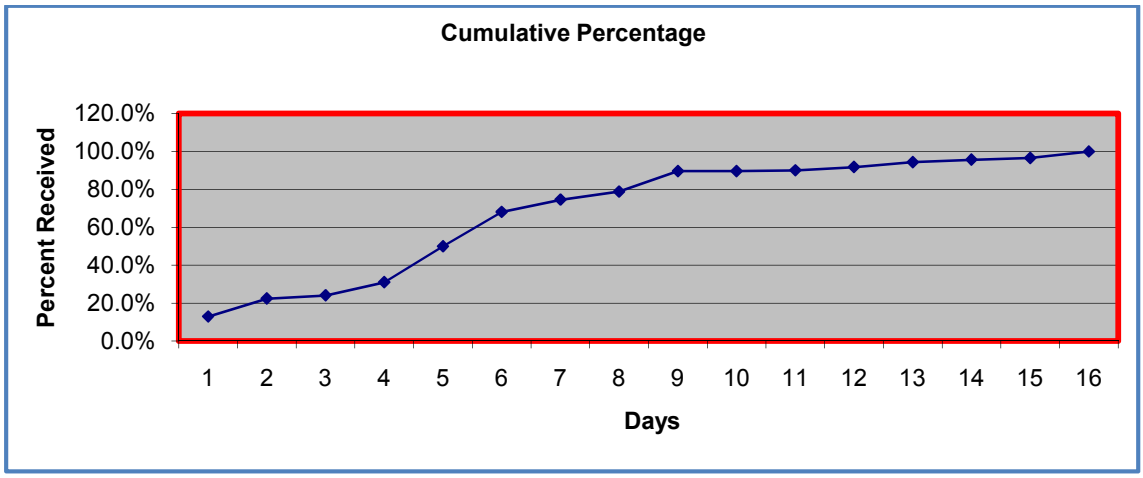
Dollars Quoted		$ 300,000									
Hit Rate		18%									
Forecast Volume		$ 54,000									
Quote Rate		$ 45									
Forecast Hours		1200									
Work Centers	Saw	CNC Lathe	CNC Mill	Manual Lathe	Manual Mill	Surface Grind	ID Grind	OD Grind	Jig Grind	EDM	Bench
% Load	0.40%	12.20%	38.00%	2.40%	5.10%	16.40%	1.50%	9.20%	8.80%	5.20%	0.80%
Forecast Load	4.8	146.4	456	28.8	61.2	196.8	18	110.4	105.6	62.4	9.6

Note: If you want this model to play around with, send us an email at **ddilink@aol.com** and we will send it to you. Follow the process described in this article to set it up and use it in your shop.

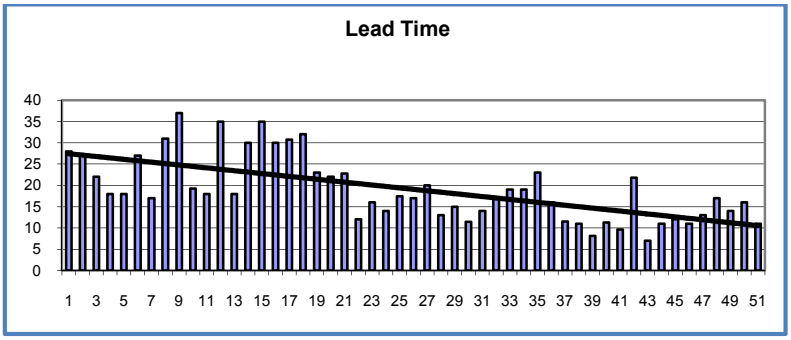
You can immediately compare the expected total volume in dollars and hours to your average weekly volume. If it is significantly greater, then you can start planning how to accomplish this work within your quoted lead time. If it is significantly less, then it may be time to encourage people to take vacations, or go to a four-day work week, or take other measures to reduce capacity and costs. You can also see how the anticipated volume is distributed by work center. If one or more is significantly overloaded, then you may consider outsourcing, working weekends, or other measures to increase capacity.

When Can You Expect the Work to Hit the Floor? Two things are involved. One is the time it takes to receive an order once it has been quoted; the other is the average lead time in your shop. The following graph shows the time between the submission of a quote and receipt of an order in our general purpose machine shop. You can see the response is very rapid. Fifty percent of the orders were received within 5 days of submitting a quote, and 90% within 10 days. This is important information. For one thing, it tells us that quotes older than 10 days are not likely to become orders so don't waste your time following up on them.

Time from Quote to Order



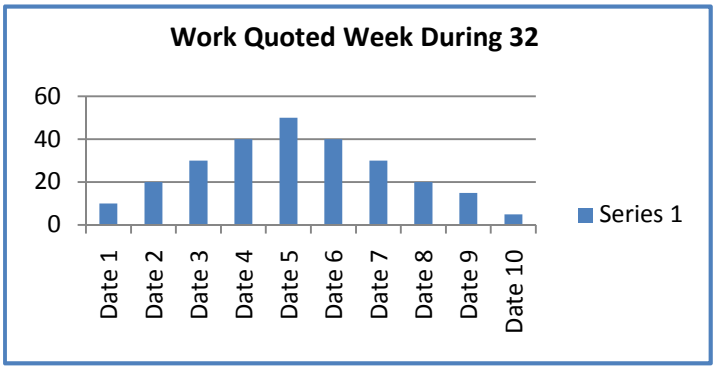
The following graph shows lead time or how long it takes to process orders though the quotes to cash process. (Note the improvement this shop made over the course of a year to reduce lead time from 28 days to10 days.)



You can see that new work can start to be introduced on the floor within a few days…as soon as the preproduction work is completed, the materials received, and the capacity becomes available.

An Alternative Method: Another method for calculating when new work will hit the floor is to tag orders when they are quoted, and then see when they hit the floor. You can build a histogram that shows how much work quoted during a given week hits the floor on subsequent dates, and what the pattern looks like. That will provide you with a volume profile that is tied to the actual performance of your shop.

Note: Be aware that when demand increases, lead time has a tendency to stretch out because you are exceeding normal capacity limits. The trick is to increase capacity in advance of the higher workload which this forecasting model is designed to help you accomplish.



Summary: One of the most prevalent problems in job shops is overloading capacity which results in scrambling to get work completed by promised ship dates. Getting jammed sets off a chain of events that often includes last-minute rushing, taking shortcuts, making mistakes, adding to rework, more delays, and unnecessary costs. (See the Article, Hockey Stick Blues for more.) The value of a workload forecast would be to give you a heads up when a surge in demand is imminent so you can prepare for it, rather than having to deal with it at the last minute. The same is true when demand falls off. How are you going to reduce capacity (and costs) in order to adjust to a reduced workload? Being able to anticipate fluctuations in demand, even a little bit ahead of time, is important because it gives you an opportunity to adjust to changes more effectively.

[i] Frank Grange & Gregory R. Clay, Proceedings of the 1997 Winter Simulation Conference, Informs Simulation Society
Ii Pantazopoulos S.N.& Pappis C.P.: European Journal of Operational Research, Volume 94, Number 1, 11 October 1996

Tooling Industry Survey

Speed to Market readers may recall the note in the March 2007 issue regarding the tooling industry survey being developed by William Loendorf, a Ph.D. candidate at Walden University. William is researching how the tooling industry is responding to increased global competition. Specifically, he's interested in learning what individual shops are doing to address the need to modernize, restructure, and reorganize in order to meet both current and future global challenges.

The survey is now complete and available on line. . Please take 20 minutes to support this research by completing the survey which can be accessed at:

http://www.surveymonkey.com/s.aspx?sm=3QC4sufmUWG8pSKAoNwm_2fw_3d_3d

Everyone who participates will get an executive summary of the results and conclusions.