42 Principles of Forecasting

Bill Whiteside



Demand Solutions®

Global Solutions Delivered Locally™

"In the beginning, I was a complete novice, and now I'm a complete novice with 30 years of experience."

Record producer Rick Rubin, in a Rolling Stone interview, provides a fitting analogy for my career in the forecasting profession. Over the past three decades, I've worked with hundreds of companies that rely on forecasts to drive their supply planning, their inventories - and ultimately - their profitability. At a point in my career where I might be expected to know it all, I'm humbled and inspired each day by how much I continue to learn.

So why should you pay any attention to what I write? This book is a product of the lessons I've learned and continue to refine. As you will find with most honest forecasters, I've learned more from my mistakes than I have from my hits...and I've made every mistake that one can make. The 42 principles that follow are drawn from those lessons.

It's a safe assumption that you already know much of what's in this book. In all likelihood, you include many of these principles in your forecasting routine. But I'm confident that in addition to the reinforcement of what you already know about the best practices in the preparation, execution, management and analysis of your forecasts, you will also find a number of fresh ideas.

You will also find several ground-breaking insights, including an introduction to the economic impact of forecast error.

There's a lot here—more than you should probably try to digest in one reading. We suggest that you absorb an idea or two at a time. It's fine if you start at the next page and read these ideas in sequence, and equally fine if you don't. We hope you find "42 Principles..." to be a "snackable" source of information.

This book won't teach you how to forecast. It will, however, help you become a much better forecaster.



Bill Whiteside

1

Start with the best data

Sales history that's based on your customers' expected delivery dates and quantities - i.e. demand history - tells the true story of the demand for your products over time.

It's fairly common, however, for companies to drive their forecasts with shipment history. But shipments are not so much a picture of your customers' true demand as they are a reflection of your ability to supply your customers.

If your business suffers from significant late shipments or mis-shipments, shipment history tells a distorted tale of what you *could* have sold...which will result in a similarly distorted story of what you expect to sell in the future.

Flawed data will guarantee flawed results. If your history is pockmarked by short or delayed shipments, enter selective adjustments to reflect your customers' true demand and improve its forecasting value. (Those adjustments should fix significant flaws. Don't waste time on minor corrections).

When I was a forecaster, the thought of adjusting our shipment history initially struck me as heretical. However, when our results proved that realistic history resulted in reliable forecasts, I embraced the wisdom of adjusting history one time instead of continually adjusting forecasts.



If the best data isn't readily available, don't simply make the best of what you have; take what you have and make it better.

2

Nevertheless, condition your data

Your data could be 100% accurate but still imperfect…at least as far as its forecasting value.

What do we mean by imperfect data? If your history is accented by non-recurring spikes in demand, in all likelihood those spikes will drive shouldn't-be-occurring spikes in your forecasts. Negative values in history— possibly caused by net product returns—will distort most systems' ability to calculate accurate forecasts. Shipments that have shifted in time due to stock outs or supplier delays could provide a misleading picture of the timing or seasonality of a product's true demand. These and other hairballs in your data will diminish your system's ability to detect plausible patterns in your sales.

By "condition your data," we mean that you should do what you can to improve your data's predictive value. Edit these "actually happened but shouldn't have" abnormalities (such as the examples noted just above) to create a better picture of what you should have sold. Identify the items with imperfect or distorted sales patterns…and selectively adjust history to better reflect the true course of your business … which will help ensure more accurate forecasts.

As you condition your data, consider the maintenance of product lifecycles as well. Perhaps your forecasting database is cluttered with inactive or obsolete items that needlessly occupy your time and drag down your overall forecast accuracy. Remove that unhelpful clutter from your database. If you offer transitional products—where products are phased out as they're replaced by similar new products—the old-to-new product links should be regularly maintained. Brand new products should be identified for the selective treatment that we'll discuss separately.



Spend…no, invest…time in cleaning up and conditioning your data to ensure that it provides a clear, high definition picture of the true demand for the products that you'll be forecasting.

3

Keep score

Would you play golf in the dark of night? Would you go bowling and not keep score? Would you buy a lottery ticket and not check to see if you won? So why would you ever publish a forecast and not review your results?

You've undoubtedly read variations of "you can't manage what you don't measure." Forecasting is not a game of chance in which you must mindlessly accept the results. It's a craft, one that can be honed with discipline, experience and skill. We've helped thousands of companies with their forecasting processes. Without exception, the companies that consistently measure forecast accuracy, analyze the cause of forecast error, and apply the lessons learned to future forecasts enjoy consistent improvements in forecast performance.

Keep score. Measure your forecast accuracy and identify the forecasts that missed by the most. When you focus your time and attention on the items with the least accurate forecasts, you will be astounded at how obvious—and obviously fixable—the causes of forecast error will often appear.



4

Keep more than one score

While we all but insist that you analyze forecast accuracy for each individual month, we recommend that you analyze your accuracy on a rolling 3-month basis as well.

Unforeseen and uncontrollable events can potentially distort an item's accuracy in any one month. For example, a shipment that's delayed by a few days and falls into the next month could throw off both months' accuracy.

While your rolling 3-month forecasts will almost certainly be more accurate than your 1-month forecasts, this is not a charade to game the system. It's simply another relevant performance measure that you should seek to track—and improve—over time.

Analyze forecast accuracy for one-month and for rolling-3-month periods.



5

Measure without Mercy

For a measurement to be meaningful, it must be relevant and understandable. For a metric to have an impact, it should be demanding…perhaps even merciless.

Weighted Mean Absolute Percentage Error (WMAPE) is relevant and—with a bit of explanation—understandable.



WMAPE provides a weighted average of the absolute (or unsigned) percentage error of the items that you measure, regardless of whether the forecasts were high or low. In other words, it shows how much you missed with your forecasts in either direction. In contrast to companies that calculate forecast accuracy by simply comparing the total forecast to their total sales, WMAPE is positively merciless.

Here's a quick example that shows how WMAPE is calculated:

	Forecast	Actual	Unit Error	Error %
Item A	100	75	25	33.3%
Item B	100	120	-20	-16.7%
Total	**200**	**195**		
Total Signed Error			5	2.6%
Total Absolute Error		**(WMAPE)**	45	23.1%

WMAPE is a clear and objective measure of the accuracy of your forecasts. It's also a merciless measure of performance that catches sandbaggers as well as smokeblowers. It's an essential tool for quantifying the quality of your forecasts.

6

Publish your results

If I was a forecaster at your company, you can rest assured that I'd work diligently to provide forecasts that were as accurate as possible. However, if you told me that my results were going to be tacked to a billboard or published in any other way, all of a sudden forecast accuracy would be raised a notch on my priority list. Somehow I'd find a way to make those "as accurate as possible" forecasts even more accurate. If the stakes were raised even higher, and I learned that my forecast results would be compared with my peers', well, there's just no way I'd let any of them beat me.

Competition typically improves performance…and it always improves effort.

Publish your forecast results. Report your overall accuracy and the accuracy of each forecaster. That simple step will have a remarkable impact on your forecasting process. By regularly analyzing and communicating forecast accuracy results you will find that forecasting will soar in priority, and forecast accuracy will rise as well.



Reward accuracy

I once managed three forecasters, each responsible for a different segment of our business. Their challenge was to use their knowledge of our products, customers and markets to improve our software's system-generated forecasts. Each month, I awarded five dollars to the manager who most improved the system's forecasts.

Initially I didn't expect anyone on my team to outperform our software, but at least one person beat the system's forecasts in 23 of the 24 months that we tracked. More important, this small recognition drove a marked improvement in our overall accuracy … from 67% our first month to 88% accuracy at the end of two years.

I've worked with companies that rewarded forecasts on the basis of Accuracy, Completeness and Timeliness (A.C.T.). These programs earned buy-in (even from sale reps) by including reasonable expectations for forecast accuracy. For example, if a salesman's forecasts were within 30% of actual sales, they were considered "accurate." The initial tolerances for forecast variance were set to ensure that success was reasonably attainable, then tightened over time,

The incentives don't have to be lucrative. Lottery tickets, a gift card, a crystal ball or a wizard's hat on the top forecaster's desk...the recognition is more important than the value of the reward.



Just as incentives work in so many other parts of your business, incentives will also help improve forecast accuracy.

Use checklists

In *The Checklist Manifesto: How to Get Things Right*, best-selling author Dr. Atul Gawande provides vivid and compelling examples of the impact of checklists on repeatable tasks ranging from the common to the complex.

A checklist is a simple tool that helps ensure reliable performance. Checklists can be adapted to surgery, air safety, construction projects, food prep, Van Halen concerts (it's all in the book)…and countless other endeavors, including, of course, forecasting.

Forecasting can and should be a process of continual improvement. The only way to improve is to keep score, evaluate the results and apply the lessons learned from each month's critique. The process requires discipline and consistency. Discipline and consistency can best be enforced through the use of checklists.

We've developed a checklist to help businesses of all types and sizes manage a process to analyze and refine the accuracy of their forecasts and, as an indirect result, improve their inventory turns and profitability. Click below to download a copy of our Performance Analysis checklist.



Demand history

Before I knew what I was doing, I would occasionally accept challenges to provide spec forecasts despite not having the appropriate amount of history to drive realistic projections. A manager would send me a spreadsheet with 6-10 months of history and expect monthly forecasts for the next year. I'd deliver…but none of those forecasts were any good.

"The system doesn't know it's Christmas until it sees it twice" is one of the great mantras of Paul Secraw, my longtime business partner. A forecasting system needs at least 2 full years of history to reliably detect trends and to confirm seasonality. 24 months of history is a realistic minimum for realistic forecasts. That volume of data will provide your system— and you—with visibility into seasonal patterns and annual trends. With less history, you'll have neither.

(Yes, we understand that new products and line extensions with little or no history are essential facts of life. We address the care & feeding of new products separately).

As companies grow and especially as companies migrate from one ERP system to another, prior years' history is sometimes elusive. However, its value to your forecasting process is worth the effort to track it down, access it and load it into your forecasting software. Demand history.



Without at least 24 months of history, your forecasting software will not be able to reliably recognize trends and seasonality.

Manage what matters

Most forecasters and planners know their companies' top-selling products. When the Pareto Principle (a.k.a. ABC Analysis or the 80-20 rule) is applied to rank items by sales volume or margin, there are usually few surprises among the top-sellers.

What's often surprising, however, is just how dramatically those sales are concentrated. While "the 80-20 rule" is a common term, it's not at all uncommon to find that 90 percent of a company's sales come from just 10% of their items. At the other extreme, it's also fairly common to see that the "bottom 50%" of items account for just 1% of sales.

In a vacuum, ABC Analysis is thought-provoking but relatively inconsequential. However, when you apply exceptional strategies, policies and time to the different product segments identified by the ABC Analysis process, you will begin to make an exceptional impact on each segment and on your forecast as a whole.



ABC Analysis will objectively identify your most important—and least important—items. Spend the most time analyzing and managing the forecasts of your A-items. Also, consider applying different forecasting strategies to your A-items. Set the tightest forecast error tolerances for your A-items. Manage what matters.

Manage where it matters

The last time you bought a shirt, you hopefully selected a style that you liked in a color that suited you in a size that fit you. Most apparel forecasters recognize that such granular detail—Style-Color-Size—is just too low and much too noisy to provide predictive value. Rather than forecast at that micro level of detail, they manage their forecasts at the style-total level, and rely on their software to spread the forecasts according to the appropriate color and size scales.

As apparel forecasters know, more data doesn't necessarily translate to more reliable or more accurate forecasts, and certainly not to efficiency.

In determining the appropriate level of detail at which to manage your forecasts, two good questions to ask are:

1. Does the data have meaningful patterns and predictive value?
2. Are there a manageable number of records at this level?

If you forecast by customer, apply ABC Analysis to identify your top customers—i.e. the key customers that can individually impact sales and forecasts. Group your remaining customers into "All Other" records for each item. Think of those top customers as "whales" which individually can make a splash on your business, and consider the "all other" grouping of smaller customers as a school of fish that will move together in a similar pattern.



By identifying the level at which your forecasts matter and then managing the forecasts at that level, you will enjoy more accurate forecasts and a much more efficient process.

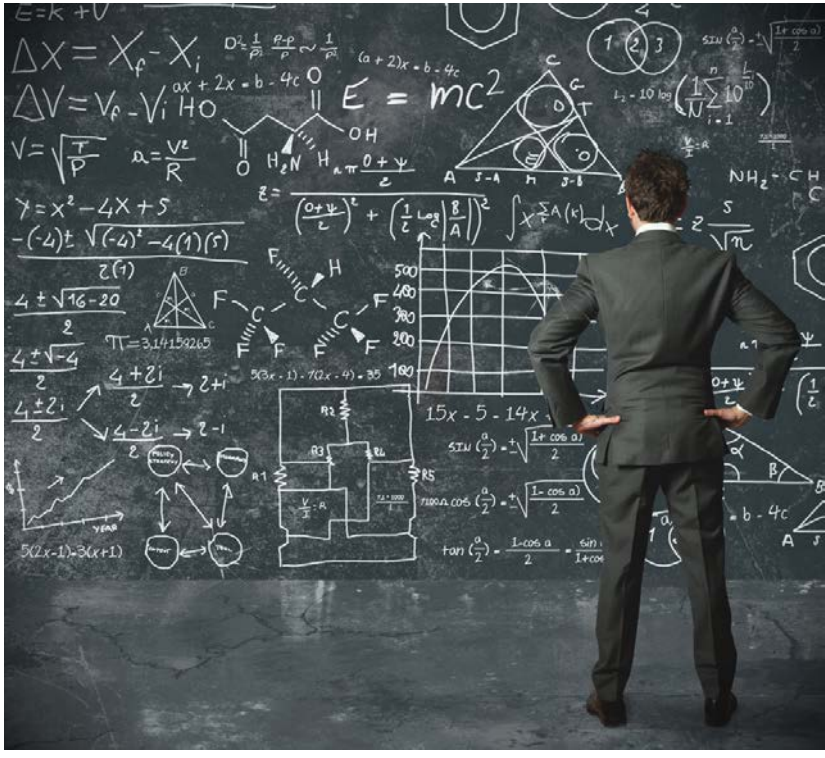
Don't trust a black box

Some forecasters—and some forecasting systems—will mask their uncertainty in a fog of confusion. Indecipherable equations will be used to produce unexplainable projections of an unpredictable future.

There's no other part of your business in which any degree of mystique would be acceptable. In his book *Beyond Numeracy, Ruminations of a Numbers Man*, Professor John Allen Paulos defined statistics as "formalized common sense, quantified straight thinking." Statistics are not the same as forecasts, but this definition applies nicely to the clarity that you should expect in your forecasting process.

If you're currently subject to a black box approach to forecasting, here's what will happen when you convert to a more logical, understandable and transparent approach: your forecasts will be every bit as accurate (or inaccurate). But since you will understand the logic behind those forecasts, you'll be able to analyze, dissect, challenge, improve, communicate and execute those forecasts much more effectively.

A process that produces forecasts that people understand will also reinforce ownership of the forecasts. In the absence of this clarity, managers will be all too willing to blame the system when forecasts are questioned.



Don't accept a forecast that you can't explain or which can't be explained to you.

Don't rely on historical seasonality

It's surprisingly rare to find a product that exhibits no repeatable seasonal pattern. Sometimes seasonality is organic. You sell more ice cream in the summer and more cough syrup in the winter. Sometimes seasonality is self-inflicted—as a result of recurring events or incentives.

Most forecasting systems will quantify the seasonality of your history and replicate that seasonality in the future.

While that's a sensible and generally reliable starting point, be alert to changes in seasonality. Some holidays and a number of other events that affect seasonality—such as Thanksgiving (in the U.S.), Lent, trade shows, promotional activities—will shift on the calendar from one year to the next.

Budget season is a great time to pause and reflect on the likely seasonal patterns that you should expect in the months and the year ahead. If those patterns are likely to differ from recent years' seasonality, be sure to re-seasonalize your forecasts to best reflect the likely course of your sales.



If the seasonal patterns that shape your history will shift in the future, be sure to appropriately shift the seasonal spread of your forecasts.

Harness your system's optimism

Most forecasting algorithms extrapolate patterns from history into the future. If an item has enjoyed recent sharp growth, in all likelihood your forecasting system will project a similar rate of growth into the future. You can be quite certain that this same rate of growth will *not* continue into eternity…so how about giving some consideration to how likely it is to continue into the next year?

If your system enables you to dampen growth factors, you should. Allow individual items plenty of room to grow… perhaps five times the rate of growth of the entire company. There might be some items for which heightened growth is realistic. We suggest that you review the items whose actual growth over the past year exceeds the maximum growth factor threshold that you set for your forecasts, and, where logical, apply the appropriate adjustments to those items' forecasts. (And for other items, where logical, embrace the likelihood that their growth will continue to outpace the rest of the company).



What's the likelihood that an item will grow at the same rate from year to year? Take the time to consider if key items' forecasted growth is plausible.

Vary your strategies

Most forecasting systems enable you to tailor and tweak growth factors, seasonal profiles and other parameters. Many systems also allow you to selectively pick or ignore specific formulas.

Most forecasters carefully structure the rules by which their forecasts are generated… and then apply a common approach to all items. That would be fine if your products all traced similar sales patterns. But of course they don't.

You might find that your forecasts will improve if you vary the settings for different segments of your business – for example by product family or by sales channel.

Or if you rank and stratify items by ABC code, consider giving your system free rein over your A items (typically your most predictable items), while limiting C & D items to exponential smoothing formulas..

Another idea would be to manage your top items and customers at a detailed level, and to roll the remaining items and customers with individually erratic and data into "all other" records.

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If different segments of your business move in different ways, consider varying your forecasting strategies to adapt to those different patterns.

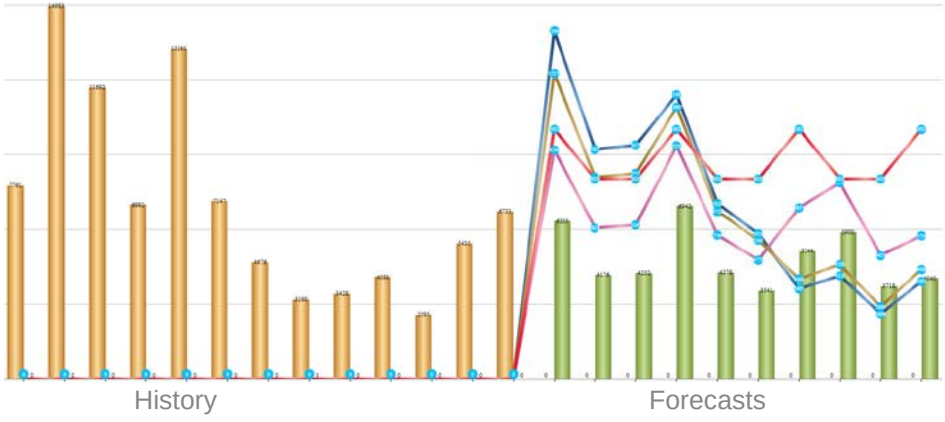
Don't use every formula

Most forecasting systems offer a variety of formulas, running through a simulation process in which "the best" formula is automatically selected for each item.

However, the formula with the best fit with your data will never be a perfect fit…and it won't necessarily even be a very good fit.

To their credit, companies that market forecasting software set out to provide formulas that will cover just about every possible scenario—from consistent long-term growth to sudden near-term spikes. By nature, your business might exhibit particular characteristics that render some formulas irrelevant and perhaps even dangerous. Or, even more likely, a turning point in economic trends might provide a good reason to at least temporarily inactivate one or more of the formulas in your system.

Don't necessarily use every formula that your system offers. Evaluate the applicability of your system's forecasting formulas at least once a year. De-select the formulas that are like to result in distorted forecasts.



More formulas don't necessarily mean more accurate forecasts.

Collaborate

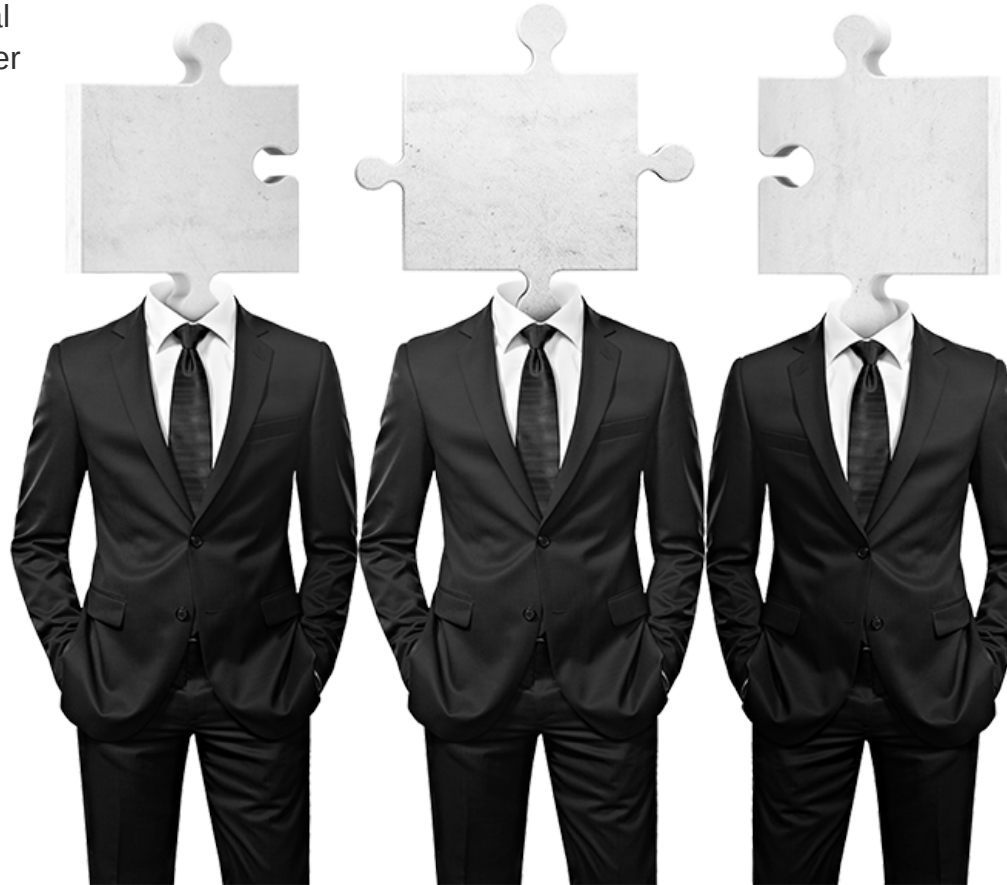
Since the goal of any sales forecasting process is ultimately to predict human behavior, why not listen to those humans who have unique insights and a vested interest in your forecasts: your customers, and the sales reps who work with your customers?

In the supply chain forecasting arena, the two most critical questions about human behavior that you need to consider are: "How much will our customers buy?" and "When will they buy?"

Who has the best answers to these questions?

Who has the most direct interaction with the decision-makers at your customers? Whose job is it to guide and shape your customers' buying behavior?

At most companies those responsibilities rightly fall to the sales force. Sales people most typically interact with the decision makers who most directly affect your future demand. If they're really good, your sales people also guide and shape your customers' demand. If your forecasting process doesn't incorporate input from your sales force, then you're missing out on valuable insights and perspective.



Be curious

Collaboration is typically understood as a process in which multiple people provide input. However, in addition to collaborating with others, you can perform collaboration on a personal basis by gathering the information that you need to shape and temper your projections and plans.

With a raw statistical forecast as your starting point, you can develop a personal consensus process to refine the forecast by tempering and shaping it based on a variety of inputs from the real world. In addition to previous years' demand levels and statistically-generated forecasts, consider reviewing:

- Point of Sale consumption data
- Customers' inventory data
- Consumer confidence indicators
- Gross Domestic Product trends
- Housing starts data
- Unemployment rates
- Gasoline & other energy costs
- Regional forecasts of significant weather developments
- Competitive information
- Intelligence from Customers, sales reps, suppliers and shippers
- Trends on social media



In addition to collaborating with others, collaborate with yourself, and use the information that you gather to shape and polish your forecasts. Ideally, initiate a process in which you consistently incorporate external information that's relevant to the future of your business.

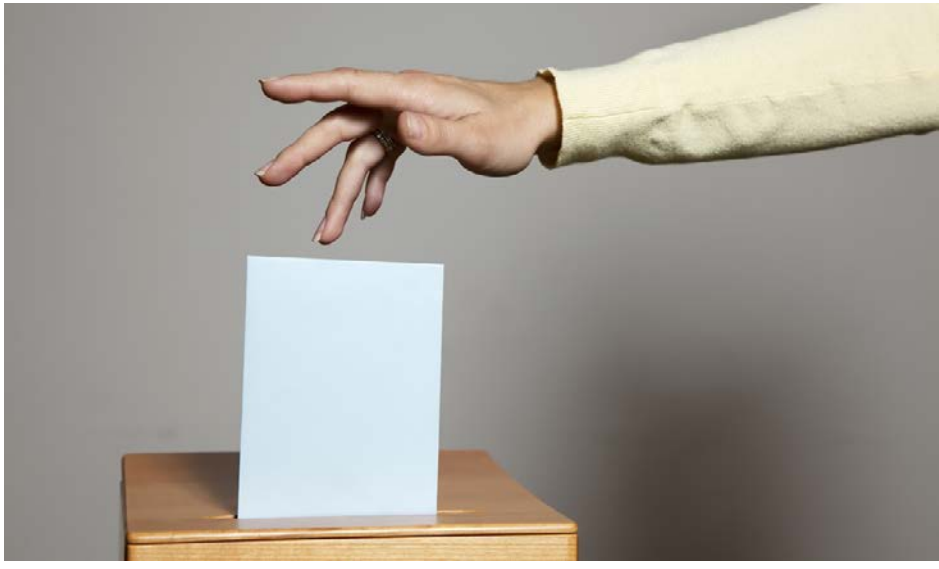
Delay commitment

In his best-selling book *The Signal and the Noise: Why So Many Predictions Fail – But Some Don't*, author and pundit Nate Silver notes that a five-point lead for a political candidate a year in advance of an election isn't very significant. However a five-point lead the day before an election signifies an almost sure thing.

The same principle holds true in supply chain forecasting. The farther into the future you forecast, the less accurate your forecasts are likely to be. The closer you can update your forecasts to the point of decision, the more you improve your chances for accuracy.

What then is the optimal time to commit to a forecast? It's when a decision has to be made based on that forecast—typically a commitment to production or to a purchase. If you understand that your forecasts drive other colleagues' decisions, and if you understand that a forecast is truly a commitment - not just speculation about the future - then you will be an uncommonly valuable contributor to the forecasting process.

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At the very least, carefully review your forecasts one last time before turning them over to your planners. Update them to reflect any recent changes in your business or your expectations. Enrich your forecasts with the freshest possible data and insights.

Think like a poker player

Early in his journey to prominence as a handicapper of political races, Nate Silver won and lost substantial sums playing online poker. He shares lessons from his poker experiences in a chapter in his best-selling book *The Signal and the Noise*.

Silver notes that even the best poker players are subject to the cards they are dealt. Skill and temperament help some win more often than others, but there is truth to “the luck of the draw.” Accomplished players understand "there is a difference between process and results,” and while they have no control over the cards they are dealt, they do control the decisions they make about those cards, as well as about the other players at the table.

Forecasters also face “luck of the draw” events on a regular basis. Events like production and delivery problems, competitive activity, customer issues and dramatic weather changes can disrupt even the most diligently planned and plausible forecasts.

With forecasting, as with poker, when you lose it’s essential to understand why you were wrong…and to use that knowledge to enhance your chances of winning in the future. Your process should include disciplined, accountable reviews of forecast accuracy. An objective review of the key drivers of your least accurate forecasts will often identify strategies to help ensure that those same issues don’t impact your forecasts in the future.



Your forecasts will always be wrong to a degree. But if you use appropriate tools and consistently adhere to a formal process, our experience indicates that your results will consistently improve over time. Don’t abandon a winning process after a few bad hands.

Manage new product forecasts with special care & attention

Forecasting new products— for which you have limited history (or no history), but for which you might have an abundance of subjective enthusiasm—just might be the most difficult forecasting challenge there is.

As a former director of marketing who used to practically sell my soul to get new items (and their forecasts) approved, I understand how challenging it is to be objective … especially when new products under-achieve against your forecasted expectations.

New products' sales volumes are likely to differ from your expectations more quickly and more explosively than mature products. They should be managed separately, and you should apply specific new product forecasting strategies.

One effective and responsive approach for objectively forecasting new products is to quantify seasonal or life-cycle profiles by cloning the demand pattern of similar products. Then, update your new product forecasts by applying their initial actual sales to that curve.

Review your new products' forecasts frequently, and adapt quickly as their sell-through data provides indications of market acceptance and the likelihood of success or failure.

If you don't isolate new products and apply specific new-product forecasting strategies, you'll get the results that you deserve.



Focus separate care and attention on new products' forecasts. Your process for managing new products should enable you to recognize, respond and adapt quickly.

Does the forecast make sense? A great instant sanity check

Is there a quick and easy way to determine if a forecast is realistic? When I was a forecaster I'd start my monthly process with a comparison of the projected percentage growth in the annual forecast against the item's actual percentage growth over the past 12 months.

I didn't expect the numbers to match. My hope was to find them moving in the same general direction at a similar order of magnitude. I was most inclined to question items with forecasted growth out of sync with the item's recent historical growth.

For example, if an item grew by 7% over the past 12 months, and the forecast called for 11% growth (or even a modest decrease), I was OK with that. If, on the other hand, another item also had a 7% historical growth trend, and the forecast called for a 26% increase (or a 19% decrease), I'd be more inclined to question its forecast.

For a first-pass review, arm yourself with this quick comparison between historical and projected growth. When an item's history and forecast are moving in general concert, that's a good sign—but not necessarily a guarantee - of reasonable accuracy. But if the two values are clearly out of sync, that's a good indication that the forecast is flawed.



This first-pass review of your projected growth against actual historical growth will quickly identify items whose forecasts are out of sync with historical momentum, which, of course, will assist you in adjusting your forecasts accordingly.

Catch lousy forecasts before they become horrible forecasts

I got off to a rough start as a student-athlete in college. Midway through my first semester, the academic advisory office sent a summons: "Please report to Mr. DeCicco's office immediately. No excuses will be tolerated." During a brief meeting, I was pointedly informed that I was on a path to failure and ineligibility. Alerted and warned, I buckled down and earned the continued privilege of membership in the student body and on the hockey team. If I hadn't been alerted to my progress and taken action, I very well might have failed.

If you have forecasts that are very likely to fail, should you wait for them to flop before taking action? Of course not. Forecasting is more than a statistical exercise. It's the process by which you drive the direction of your business.

To catch lousy forecasts before they become horrible forecasts, track the progress of month-to-date sales against the forecast. When items begin to slide significantly above or below where they should be at that point in the month, revise your forecasts and alert the appropriate stakeholders in your forecasts (typically planners) so they can make timely adjustments to their production or purchase plans.

Use a sliding scale as you review your month-to-date progress each week.



For example, after two weeks, month-to-date sales would ideally be about 50% of the month's total forecast. However, you should view your forecasts within a realistic tolerance. At that point in the month, items with month-to-date sales of 30% or less or 70% or more of the month's total forecast should be flagged for review.

Catch and correct lousy forecasts while there's time to fix them. No excuses should be tolerated.

By all means use forecasting time fences. And by all means violate your time fences.

A time fence is a defined period within which the forecast should not be changed. A forecasting time fence often mirrors an item's planning or sourcing lead time. If it takes two months from when an item is ordered to when it's received into inventory, there's logic in not changing the forecast within that two-month period, since a change to the forecast will have no impact on the item's availability.

A time fence provides planners with assurance that the forecast will not change within the item's lead time. Is this necessarily a good thing though?

One school holds that since supply plans cannot be changed within the time fence, forecasts should not be changed. Another holds that since supply and demand should balance over time, it's foolish not to reflect significant changes in expected demand —even within the time fence. A forecast change within the time fence won't impact an item's near term availability, but it will be reflected in the item's longer term projected inventory.



We suggest that you employ time fences to ensure discipline and accountability. Forecast accuracy measurements should be based on the forecasts just outside of the time fence. At the same time we also recommend that you update forecasts within the time fence when you are highly confident of significant changes in demand. The result will a more dynamic and realistic set of forecasts and plans.

Share your uncertainty

Every one of your forecasts will be wrong. As you and the recipients of your forecasts both know, some forecasts will be more wrong than others. So go ahead and manage expectations for the accuracy of your forecasts. Quantify a reasonable expectation for forecast accuracy (or error) and share it with the other stakeholders in your process.

One of the best ways to quantify uncertainty is to share your system's "simulation error" – which provides an indication of how well your forecasting software was able to fit its recommended forecasting formula to history. An item with consistent, stable history will be relatively easy to forecast, and thus will have a low simulation error. Items with "noisy," less stable history will be more challenging to forecast, and that uncertainty will be quantified in the form of a higher simulation error.

When you publish your forecasts to the most significant "customers" for those forecasts (your planners, in particular), consider adding a column that provides a valuation of uncertainty (e.g. simulation error).

Also, make time in your review process to focus attention on the high volume or high value items—your A-items in particular—with the highest levels of uncertainty.



By helping to manage the expectations of the recipients of your forecasts (as well as your own expectations), you will enhance the utility and the value of the data that you share.

Add perspective

In a discussion of data and context, the author Nate Silver promotes the theme of “plausibility.” A forecast might fit neatly with a trend and have a comfortably low forecast error in a simulation of previous history. But if the forecaster neglects to take marketing plans, new product programs and capacity constraints into consideration, she’s missing valuable context, and her forecast might not be a plausible fit with reality.

True confession: I didn’t grasp the significance of my forecasts until my company launched a formal Sales & Operations Planning process. S&OP is a monthly review and decision-support process in which forecasts and supply plans are reviewed against the perspective of inventories, capacities and budgets…typically by product family.

Prior to my exposure to S&OP my forecasts were little more than theoretical projections to me. When I viewed them in the “classic” S&OP presentation – against the perspective of past forecasts, supply plans, inventory and capacity plans, I was transformed. To then, I fit the stereotype of the genetically optimistic, not-exceptionally-accountable marketing manager. After being exposed to—and deeply involved in—the S&OP process—I evolved into a manager who…well…got it.



Month	May	Jun
Sales/Production Days	20 / 20	20 / 20
Demand Plan		
Last Years Actuals	569	1,027
Budget	620	1,050
Latest Estimate	620	1,075
Previous Forecast	606	950
History/Forecast	662	1,002
Units (or $)/Day	33	50
Deviation to Budget	42	-48
Cumulative Deviation to Budget	-322	-370
Deviation to Latest Estimate	42	-73
Cumulative Deviation to Latest Estimate	-347	-420
Supply Plan		
Budget	950	1,250
Previous Plan	956	1,390
Current Supply Plan	931	1,550
Actual/Planned Capacity	1,390	1,815
Deviation to Budget	-19	300
Cumulative Deviation to Budget	-67	233
Units (or $)/Day	47	78
Inventory Plan		
Budget	1,036	1,341
Previous Plan	1,002	1,494
Current Inventory Plan	1,074	1,622
Deviation to Budget	38	281
Days of Supply	21	27
Line Fill Rate	97.3%	97.5%
Turns	5.5	5.7

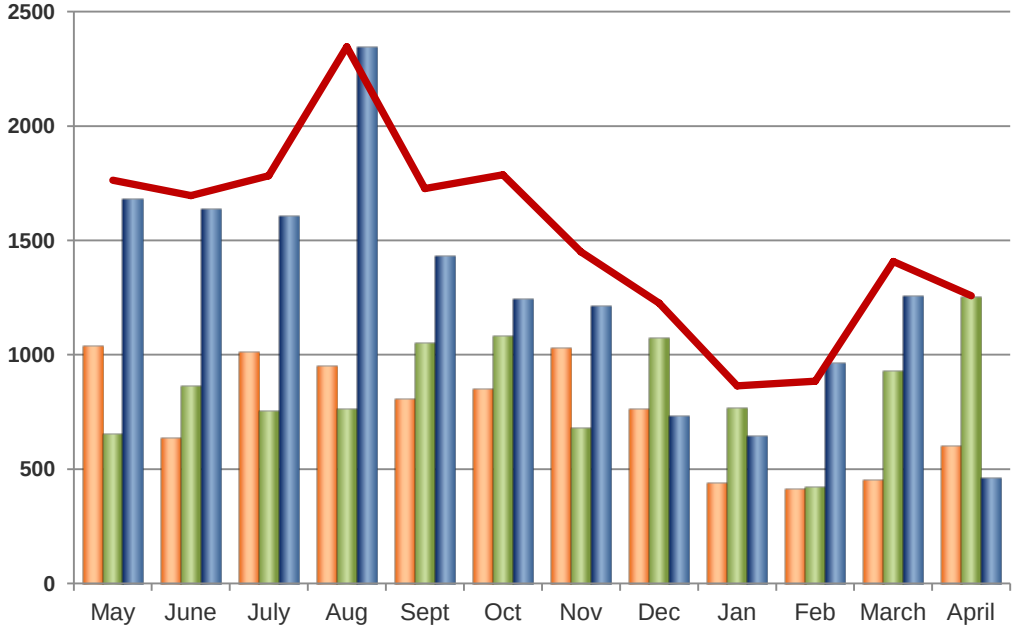
It’s a beautiful thing … just as forecasts are the most important input into Sales & Operations Planning, the perspective provided by S&OP sheds light on the plausibility and impact of your forecasts.

Visualize

A line graph of an item's forecast overlaid on a bar chart of the item's last 3 years of history will tell a more compelling story than four dry columns of numeric data.

Spikes, trends and other abnormalities that might literally get lost in the numbers are much more likely to jump out at you in a chart.

Incorporate data visualization into your forecasting process to help ensure that the forecasts you produce tell a plausible story of your business.



Trust your vision

OK, time for a pep talk.

I've worked with progressively enhanced versions of the software that I sell since the late 1980s. In all humility, I know that software as well as all but a handful of people in the world. I've used it in a real job. I've written user manuals and trained hundreds of people on how to use the software.

And yet, if your company hired me as a forecaster, your initial forecasts would be more accurate than mine. Your experience with your products, customers, sales channels, etc. would outweigh my experience with the software.

You know where to find the most meaningful data. By slicing, dicing, rolling up, drilling down and pivoting your sales and forecast data in knowledgeable ways, you can find insights and exceptions that computers will speed right by. Software is a tool, and the skill of the carpenter is always more impactful than the quality of the tool.

You know many things that software doesn't. You see things that a computer can't. By all means rely on the computer's forecast as a starting point. It's easier to change a forecast than to produce one from scratch. As you invest your time in learning the software and in executing an accountable forecasting process, your forecasts will become even better over time.



Don't hesitate to trust your vision, add the refinements and enter the forecast adjustments that your vision, experience and confidence guide you to make.

No, I'm sorry, you just cannot mandate a specific level of forecast accuracy

We occasionally hear from forecasters and planners—usually with a high degree of despair—that a senior manager has insisted on a specific level of forecast accuracy. Of course those expectations are always high.

You will be about as successful mandating a specific level of forecast accuracy as you will be if you mandate a specific daily temperature or a specific score for a round of golf.

To a degree, a forecaster is subject to the cards she is dealt. Some products and customers are more forecastable than others. There are always opportunities to improve accuracy. But it's just impossible to guarantee a specific level of forecast accuracy, no matter who delivers the mandate.

Recognize too that the management of others' expectations is often an integral part of the forecasting process. If you provide meaningful metrics and consistently demonstrate a disciplined process and a track record of improvement, you might just have at least a fighting chance of reining in unrealistic expectations.



Rather than chase an unreachable goal, measure what you should, improve what you can, and focus your time and energy on delivering honest and reliable forecasts.

"It is better to be roughly right than precisely wrong“*

Do you happen to know what the precise weather forecast was for today? Did the forecaster call for a high of forty-seven degrees? Sixty-two degrees? Eighty-four degrees? Does it really matter? Wasn't it sufficient that you knew it would be warm enough that you wouldn’t need an overcoat, but not so warm that you should wear short-sleeves?

How precise do your company’s forecasts really have to be? If you manufacture or purchase goods in lot-sized quantities, in all likelihood pinpoint accuracy wouldn't make a marked impact on your planners' decisions. Yes, I acknowledge the heretical implications here, but let's remember that minimum order quantities in particular—as well as current levels of inventory—will often dampen the effect of small-to-medium changes in your forecast quantities.

Certainly, your forecasts should reflect your honest expectations for future demand, honed with input from your colleagues in sales and marketing who have a direct impact on the forecasts. You have a right to expect forecasts that will reasonably project the direction and volume of your business. You will not find a stronger advocate than me for the value of a process that expects and rewards continual improvements in forecast accuracy. But you will be disappointed if you expect unreasonable precision.



Focus your time and attention on improving forecasts to the roughly right level of accuracy.

** Often attributed to John Maynard Keynes – perhaps incorrectly*

Apply Pareto analysis to performance analysis

Pareto's Law applies to many walks of life. Also commonly known as the 80-20 rule, it holds that a relatively small percentage of any population will account for the majority of the observed results. For example, 80% of a company's sales are typically accounted for by about 20% of the items it offers for sale.

One of the most interesting aspects of Pareto Analysis is that it can be used to rank and stratify *any* universe of data. For example, in addition to ranking your items by unit volume, revenues or margin, Pareto analysis can also be applied to rank and stratify your items by forecast error. In all likelihood, the 20% of your items will account for about 80% of your overall forecast error.

By ranking your items based on the descending value of their absolute forecast error, you can quickly and objectively identify the relatively small group of items that account for the top 80% of your overall forecast error. More important, by analyzing these items in detail and taking the appropriate action to correct their forecasts in the future, you will address the items that have the most significant harmful impact on your overall forecast error.



Vilfredo Pareto

The good news here is that you can markedly impact your overall forecast accuracy by focusing on the flawed forecasts of a relatively small group of items.

The Terrible 25

OK, you might have thousands of items or more in your product line... which would make it impractical to analyze the individual products that account for 80% of your forecast variance. If that's the case, at minimum, review—in detail—the 25 items with the least accurate forecasts each month.

Compare their forecasts against actual sales for the month, and calculate the unit and percentage variances. If you have both system and adjusted forecasts, determine which forecast was the "winner." If system forecasts are more accurate than your adjustments for a clear majority of items, reconsider the wisdom and value of your adjustments.

Look at the current forecasting screen for each of the items in your terrible 25 each month.

That perspective will often help you determine why the now-flawed forecast made sense at the time you committed to it, especially if you're able to display several years of history along with your forecasts. It will also give you a sense of what you can do to avoid repeating past errors, and should provide an indication of what you should do to improve the item's forecast going forward.

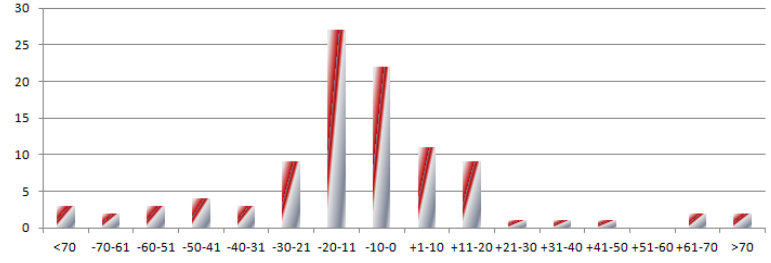


By actively managing this important slice of your forecasting universe, you will help ensure that this month's terrible 25 doesn't repeat as next month's terrible 25. And you will see your accuracy improve over time.

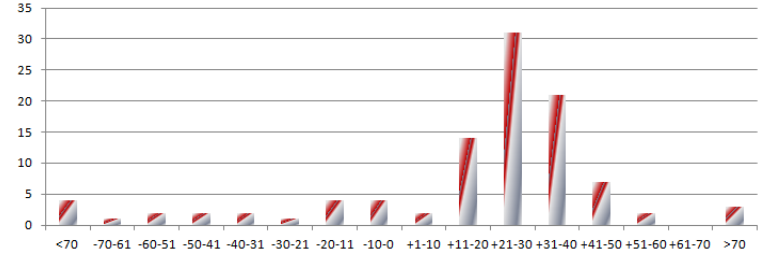
For extra credit, extend your detailed analysis to include the Filthy 50: the 25 items with the highest variance on the plus side, and the 25 items with the highest variance on low side.

Forecasters have personalities?!?!?

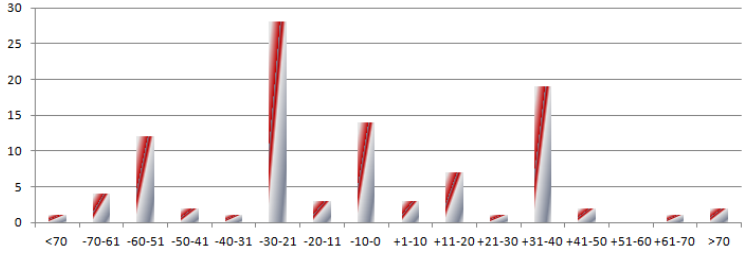
A Histogram is a visual presentation of the distribution of data. An interesting way to view forecast accuracy is to graph the percentage of forecasts that were within 10% of actuals, within 20% of actuals, etc., on either side of perfection. In the mythically perfect bell-shaped world a histogram of your forecast results will resemble this:



If, like me, you tend to be optimistic, yours will more likely look like this:



And don't be surprised if a number of histograms look like the one just below. Some items or companies or customers just cannot be forecasted with any consistent level of accuracy.



When you view histograms for each forecaster, key customer, product family, sales channel, etc., you will see the personality of each subject brought to life. More important, by capturing, quantifying and visualizing their personalities with histograms, you will be better able to identify biases and outliers as well as exceptionally good performers.

(By the way, I am proud to call myself a forecaster)

Incorporate the appropriate lag time in your performance analysis

When you analyze the accuracy of your forecasts, which month should you analyze? Since your forecasts probably extend at least 12 months into the future, for which of those periods should you be held accountable?

Lead time is the most important factor in this decision. For example, if you have a manufacturing lead time of 1 month or a sourcing lead time of 4 months, you should record, track and analyze the forecasts for the first period outside your lead time. That's the key point of decision, the time when buy or make decisions are most reliant on your forecasts.

(In forecasting parlance, the difference between the period in which forecasts are calculated – and saved – and the period in which they are analyzed is referred to as lag time).

If there's any degree of lead time in your business, and if you track your accuracy for just the current period, then you're providing an irrelevant measure. There's a story that's been told about a farmer who aimed his rifle in the general direction of his barn and, after firing off a few shots, painted a target around the bullet holes to show off his accuracy. Don't be that farmer.



When saving forecasts for performance analysis save the forecasts for the time period in which planning or purchase decisions are being made. Forecasters should be accountable for the forecasts made for the key point of decision.

Always divide by the Actuals

The calculation to determine an item's forecast accuracy is very simple: subtract the actual sales from the forecast and divide by…well, you can divide by either the forecast or by those actual sales. In my experience, half the world believes you should divide by the forecast, half preaches that you should divide by the actuals. Both sides share a sense of certainty that their approach is absolutely correct.

Between us, when it comes to selecting a divisor, there's one thing I know for sure… it just doesn't matter. Neither approach is consistently more objective or more accurate than the other. What counts is to pick one approach and to apply it consistently.

I will add this: Many companies track more than one forecast. For example they may have some combination of system-generated forecasts, management overrides, sales-force forecasts, customer forecasts, etc. Each forecast will be compared against actual sales, so it just makes sense to use—literally—a common denominator—your actual demand.



Chart your WMAPE over time

Forecast accuracy is typically calculated as a snapshot in time. "Last month we forecasted X, we sold Y, and our accuracy was Z."

In addition to publishing your forecast results each month, we also encourage you to track the time-phased progress of your Weighted Mean Absolute Percentage Error, or WMAPE. Track the numbers in a table, and provide a graph of your progress as well.

I once worked with a company where a graph of their month-to-month forecast accuracy was posted on a bulletin board. The graph showed a consistent upward slope, with the exception of one month in which the line traced a deep dive. Of course I just had to ask about that one outlying month I was told that a senior manager wasn't comfortable with his planner's forecasts, and mandated a new set of numbers for the month.

The graph was great reinforcement of the success and progress of the forecasting team. Also, a consistent upward trend—for forecast accuracy in particular—is a psychological reward in itself.



As we continuously note, forecasting should be a process of continual improvement. The perspective of time that a graph provides will help bring your progress to life

Quantify the cost of forecast error

There's a cost to forecast error. However, very few companies track or even know how to calculate this cost.

And yet, consider this: As a result of forecasts that are too high, a company might buy or make more product than it needs. Conversely, forecasts that are too low can potentially result in lost sales. When you calculate those costs, you will add an entirely new perspective to your performance analysis

Because forecast error will affect businesses in so many different ways, let's not consider this a precise, down-to-the-penny-calculation. Instead, let's view the cost of forecast error as a relative measure that provides a meaningful indication of the financial impact of forecast error, especially when it's tracked over time.

For starters, let's reasonably agree that some degree of forecast error is inevitable. There should be an accepted tolerance…let's say 25%. In this case, forecasts that are high by more than 25% cost the company the value of the inventory based on this excess forecast. Conversely, as a result of forecasts that are too low, the company potentially loses sales. Again, there should be a tolerance. Using the same 25% tolerance, forecasts that are low by more than 25% cost the company the gross margin on these potentially lost sales.

Note that it's not necessary to use the same tolerance for over-forecasts and under-forecasts. For example you might want to use a 25% tolerance for over-forecasts and a 35% tolerance for under-forecasts in your calculations.

The simple spreadsheet on the next page provides an example of how the cost of forecast error can be calculated.

By calculating the cost of excess inventory as a result of over-forecasting, and the margin that was never received as a result of lost sales due to under-forecasting, you will have a tangible measure of the cost of forecast error, and a valuable metric to use in tracking the effectiveness of your forecasts.

Quantify the cost of forecast error

Here's how to calculate the cost of forecast error for items with forecasts that are too high:

Item A "Over-Forecast" Example		
Unit Forecast	130	This item's forecast was high by 30 units (or 30%)
Actual Units	100	
Unit Error	30	
% Error	30%	
Acceptable Error %	25%	Our "acceptable" error is 25%, which equated to 25 units for this item.
Acceptable Error Units	25	
Excess Error	5	Our excess error, then, is 5 units
Unit Price	$20	Since the forecast was high on this item, this resulted in excess production. In this case, the cost of forecast error = (Excess error x Unit Cost)
Unit Cost	$15	
Gross Margin	$5	
Cost of Excess Error	$75	Cost of Forecast Error = Excess Error (**5**)* Unit Cost (**$15**)

Here's how to calculate the cost of forecast error for items with forecasts that are too low:

Item B "Under-Forecast" Example		
Unit Forecast	65	This item's forecast was low by 35 units (or 35%)
Actual Units	100	
Unit Error	-35	
% Error	-35%	
Acceptable Error %	25%	Our "acceptable" error is 25%, which equated to 25 units for this item.
Acceptable Error Units	25	
Excess Error	10	Our excess error, then, is 10 units
Unit Price	$20	Since the forecast was low on this item, this resulted in lost sales. In this case, the cost of forecast error = (Excess error x Gross Margin)
Unit Cost	$15	
Gross Margin	$5	
Cost of Excess Error	$50	Cost of Forecast Error = Excess Error (**10**)* Gross Margin (**$5**)

In this mini-universe of 2 items, the total cost of forecast error is $125.
We recommend that you calculate this value each month, and track it from month to month.

Quantify your contribution

If you make a conscious decision to adjust your forecasts, you should know if you are improving—or hurting—the accuracy of your company's forecasts.

Your process should include an item-by-item review of forecasts against actuals, and a comparison of adjusted forecasts against system-generated forecasts.

Determine which forecasts were more accurate, the system's or yours. Quantify the number of items for which your adjustments were more accurate, as well as the number of items for which the system was more accurate. Verify your personal impact on forecast accuracy.

You should know—and consistently track—the following:

- Total forecast accuracy, based solely on system-generated forecasts (as if you had made no adjustments)
- Total forecast accuracy, including adjusted forecasts
- Number of items for which the system forecast was more accurate
- Number of items for which the adjusted forecast was more accurate
- The unit, dollar and percentage impact of your adjustments on overall forecast accuracy
- Percentage of total forecast error from adjusted forecasts



Know—and quantify—just how significantly your forecast adjustments are helping or hurting the accuracy of your forecasts. Be sure you're adding value to the process.

Have you considered Weighted Mean Absolute Percentage Accuracy?

Perhaps it's just a matter of spin. But imagine an alternate universe in which the scoreboard at a bowling alley recorded how many pins you missed. Or a world in which baseball players were ranked by their out-percentages (not a term a sports fan would ever use, I know) instead of their batting average.

In most competitive endeavors in which scores are recorded, it's the positive results that are tracked. In the world of the forecaster however, forecast inaccuracy is "celebrated" (or at least widely publicized).

You should measure, track and publish forecast error. But you should also tout your forecast accuracy.

Weighted Mean Absolute Percentage Accuracy (WMAPA anyone?) doesn't exactly role off the tongue. But the calculation is very simple. First calculate your WMAPE (Weighted Mean Absolute Percentage Error) as you (hopefully) do today. WMAPA = (1 – WMAPE.)

If your WMAPE is 18%, then WMAPA would be its reciprocal, or 82%.

Or just call it forecast accuracy. And track it and work hard to improve it over time.



Weighted Mean Absolute Percentage Accuracy, which is simply the reciprocal of Weighted Mean Absolute Percentage Accuracy – puts a more positive spin on the reporting of forecast accuracy.

Tell the story of your business, not the story of your data

Forecasting software will always produce a forecast. But that forecast won't necessarily be a good one. The best forecasting systems use dozens of algorithms and automatically select the best algorithm for each product. However, the algorithm that best fits your data isn't necessarily the best fit with the future direction of your business. As Nate Silver hammers home in his best-selling book *The Signal and The Noise*, your forecasts should tell the story of your business, not the story of your data. Your knowledge of your products, customers and your general business environment will help you recognize statistical misfits, and enable you to enhance your system's forecasts.

Think of your data as moist clay, and consider the statistical forecast to be a roughly shaped vase. In the potter's hand that forecast can be transformed into a thing of beauty...or into a pile of muck. Just as pottery-making is a craft, so is forecasting.

The forecasts that you mold should fit the reality—and the plausibility—of your business, not just the mathematical proof in the data.



While the statistical forecast provides a vital starting point, your understanding of the story behind the data is an essential requirement for an effective process. Make sure your forecasts are plausible and that they tell the story of your business.

When surrender is the best option, fly the white flag

Hey, let's face it…some items just flat out cannot be forecasted. An example of a non-forecastable item would be one with sales history that's so erratic and spiky—with not even the faintest repeatable pattern—that it would be foolish to place any degree of confidence in any projection of when its future sales will occur.

If your company carries items for which you have an approximate sense of their future sales volume, but no confidence in *when* those sales will occur, rather than try to forecast the impossible, a reasonable and practical fallback would be to ensure that you have the inventory in place for when those sales do occur.

Rather than waste time trying to fine-tune a forecast that can't even be roughly tuned, calculate objective safety stock targets for these unforecastable items.

By not throwing away your time trying to forecast items that cannot be forecasted, you will be able to spend more time on items and customers where your work can bear more productive fruit. And, if you focus instead on having optimal levels of inventory, you will address the "right product in the right place" objective that should be the ultimate goal of your forecasting process.



Sharpen your saw

Author Stephen Covey capped his list of *The 7 Habits of Highly Effective People* with an appeal to "sharpen the saw." This final habit emphasizes the importance and the benefits of education and self-improvement.

It's often said that forecasting should be a process of continuous improvement. What's not said as often is that improved performance requires diligent and disciplined effort.

At various times in your life you've probably set your sights on becoming a better athlete, a better user of Excel, a better musician, cook or mechanic, a better writer, etc. Any gains you made were the result of the time you actively invested in improving your skills.

As a forecaster, there's no substitute for knowing your company's products, customers, sales channels, etc. You should also seek to improve your craft. Read forecasting blogs and publications. Attend forecasting conferences.

Join and participate in social media discussion groups with forecasting and supply planning themes. Network with your peers. Pay particular attention to best practices, and apply those practices to your forecasting process.



Don't ever let your mind or your talents become dull.

About Demand Solutions

Since 1985, Demand Solutions has been providing software for the full spectrum of supply chain management – inventory planning, sales & operations planning (S&OP), demand planning and forecasting, collaboration, inventory optimization and replenishment, advanced planning & scheduling and retail planning. Our products are affordable, easy to implement, easy to use and deliver fast ROI.

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The days of working with siloed data sources throughout an organization are gone. Demand Solutions customers recognize that today's best-practice approach is more comprehensive and based on a holistic view of the enterprise that incorporates people, process and technology to ensure optimal demand planning.

Headquartered in St. Louis, Missouri, Demand Solutions is a global company with thousands of customers in over 75 countries and major support centers worldwide.

Demand Solutions

1 CityPlace Dr., Suite 540, St. Louis, MO 63141

1-800-886-3737
info@demandsolutions.com
www.demandsolutions.com

About the author

Bill Whiteside was introduced to Demand Solutions in the late 80's when he implemented the software while serving as director of marketing for an ice cream manufacturer in Lancaster County, Pennsylvania. In December 1989 he made the ultimate product endorsement by founding Demand Solutions Northeast to market and support Demand Solutions software in the Northeast U.S. Prior to working with Demand Solutions, Bill's professional experience included 14 years of consumer goods marketing.

In his sales, marketing, and support roles with Demand Solutions, Bill has worked with more than 400 companies across a diverse group of industries.

Bill is a graduate of the University of Notre Dame, a member of APICS, the IBF and the International Churchill Society.

Bill Whiteside
Demand Solutions Northeast
Lancaster, PA
bwhiteside@demandsolutions.com
717-575-4513

Additional resources from Bill Whiteside

White(side) Papers

12 Supply Chain Forecasting Lessons from *The Signal and the Noise*

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