Forecasting

'With a good assist the chance on a goal is higher' or 'with a good forecast the chance on a good demand plan is higher'.

Anton Boonstra, May 2021

Introduction

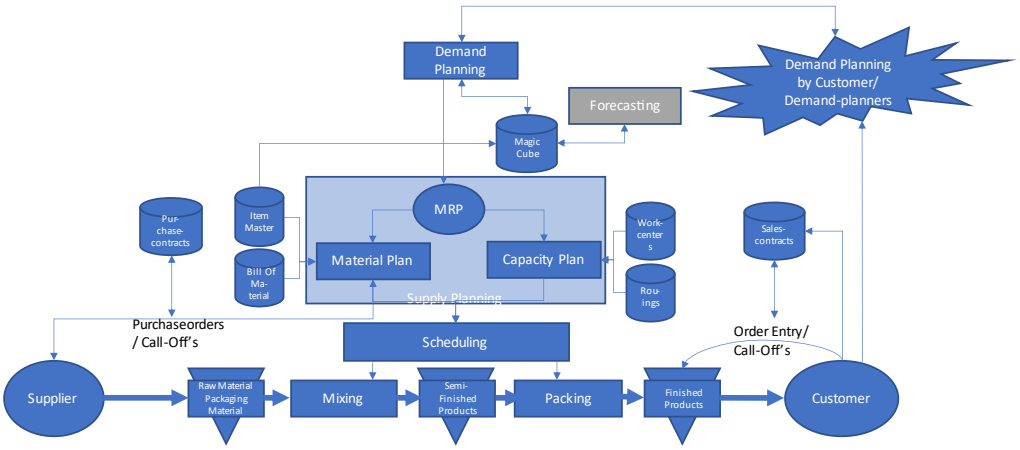
Demand Planning and Forecasting are terms often used as if they were exchangeable for each other. But they aren't. Forecasting is mostly referred to as a statistical program, a tool to generate a forecast, therefore also often called 'statistical forecasting' to offset this clearly to non-statistical forecasting or demand planning. When we talk about forecast, we mean this 'statistical forecasting'. Demand Planning is more a deterministic approach to generate Demand and dependent on how good the Salesperson, with the support of the Demand Manager, translates the market-potential into figures. Forecast can support Demand Planning but not the other way around.

So, in practise a Forecast tool is used to generate a forecast from basic historical data which is then loaded into a Demand plan. Then generally a Salesman and/or Demand planner are changing the Demand plan according to their insight and contact they have with the Customer. So, in that sense Forecast generates a proposal which can be changed in the Demand plan by generally a Salesperson of Demand Planner.

In this chapter we will speak about a simple set of KPI's from where you should determine how could improve on Forecasting and Demand Planning.

I am convinced that Forecasting plays an important role to analyse sales and demand, therefore we will elaborate a bit on the approach how you could do this analysis.

'Forecasting' within the total Concept

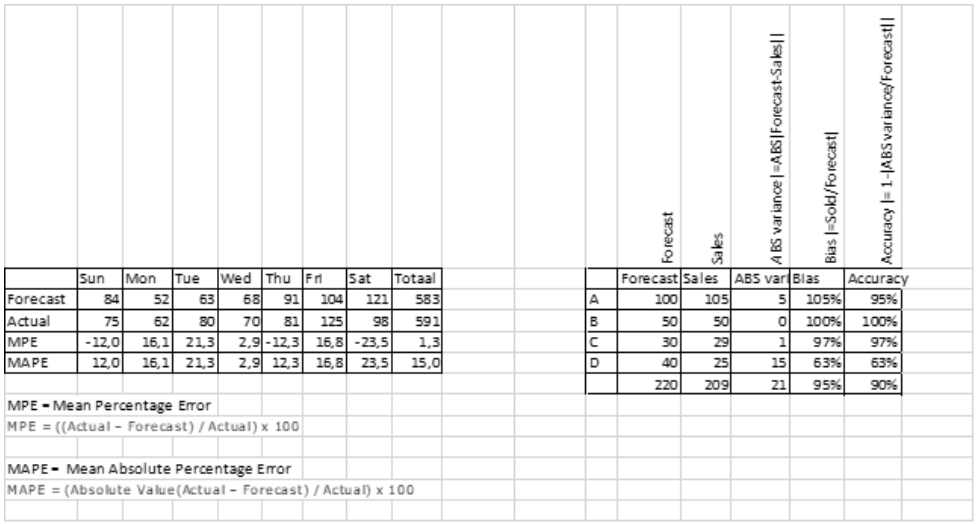


KPI's

In most of the projects, and S&OP-ones are no exception, the definition of KPI's is kept as one of the last steps before you finalize the project. When all the detailing is done, the systems are built and in place, the implementation is done and finally the KPI's are lagging. I would like to turn this around. So, start S&OP by defining the most relevant KPI's and from there you define what you need to improve on demand planning and forecasting.

If you dig into the literature on forecasting you can easily get lost. You can make it as sophisticated and complex as you want, it has all done before you. I advise you to choose a limited reasonable simple set of KPI's, which has proven itself through the years, you do not have to invent them again, in summary they are: MAPE; Bias/Accuracy. Just want to elaborate a bit more on these ones below.

Key Performance Indicators Forecasting



	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Totaal
Forecast	84	52	63	68	91	104	121	583
Actual	75	62	80	70	81	125	98	591
MPE	-12,0	16,1	21,3	2,9	-12,3	16,8	-23,5	1,3
MAPE	12,0	16,1	21,3	2,9	12,3	16,8	23,5	15,0

MPE = Mean Percentage Error

MPE = ((Actual – Forecast) / Actual) x 100

MAPE = Mean Absolute Percentage Error

MAPE = (Absolute Value(Actual – Forecast) / Actual) x 100

	Forecast	Sales	ABS variance |=ABS(Forecast-Sales)|	Bias |=Sold/Forecast|	Accuracy |= 1-|ABS variance/Forecast||
A	100	105	5	105%	95%
B	50	50	0	100%	100%
C	30	29	1	97%	97%
D	40	25	15	63%	63%
	220	209	21	95%	90%

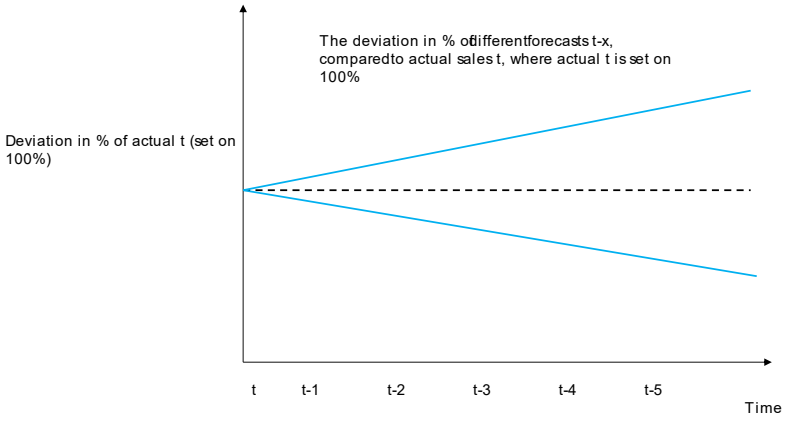
MAPE (Mean Absolute Percentage Error) looks at the absolute deviations between Sales and Forecast. So, let's start with the product-axe. Start with analysing from the top of the product-pyramid, so start with the category, then product group and then product. Then we come to the time-axe. In the analysis you should focus on trends and structural deviations, so you need more forecasts, so probably a monthly-one at least over a half year but preferably a total year so you can take seasonality into your considerations. I know it's tempting to start analysing after a couple of months you have started and of course it is not bad to have a quick look on it, but please wait with real analysis before you have data enough to be able to really analyse and draw conclusions from there.

If you forecast, you usually do that several times in different months for the same month, so in January you already forecast May, In February again for May, in March and April as well. It doesn't make much sense to compare May's forecast with May's actuals. Usually you take 3 months, so in this example you compare the forecast you made in March for May with the actuals May.

Forecast in the month for May (= Actual)									
	Jan	Feb	Mrch	Apr	May				
Jan	30	35	32	31	29				
Feb		34	31	30	28	32			
Mrch			30	30	30	31	29		
Apr				30	31	32	29	32	
May					30	32	29	32	30
ACTUAL					30				

Ideally, technical speaking you should have what's sometime referred to as: 'the big mouth of Sales'. Forecast is higher when start forecasting a month, month's ahead before realization, if you come nearer, Forecast is reduced gradually. Reason for that is that you try to be ambitious regarding Sales and you build up some stock already. It's easier to correct with a stock-reduction later in time and getting extra stock in on shorter term.

'The big mouth of Sales': farer away from the actual period the deviation is higher and the nearer you come the actual the deviation becomes lesser.



Bias and Accuracy are useful KPI's to see whether you're structurally too high or too low with your forecast. I must say these are the first changes easily made to improve forecasting. It can also help to report these types of KPI's per relevant Salesperson. It can convince them to look on a regular basis and commit to the forecast. Somehow Salespeople don't seem that interested in Forecasting and Demand Management, so forecasting is done by Demand Planners or Forecasters, but the input of Customers and Salespeople is particularly important certainly for the deterministic non-forecastable demand. If you don't forecast it then you won't get it, it's basically that simple. Another simple rule is, the earlier you put the demand 'right', the easier it is to realize.

So back to reporting the KPI's per relevant Salespeople. I must honestly say we tried that within a company in the UK and I wasn't really in favour doing that. It reminds me a bit of what I have seen in former Eastern Germany: 'the worker of the month', with photo and name hanging on the wall. In that company in the UK, Bias and Accuracy became even a part

of the bonus of the Seller and I must admit it really worked surprisingly well. The main thing we reach was that de Salespeople were really changing the demand themselves, of course with the help of the Demand-planners, so it really helped. KPI's were improving dramatically.

It became also clear that as a management team we always thought price-discounts were effectively communicated through the own organisations to the customers, but they weren't, Sales were always 5-10% lower than predicted. The Sales-department thought they communicated it internally well, but they didn't, the demand planners didn't change the forecast at the customer side. This was one of the outcomes of analysis of the forecasting figures compared to the actuals. Unfortunately, we came into a 'blaming' culture, that wasn't the intention of course. After a couple of months that disappeared. I am always in favour for transparency and of course you should really try to avoid a blaming culture, but such things happen, mistakes are made. So, solve it in transparency and then you see the KPI's going in the right direction. And that's stimulating and motivating organisation and people.

People ask very often what's possible to achieve on accuracy. I must say in that project in the UK, we started below the seventies. It's easy to come reasonable fast in the neighbourhood of 75%. I think our maximum accuracy came finally on a steady 83%. So certainly, an accuracy of 90% is out of reach I would say. 85% will be exceptional good.

To make the set of KPI's in relation to Demand Planning and Forecast complete, you should also consider: -

- Delivery performance (on order and on order line), On order line 98,5% is possible, on order-level it's difficult to be above the 95%
- Stocks (in numbers of days). Play also here with the Pareto-principle, so see that A-items are made with a higher frequency and a lower safety stock, C-items made with a lower frequency and a higher safety stock, B-items in between. On average 3weeks is reasonable. I always say that you shouldn't take too much risk having too low stocks. Real OOS (Out Of Stocks) and solving them at short notice is far more expensive, so try to avoid that.

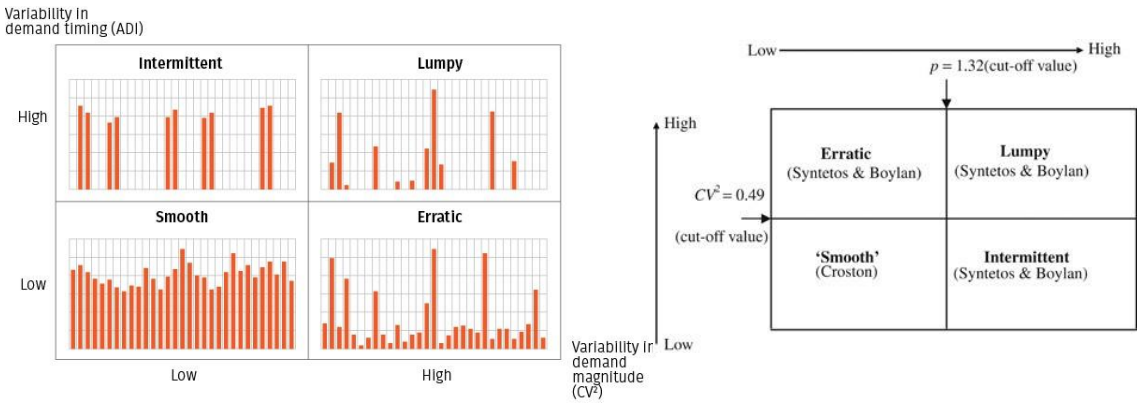
Until I started with S&OP 5 years ago, I always thought Delivery performance was the most important KPI within Supply Chain, but with S&OP, I learned that mentioned forecast KPI's are even more important. If you can get them stable you will see that it is easier to hold delivery performance steady as well.

Analysis

If you start analysing forecasting you should do that by using a) the KPI's as explained above b) do not use only historical data but also use forecast. What's very often done in such cases is that you pretend you are in January for example but, you are already in May. You use the forecast of Dec-forecast to forecast Jan-May for example, and you compare that to the real sales Jan-May.

Nowadays good but also complex software is on the market to help you analysing forecasts. I am not a fan of it. Try to use simple statistical formulas to support your analysis: mean, standard-deviation, simple exponential smoothing. It's important that you analyse the forecast together with the Sales & Marketing people. It should help you to make forecasting better, and that is not a matter of formulas but more understanding how the market is functioning. For instance, you have those typical Christmas-products, they are very often made in the summer, inventory build-up is gradually done in the period until Christmas and already start of December you need to have those products in the shops for instance. So, formulas can help you to understand forecasting compared to actuals, but forecasting remains a matter of deterministic figures. That's what makes demand planning something different then forecasting.

The pattern. Below you see a picture of the typical models you will encounter. Statistics can only be used properly if you have enough per period that don't differ too much from each other. But those statistical models become a lot more difficult to apply if you must deal with a certain trend, or you have a lot of 'zero' values, or the pattern is lumpy (irregular demand, of a sudden you have a high demand after periods of no demand at all). When determining the pattern, it useful to calculate the mean and the deviation within for instance 1*STD, 2*STD. This really helps to understand the pattern of large rows of numbers. Excel still is of extreme value in these instances is my opinion, more then all kinds of sophisticated tools.



Pareto analysis. It is useful to include the so-called Pareto Analysis in your analysis. In short, this the 20/80 rule. It means for instance that 20% of your products account for 80% of the turnover and the other way around that the remaining 80% of your products account for just 20% of the turnover. In practise this is a very handy rule to apply with all kinds of variations, for instance instead of products you can do this for customers. So, 20% of the customers are accountable for 80% of the turnover and with remaining 80% of the customers you just make 20% of the turnover.

So back to demand planning and forecasting, why is this relevant? Well, this means you want to be busy with those top20% and shouldn't spend too much time on the remaining 80%. So, Demand planning should be focused on those 20% and for the remaining 80% you need some algorithm like forecasting. This does not mean you don't use forecasting for the top20% of course, on the contrary, if we can use a handy algorithm which is rather good, of course you should use it.

Let us elaborate a bit on this. Keep in mind that many manufacturing organizations can easily have something like 1000 products, in Retail 20000 is not that unusual. What you will see out of forecasting analysis is that certainly in the 'tail' you will typical have relatively more products with an abnormal pattern so statistical forecasting is difficult to apply. Those products aren't the profit makers, mostly they are kept because of service reasons for example, the advantage is that keeping stock is not that relatively expensive or you aren't going OOS faster. So, a service-level of 90% for instance instead of >98% which is quite normal in business might be then a solution. You still need some algorithm which is rather good and not necessarily exactly right. When a statistical formula doesn't help, see that you get some simple algorithms in place like: - forecast the same as sold last year with an upgrade of 10% for instance. Or a rule I often apply take the mean pattern of three calendar years and put an upgrade of 10% to it.

Analysis in praxis. In advance I want to make clear this is not a kind of dogma; I am going to tell you now. This is mainly something of trial and error, every situation is slightly different and of course there are also certain patterns which are similar. I want to show you how I do an analysis on demand in a practical way. It's up to you how and what you do. The steps I usually go through when I analyse the forecast in a specific situation are something like:

- Make first a download of the relevant data from ERP to Excel: -

  - For the forecast you need at least the sales of the past 3 years, preferably per day, but a week or month is also possible. Why per day? Very often it has been agreed on which days the orderintake takes place or on which day the delivery is done, so certain customers have certain 'fix' order/delivery days in the week. So this leads to certain patterns in the week which aren't really demand driven but on your own rules. Why 3 years? Because that way you can clearly see whether there is a seasonal pattern.
  - Then I do the Pareto analysis. For this I usually take the annual volume times the price and then you divide that by the total annual turnover. Pay attention to whether you are working with cost prices or with selling prices. It is best to work with cost prices.
  - Then you determine the mean and variance and try to determine initially for the A articles whether you see certain patterns, as in the PowerPoint above. It also helps to make a quadrant like in the above PowerPoint on the right. First try to plot all articles in which part of the quadrant the articles fall. You will notice:

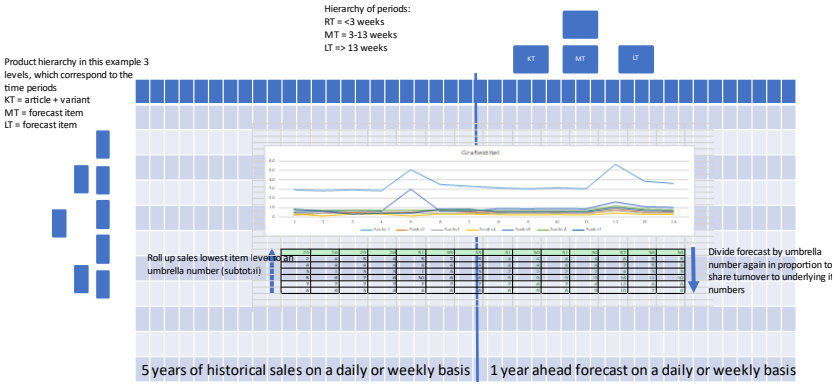
    - On the one hand, articles show a nice regular pattern, in other words forecast adds little, but in case of C-items you might want a forecastformula to generate automatically a forecast-pattern.
    - On the other hand, articles show a very irregular pattern or be lumpy or something similar. Then, in my opinion, statistical forecasting is of little help either. It flattens the question. It is then better, as I said before, to resort to methods such as taking last year's sales and attaching a growth figure and the like.
- I use the Camp formula to determine the optimal stock/series size. Basic data you need are question about the entire year; estimate of the conversion costs (I usually vary this when I have the model) to determine the sensitivity. You must assume of the inventory costs. I always assume 15% of the cost price. The approach is then: -
    - A-items: if you are on top of things, look at them again at least every week based on the sales of the past days and weeks. You produce or order these items weekly, so you keep stock low, you order what you need. You have a minimum safety stock to ensure you keep the service level above 98%8%
    - C-items: you are not on top; you check it once a month and perhaps even with a lower frequency. You need a reasonable forecast; you produce this item with a lower frequency and accordingly you have more in stock and your safety stock is also higher.

  Camp's formula can help you determine the best ratio between production frequency and stock holding. It helps you determine what the costs are of a higher service level, for example.
- You now have a complete model with the basic data. Then you sort, refine, etcetera until you have the idea that you have the 'grip', which models you need, what savings or extra investments are.
- Make sure you think in 'classes'. By this I mean that you, for example, treat A-articles in the same way, you can then easily update the Item Master by telling the ERP system: all A-items must have that value in that field and that value in that field.
- You do this type of analysis frequently in the beginning, of course, but at a certain point you get more into a mode that you can quickly perform an analysis and that you do that quarterly or half-yearly, occasionally of course more often.

Connection to Demand Planning directly or via the Magic Cube.

I did now several S&OP-implementations and I must say I have a preference to save all the data in the magic cube, so separate and not part of some forecasting-tool or so. In that way you can select history and forecast on the same dimensions and from there you go into Demand planning on the level you prefer. Of course, you can go directly from history to forecast tool to demand plan, but it seems to me more complicated.

Input-Output table from which data is sent to planning tool in the desired format



In an assignment I developed an 'Input-Output'-model (see picture above) where the history is coming from the ERP-system (Sales) on a certain level (invoice-level). Within the product hierarchy you can roll up the history say to product group level. This level is exported to the Forecast-tool, then forecasted and the output goes back on the same level to the input/output model. And then the figures are rolled down the inverse way as they were rolled up earlier for the history. In that way you have in the input output model all the dimensions available. On the horizontal axis you can do something similar with the time. So, the smallest dimension is probably days, and you can roll up scale to weeks for example.

This input output model was later in the project after several discussions put in a BI-report on which you select the dimension you want, so also a sort of magic cube.

Summary

Start an S&OP-project with defining a simple set of KPI's for forecasting/demand planning.

Use the Pareto-principle so you can focus on the top20% and see that you get for the remaining 80% algorithm, so you automate the forecast generation and with that demand management takes less time and attention.

Use Forecast to have a basis for Demand Planning, from there you 'finetune' the Demand with the ideas of the Customers and of course yourself in the role of Demand Planner.

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