



Calculating Supply Chain Forecast Error A new approach to an old problem

by Duncan McLeod

IF CHANGE IS SO GOOD THEN WHY DO WE AVOID IT?
COME AND HEAR DUNCAN SPEAK AT THE 2009 APICS INTERNATIONAL CONFERENCE, TORONTO, (OCTOBER 6TH)
TOPIC: CHANGE IS GOOD...YOU GO FIRST!
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Process reviews always result in questions. This is a good thing because it shows that people are listening and thinking about what is being said. No questions mean I haven't explained the topic well enough. So, I was relieved when, after a long review of a client's S&OP process, I was asked: "How should I measure forecast error?"

The standard answer was simple and inappropriate. A useful answer took a lot more thought.

Read on and see how the standard answer only applies to one level of the supply chain bill of material, and how my new measurement is more predictive.

Why Measure Forecast Error

Before I go further, let's review the reasons for measuring forecast error.

1. The forecast error rate helps us determine our strategies for safety stock, safety capacity and backlog management.
2. Performing root cause analysis on forecast errors helps improve the forecasting process.
3. A timely and appropriate response to forecast errors minimizes the impact of the error.

If the measurement does not support these reasons it may be irrelevant. The measurement I am referring to is at the family and not at the SKU level. It should not be a "CYA" measurement used by operations to shift blame to sales and marketing. This solves nothing. Instead, it should be a measurement that improves the supply chain processes.

Classic Approaches to Forecast Error

The standard S&OP approach is to compare the actual results to the last period plan. If the plan for last period was 10,000 units and the actual results were 12,000 units, then the error would have been 20%, $(12,000-10,000)/10,000$ – which represents the percentage of error over the forecast period.

In kanban or reorder point, this logic is applied at the SKU level. Typical formulas factor in the standard deviation of forecast error, the ratio between the forecast period and the item lead-time, and the desired service levels. There are even versions that deal with lead-time variability.

These formulas work well for managing finished goods safety stock, but they won't support your S&OP process.

Why not? Because the "O" in S&OP is about managing production and supply chain flow rates. Lead-time is replaced by a factor of supply chain flexibility and extends over the cumulative supply chain lead-time (CSCLT). Let me explain.

First, look at the CSCLT in figure 1 for an S&OP family. To do this we track through the longest branch in the supply chain bill of material. The supply chain bill of material goes beyond purchase components, and through the vendor's bills of material.

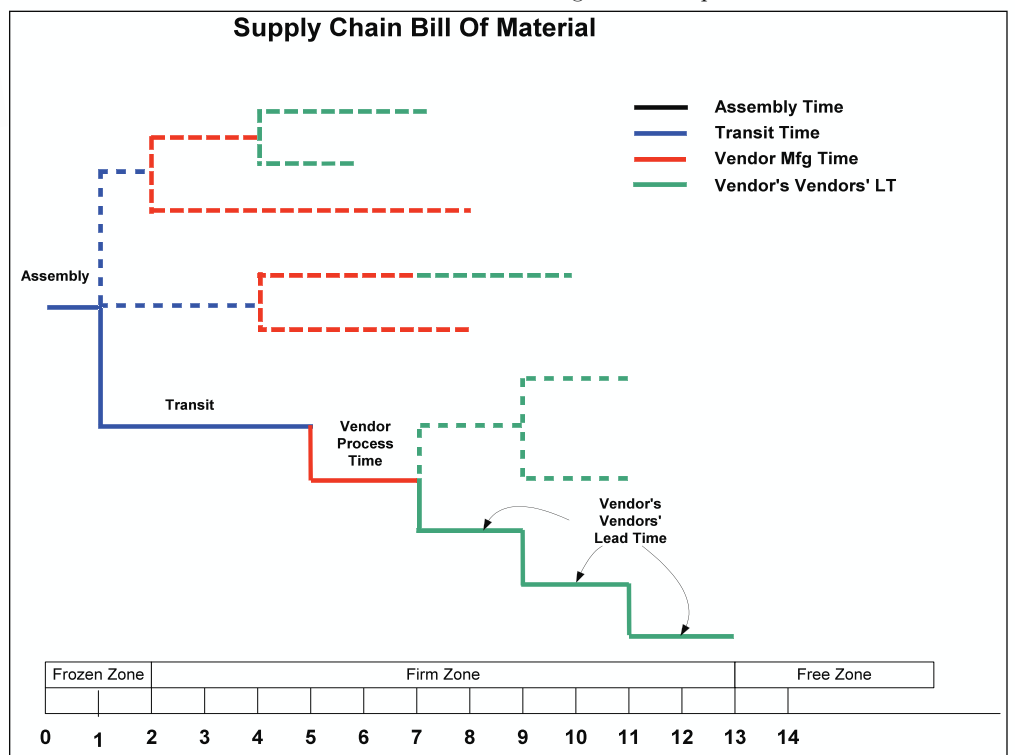


Figure 1: Supply Chain Bill of Material

In the case with Figure 1:

- The production schedule is frozen for 1 week.
- The incoming part schedule is firm for 12 weeks.
- The firm zone is made up of 3 of the 4 weeks of ocean transit, 2 weeks of frozen vendor lead-time, 6 weeks of firm vendor lead-time addressing their vendor's lead-times.
- Parts can be pulled ahead 3 weeks by using airfreight – at a cost. By using airfreight, the schedule can be increased in week 3.
- There is safety stock on unique components to address product mix changes within the family.
- Changes beyond week 13 have no significant affect on the supply chain.

Any changes to the plan in the next 13 weeks could involve airfreight or excess inventory. Any changes inside of three weeks probably won't happen unless the supply chain is designed to carry safety stock to buffer demand increases.

Now let's look at an example of what happened to this family. Figure 2 shows

	P1	P2	P3	P4	P5	P6	P7
S&OP Month							
P1	22,500	24,500	29,500	22,900	21,700	13,800	25,000
P2	24,000	26,600	34,100	22,900	21,700	13,800	25,000
P3		30,200	35,700	34,100	21,700	13,800	25,000
P4			35,300	45,200	36,600	26,000	33,900
P5				44,200	35,900	24,000	32,000

Figure 2: Waterfall Demand

the "waterfall" demand data.

Each row represents the demand (in black) and the plan (in green) for the family looking out to the end of period 7.

How did the cumulative months' actual compare to the cumulative months' plan? Average error rate of 925, standard deviation of 1,768, maximum error per period 14%. Not too shabby!

So what's the problem? Look what happens starting with the period 4 plan in figure 3. The period 4 demand was

increased by 11,100 units, the period 5 demand increased by 14,900 units, and period 6 demand was increased by 12,200 units. That's a total of 38,200 units over the CSCLT! In fact, we saw the same thing on a smaller scale in period 3.

What we need is a measurement that looks at the forecast error over the

	Plan	Actual	Error	Error %
P1	22,500	24,000	1,500	7%
P2	26,600	30,200	3,600	14%
P3	35,700	35,300	-400	-1%
P4	45,200	44,200	-1,000	-2%
Average	32,500	33,425	925	3%
Std Dev			1,768	

Figure 3: Summarized Demand

CSCLT, and helps us build the right supply chain to support the plans.

Forecast Error Measurement for the Supply Chain

I use a simplistic measurement to identify this issue. Rather than just look at the error for the last period, I look at this error plus the changes over the CSCLT. It may not be statistically correct, but it tells the story.

For example, if we look at the P4 data in figure 4, we see that the total error over CSCLT is 37,800 – which represents the 38,200 in periods 4, 5 and 6, minus the 400 units that were under plan in period 3. This is the total error the supply chain will have to deal with.



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Calculating Supply Chain Forecast Error Continued...

by Duncan McLeod

Month					Cumulative			
	Last	1	2	3	Last	1	2	3
Period	P3	P4	P5	P6	P3	P4	P5	P6
P3 plan	35,700	34,100	21,700	13,800	35,700	69,800	91,500	105,300
P4 plan	35,300	45,200	36,600	26,000	35,300	80,500	117,100	143,100
Delta	-400	11,100	14,900	12,200	-400	10,700	25,600	37,800
% Delta	-1%	33%	69%	88%	-1%	15%	28%	36%

Figure 4: Cumulative Change

Dividing this by the total planned demand gives us an error rate of 36%, or just over 3 weeks of demand. That's how much the supply chain will have to expedite to meet the plan.

Figure 4 also summarizes the P4 error by future periods. Let's look at it another way. The 3 month column is important for the item we looked at because it's the longest path through the supply chain bill of materials.

Other items will have shorter paths and may only be affected by the error over shorter time spans.

In addition, the cost of supporting the forecast error becomes clear as the

strategies are developed.

This data can be used to address the three primary reasons for measuring forecast error:

1. Understanding the error rates by time periods helps determine appropriate strategies and buffers for the parts whose CSCLT falls within the time span.
2. Understanding future forecast adjustments and the flexibility of the supply chain helps to quickly implement strategies to adjust the plan.
3. Understanding the causes of the forecast error may lead to better forecasting techniques.

Understanding the cost may lead to strategies to reduce the total cost of procurement. Maybe that best cost supplier isn't the best cost after all. An interesting idea.

Calculation Recap

- Compare the new S&OP demand plan to the previous plan.
- Measure the cumulative change for each period out to the end of the CSCLT:
 - Last period actual compared to plan
 - Last period actual compared to plan plus the changes in this period
 - Last period actual compared to plan plus the changes in this period plus the changes in the next period and so on...

Try it out and let me know what you think. This is a new idea and I welcome your comments. Please forward them to dbmexecutive@dbmsys.com.

Staying Afloat Through Economic Uncertainty A brief review of drown-proofing

by Doug Dedman

No one needs to be told that we are in one of the most difficult economic periods of our time.

The economy has gone from a period of accelerated growth, to a period of steep decline. Insurance companies and banks are no longer safe havens for investment. Any company connected to the automotive industry has seen demand for their products disappear almost overnight.

The effect of this downturn has been felt in almost all markets and geographies. When will it turn around? If you listen to the pundits, there is no clear consensus.

How do we deal with the economic uncertainty that we face today?

There are some fundamental planning principles we need to have in place to deal with uncertainty. They are simple, yet very easy to forget. Especially in difficult times. Our tendency is to focus on the challenges right in front of us. Lose sight of the bigger picture. As my grandfather used to say: "We start running around like chickens with our heads cut off!"

1. You need a plan.
2. You need a way to communicate the plan within your organization.
3. You need to execute the plan.
4. You need to monitor how you are doing compared to the plan.
5. You need to adjust the plan as required.

These planning principles are also the principles of a good Sales and Operations Planning process. S&OP is a tangible, repeatable process that you use to walk through these steps.

The following four unique characteristics of S&OP will help you

deal with the uncertainty that we face.

S&OP is a monthly process

S&OP is above the minutia of execution. It's your chance to step back from the daily challenges and look at the business.

S&OP is not a weekly master scheduling process, nor a daily plant scheduling process. Nor is it a process that monitors the order inflow rate on a daily basis. Every month you take a look at the plan that you had generated last month. You look backward and forward. You assess how you did, and if necessary adjust the plan. Why? Because if you don't step back from the day to day details you will make short sighted decisions. The monthly S&OP meeting is the place to communicate the constraints, conditions and strategy with the team. It's your chance to meet, re-plan, then move back to execution.

S&OP is done by family

Demand and supply information must be presented for each family. Decisions and trade offs can be made looking at each family as a business: opportunities, constraints, results.

Too often we look at mandates like inventory reduction and try to make some one-size fits all decisions. But these decisions need to be made at the family level. What is required to run the business for each family? To do this you need to understand your constraints, and be able to communicate them. Planning by family will present clear and executable objectives.

S&OP is a closed loop process

A good S&OP process is always

improving. A closed loop process is one where the measurement of the result is used to modify or control the input. This means that the measurement of forecast performance should be used to improve the process of putting the forecast together. In other words, as part of monitoring our performance we need to look at how we improve. The result will be a better forecast.

S&OP is a communication process

Finally, when you take all the mechanics and characteristics of S&OP and look at its objectives, S&OP comes down to communication. The purpose of this communication is to ensure that everyone is on the same plan and executing to that plan.

Ultimately a communication culture is the most critical element in tough economic times. People become more focussed on their own needs and measurements. Protectionism increases. A good S&OP process provides a forum to break down barriers and ensure that resources are aligned.

When swimming in the ocean, you put your head down and paddle with your eyes closed. Every so often you stop, tread water and look around. Then you check your progress, realign your direction, put your head back down and start swimming again.

A good S&OP process is about stopping and making sure you are going in the right direction. When the seas are rough, it is even more important that you do this, so that when you put your head down you know you're on course.

Drown-proofing of sorts.



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