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THE ANATOMY OF A **WHAT-IF**

The Anatomy of a What-If

Executive Summary

Whether short term or long term, all plans deal with the future and therefore have a lot of uncertainty built in to them. While it is a good idea to improve the plan using better techniques, it is more important to embrace the uncertainty and incorporate it into the plan. What-if planning is one of the accepted techniques to better prepare for this uncertainty. Under this technique, various likely scenarios are evaluated with the input of key constituents. Usually, a model of the business in supporting software is used to evaluate these. While this concept has been around for a while, there is no clear guideline on how to approach it. Further, inadequacies in supporting software make the whole exercise only partially effective.

This paper tries to create a what-if planning roadmap for the practitioner. It describes the essential steps of the what-if planning. It lists key features of the type of software that supports enables what-if planning. It closes out with some examples of the different types of what-ifs.

Supply Chain Planning is no longer just a once-a-month exercise. Reduced levels of inventory and the pace of market change have made it critical that both Demand and Supply Planners stay on their toes all month, monitoring not only "actual" versus plan but also any changes in the marketplace as a whole that may impact what needs to be done sooner rather than later. This means that the planners have to evaluate possible scenarios (what-ifs) so that if events go a particular way, the business is prepared for it.

The Current Plan and What-If Scenarios

Whether short term or long term, all plans deal with the future and therefore have significant uncertainty built in to them. No matter the sophisticated techniques employed to develop a plan, uncertainty will prevail. While it is a good idea to improve the plan using better techniques, it is more important to embrace the uncertainty and incorporate it into the plan. A good planner (or a planning team) realizes that the final plan is highly dependent on the initial assumptions. One of the essential truths about plans is that they are more likely to be wrong than right. A good planner accepts this as a reality and understands the plan to be a range around the final set of numbers. As long as the actuals are within a close percentage of the plan, it is a good plan. Outside such a range, the plan is no longer valid and therefore requires re-planning. The issues that make a plan no longer valid can be identified by the planners themselves. In addition, others will frequently call upon planners to answer questions with longer-term implications for supply capability. Evaluating both sets of issues can be called "what-if" planning.

Imminent Disruptions: Most plans are derived on the assumption of stable conditions. This means that the business today will be similar to business tomorrow and that there are no game changing events. This is a reasonable assumption in the near term. However, even within these so called stable conditions, the underlying parameters to a plan could easily change. For example, a big government contract could go to a customer on the east coast, but it could also go to a customer on the west coast, thereby changing the supply plan. Or a sales person could come in to their office with the possibility of a big spot order in the next month. Or a crucial bottleneck asset might break down, requiring a lengthy shut down for maintenance. Another example is inventory build for a strike contingency. A good planner will prepare for these possible scenarios by evaluating them with key people (for percent likelihood) and running what-if calculations within the planning tool he uses. These quantified impacts can then be presented to management for decision making.

Challenges to The Status-Quo: The second type of scenario deals with challenging the status quo. For example, a firm might have always made a product at a certain facility. Other facilities might be able to make this product but require certification from the customer or could require engineering changes. Just because these facilities have never made this particular product, it does not mean that they cannot or should not make it. A good planner would sometimes evaluate these as what-ifs to get his head around the possible impact of such a change.

The scenarios described above are useful to the extent that they help quantify the impact of a change in tangible uncertainty. While valuable, the gains are small and the help they provide to management in making better decisions is limited.

What Is The Planner To Do?

The ability to deal with what-ifs is a critical skill for any planner. Success depends not only upon the skill of the individual but also upon the tools (i.e., planning models) with which he has to work.

A good planner draws heavily from his own knowledge of the business to come up with possible what-ifs. He also collaborates with others in the business to come up with a list of additional what-ifs. He then evaluates this list of likely what-ifs on the following criteria:

1. Is this a significant change or just a blip on the radar? If significant, what-if planning would be needed.

2. Are the impacts at the same level, or will they manifest themselves a couple levels down the decision tree? For example, a given change may impact the availability of raw material as well as network capacity.

3. Is this a change affecting many things in the supply chain or a change with localized effect?

4. What data change will project this situation on the model? This assumes there is a model of some sort where changes can be evaluated numerically. For example:

    a. A customer going out of business could mean reduced demand (at least in the near future)

    b. A competitor going out of business could mean increased demand

    c. A labor strike means a reduction in available capacity

5. Is the change so big that it changes the underlying assumptions? For example, after the tsunami in Japan, companies which had single-sourced some of their supply from that area had to completely re-think how they were going to meet demand in the future.

6. How can we make the data change in the system? Which tables need to be edited and how can we do so effectively? How do we make the changes so that they do not affect the master data or the current plan?

For example, when one hears of a change in future demand and wants to run a what-if analysis on it, he or she needs to make an appropriate change in the data in the planning system so that future requirements can be calculated based on the changed demand. In this case, he or she will need to know the table that stores the demand data in the database/software, perhaps make a copy of it, and then change the appropriate rows.

7. How can we evaluate the differences and trade-offs across scenarios once the calculations for the what-if have been calculated?

8. How can we compare scenarios for profitability? For meeting business goals?

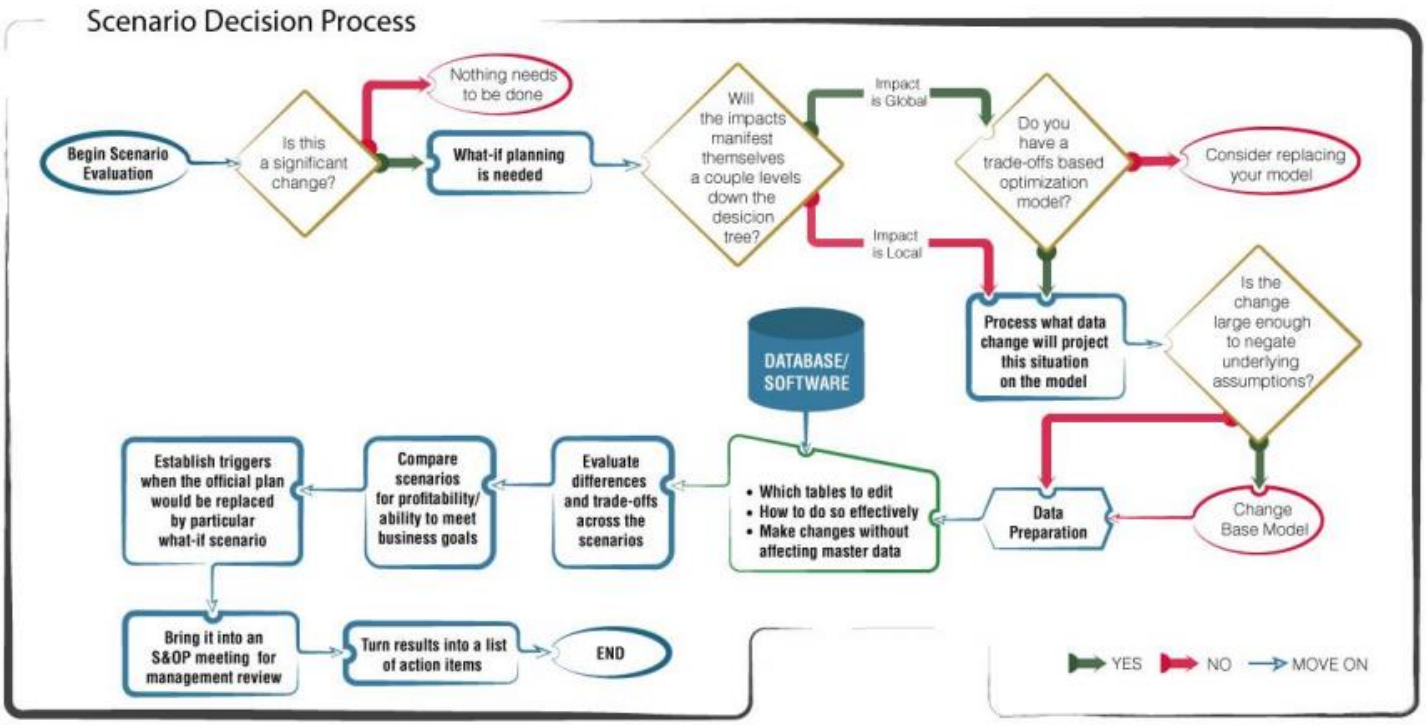
9. How can we establish triggers when the official plan would be replaced by a particular what-if scenario?

10. How do we effectively bring these scenarios into a sales and operations planning (S&OP) meeting or to management for their review? The key word is effectively, as just presenting large globs of data is not going to be productive.

11. How can we translate the results into action? For example, if a scenario were on future capacity reduction (say because of an anticipated labor strike), then the corresponding action would be to start the inventory buildup at some point. A planner who has done this particular what-if in advance will be ready to do the inventory buildup if and when the anticipated capacity reduction is confirmed.

The person who has the knowledge to perform the steps described above (both from a business process as well as the software point of view) will make a good what-if planner. Ideally, the person has a good mix of solid knowledge of the business as well as of the enabling software. Figure 1 on next page illustrates the steps involved in conducting a what-if evaluation.

Figure 1: A Flowchart showing the different steps in What-If Scenario Planning



Criteria for Enabling Software

In a modern business of a reasonable size, evaluating the scenarios requires enabling software. Such software has the following prerequisite capabilities to effectively help with the what-if planning.

1. The ability and the features needed to create a model of the business so that appropriate calculations can be carried out.
2. The ability to conduct the analysis without disturbing the master data; sometimes referred to as a sandbox environment.
3. Has a configurable model structure that allows quick changes in the model to react to a changing event.
4. Can store multiple scenarios along with underlying assumptions.
5. Has the ability to compare and evaluate different scenarios in a meaningful way.
6. Can monetize the impact of different scenarios.
7. Can report the results in a meaningful way to management. Management often needs a graphical view for quick understanding of different scenarios and their impact.

8. Ability to replace the official scenario with a particular what-if scenario. This could happen when a particular what-if scenario evaluated becomes a reality. For example, a particular high-demand scenario becomes reality when orders come in. In that case, it may be desirable to replace the official scenario with it.

Tools based in spreadsheets often fall short on these criteria. For example, creating a sandbox environment in a spreadsheet-based tool often means copying the spreadsheet. Very often, this leads to multiple copies sitting around with no easy way to compare or reconcile the results. A supply chain planning tool that is based in a database management system (DBMS) usually performs these functions well. In addition, optimization capabilities are needed to answer some questions, especially when the number of choices is high. Optimization models also make it easier to measure the impact on the profitability for each scenario.

The following sections detail example cases for a representative business.

It Usually Starts With Demand

Changes in – or proposed changes to – demand are the most common origin for what-if scenarios. Every good demand planner should recognize that a forecast is not just a number but rather a range. Implicitly or explicitly, a business should have established some degree of variation around the forecast that will be considered normal "noise." (This is, after all, the reason for having safety stock.) Otherwise, knee-jerk decisions will be made virtually daily. Starting with demand, however, does not mean ending there. All but the simplest of demand questions eventually turn into supply questions. Let's examine several instances of changing demand to determine the need for what-if planning.

Case 1: Demand Is Higher Than Expected

A forecast for a stock keeping unit (SKU)/location/customer is such a low level forecast that hitting the number exactly month by month is virtually impossible. On the other hand, it is very easy to program a system to look at orders at this level and spit out an actionable exception report. Suppose the planner decided that anything more than 10% over the forecast for an SKU/location/customer should be considered an exception. A 10% increase for a customer who takes only 1% of the monthly demand for a SKU/location is not nearly as significant as a 9% increase for a customer who takes more than half the demand for another SKU/location. So the percentage of the total SKU/location volume also needs to be taken into account – it's where to draw the line that becomes the issue. Providing decision support through online reports is the proper function of a tool here, rather than "making an automatic decision". As with all planning, the human planner always has the major role to play. Suppose we flag every SKU/location/customer order which is 110% or more of its forecast. A report should provide the following information: customer's forecast for a SKU/Location, actual as a percent over the forecast as of today, total forecast for a SKU/location, customer's forecast as a percentage of total forecast for a SKU/location, and total shipped orders in current month as of today (also known as current month to date or MTD) as a percentage of total forecast for a SKU/location as well as any open orders (or OPEN). A forecast is included as the original forecast for the month and not the netted version. Finally, such a report should clearly indicate how far into the month we are as a percentage (Percent of Month Completed). In the example below, this comes to 48% (=15/31). The report would look something like Table 1.

Table 1: When Forecast Significantly Exceeds the Actual (Report of a Certain SKU/Location through 1-15-2013)

Customer	SKU	Customer's Original Forecast	Total Customer's Orders MTD + OPEN	Actual as % Over the Forecast	Total SKU/ Location Forecast	Total Customer Forecast as % of SKU/ Location Forecast	Total Orders MTD + OPEN for SKU/ Location	Total Orders MTD + OPEN as a % of Forecast	Percent of Month Completed
Ajax Co., Ft Fox, Missouri	Product 1	45	60	33.3%	645	7.0%	340	**53%**	**48%**
Hartman's, Clinton, Ohio	Product 2	345	380	10.1%	414	83.3%	410	**99%**	**48%**

In the first instance, Ajax Co. is only 7% of the forecast for the entire SKU at Location ABC, so a 33% increase there is very likely to be offset by a decrease in someone else's orders for the month. Currently, as shown by the comparison of the last two columns, orders are running a bit ahead of "percent of month completed." The demand planner will know, for example, that "shipments plus open orders" generally are, by mid-month, ahead of the percent into the month for this business, because most orders are placed with at least 5 days of lead time. Provided that the inventory position for Product 1 at ABC looks okay, the demand planner would recognize that this variation is "noise" within the expected range and that no action is necessary.

In the second instance, however, a closer look may be called for. Hartman's provides over 83% of the usual demand for Product 2 in this location. Demand for this SKU halfway through the month is already 99% of the forecast. This situation requires a bit more investigation to determine whether or not re-planning is needed.

The Demand Planner should be able to call up electronically, at any time, a report such as the one shown in table 2.

Table 2: Detailed Report of Forecasts and Actuals

Product 2, Clinton, Ohio	Month - 2	Month - 1	Previous 4-Month Average	Current Month	Open Orders: Month + 1	Open Orders: Month + 2
Total Forecast	410	392	399	414	396	420
Total Actual	414	388	398	410	250	20
Actual Minus Forecast	4	-4	-1	-4	-146	-400
Hartman's						
Forecast	345	345	345	345	345	345
Actual/Month to date/Open	350	340	343	380	250	
Remaining	-5	5	-2	-35	95	
Cust2						
Forecast	35	35	35	35	35	35
Actual/Month to Date/Open	35	35	35			
Remaining	0	0	0	35	35	35
Cust3						
Forecast	10	12	9	14	16	20
Actual/Month to Date/Open	9	13	10	10		
Remaining	1	-1	-1	4	16	20
Cust4						
Forecast	20	0	10	20	0	20
Actual/Month to Date/Open	20	0	10	20		20
Remaining	0	0	0	0	0	0

The columns in this report represent 2 months before current month, one month before current month, and the average demand for the last four months prior to current month, the current month, next month, and the month after that.

For the current month, the rows labeled Actual/Month to Date/Open include both month to date shipments and open orders (all demand for the current month); for the future months, this row represents open orders (as there is no month to date shipments in future months at this time). Note that Forecast in all cases is the total, not net, forecast for the month. "Remaining" rows are Forecast minus Actual; a negative "remaining" amount means demand has exceeded forecast, while a positive remaining amount means the amount of orders still expected for current and future months.

As can be seen, a wealth of information has been conveyed by this report. For example, Cust4 is expected to place an order of 20 units every other month. Cust2, on the other hand, places an order of 35 units every month, but it has not yet placed an order for the current and the following months. The increase in Hartman's order by 35 units in the current month means that Hartman may wind up using the inventory intended to meet Cust2's forecast. Such a situation requires consultation between the demand planner and supply planner. Depending on what sort of production cycle this product is on and how much safety stock is kept, it may be necessary to increase this month's production in order to meet the expected order for an additional 35 units, or to transship product from another location, or to buy more from an outside vender. These alternatives need to be evaluated for costs and consequences.

Even if there is adequate inventory to cover the additional 35 units this month, more investigation is required. The demand planner should ask the appropriate sales rep to call Hartman's and find out if this is a permanent

increase in demand or merely a "borrowing" of one month's demand in another month. The answer will influence both forecasts and safety stock calculations.

If it ***is*** a permanent increase in demand, then a supply-side what-if may be called for to see how best to meet this ongoing increase in demand. Do we have the capacity to make the additional quantity? Will we have to move production to a different production unit? If we are tight on capacity, do we have an option for increasing purchases of either this or another product competing for capacity on the same production unit? What is the most cost-effective way of handling this? Running a what-if with the only change being demand for this particular SKU/customer/location will allow a direct cost comparison of various solutions (providing there is a supply planning model which optimizes profit or minimizes cost).

Case 2: A New Product Is Selling Much Faster Than Expected.

Forecasts for new product introductions are an educated guess at best. When orders exceed forecast significantly, the demand planner must evaluate different assumptions about continued growth rates. Simultaneously, he must consider whether the new product partially or fully cannibalizes an existing product. The new forecast(s) should then be passed to the supply planner for supply planning runs. Note that the demand planner must be careful not to assume that a one-for-one replacement is a no-brainer. It is quite possible that the new product runs at a very different rate or requires some special equipment or raw materials not needed by the product it is replacing.

Assuming that overall capacity is fairly tight, an accelerated new product sales rate is more likely to require what-if planning than a slight increase in sales of an existing product.

Case 3: Can We Take On X Amount Of New Business For Product Y?

Case 3 represents the sort of question most often brought to the demand planner by a product line manager or sales manager. If there is lots of "spare capacity" (which, in a process industry, probably consists of "opportunistic product" being made at minimal profit and with no long-term commitment), then taking on additional business is not likely to be a problem. As before, however, a demand planner should not presume to answer this question off the cuff, because it may be that that Product Y can be made ONLY on a production unit which IS at or near capacity.

For the sake of discussion, let's assume that the business as a whole is operating at or near capacity with a fairly profitable product mix. The issue then becomes the following series of questions:

1. If we take on X amount of new business for Product Y, what business would we displace?

2. What is the bottom-line trade-off in profitability?

3. If we displace that business, would we lose only that or also whatever else those customers buy from us? If the latter, what would the loss of those customers' entire business cost us?

A true optimization model with appropriate prioritization of products and profitability data can answer the first two questions. Only market knowledge and business intelligence can answer #3. Given the aforesaid model,

however, it will be easy to identify all demand for the displaced customers and to model the effect of the total loss of their business on the bottom line. It should be noted that simplistic supply models (such as Excel) cannot provide true optimization incorporating enough detail to answer these questions.

It Usually Starts With Demand – But Not Always

Issues impacting supply can also necessitate what-if planning. Once again, let us look at some examples.

Case 4: A Planned Maintenance Shutdown Needs To Be Moved

Planned shutdowns generally require a build-up of inventory ahead of time to cover demand during the shutdown, particularly if the shutdown is to be a lengthy one. Two types of inventory must be considered.

1. Products which can be made only on the facility that is to be shut down must be made ahead of time to cover demand during the outage. In that case, there is no alternative source of supply, and then an inventory buildup is imperative. How far in advance that build must start will depend upon not only the demand rate for these products but also the available "spare capacity" on the affected facility (see definition of opportunistic product in case 3 above).

2. If there is no opportunistic product on this facility, then the only other source of "spare capacity" for a build on the affected facility is products for which where IS an alternative source of supply, whether internal (on an alternate facility) or external (a purchase which can be repackaged and resold as one's own). Each source is likely to have its own limitations. Alternate facilities must have "spare" capacity" to make room for materials normally made on the unit being shut down, and purchase opportunities must be able to be increased in a timely fashion to meet the demand need.

Like Case 3 above, the ability to model the move of a shutdown will be quite limited unless there is a sophisticated optimization model that can identify product that can be moved from one unit to another or dropped altogether without significant penalty. Similarly, it is critical to recognize that there is not necessarily a one-to-one tradeoff between facilities, because Product 1 may take twice as long to run on alternate facility B as it does on primary facility A, displacing a disproportionate amount of opportunistic product.

Case 5: A Key Raw Material Is In Short Supply

In simplistic capacity models, supply of raw materials may be assumed rather than modeled. If this is the case, then substantial restructuring of the model would be required to indicate a limitation of a specific raw material. A properly formulated model (optimization or heuristics based), which explicitly states raw material quantities available, can reflect a shortage by merely changing the appropriate table that holds these data. (Most modern software will hold such data in tables that are kept in a database.) Alternatively, if the restriction is merely the amount available from the usual supplier, then alternate suppliers, quantities, and prices may be included. Once again, an optimization or heuristics based model will already be structured to allow for this as well as to indicate the additional cost of having to use alternate suppliers. An optimization based planning model can be especially helpful if the raw material in question goes into a lot of different materials which can themselves be 2-3 steps from the finished good in the bill of materials. Figuring out the right way to be most profitable with the short supply is very difficult in these types of situations as the number of possibilities is huge.

And Then There's The Natural World

While the cases above have dealt primarily with issues internal to one's own business and production facilities, an outstanding planner will be able to look way ahead to potential situations beyond anyone's control that could prove disastrous to a business.

Case 6: A Shipping Lane Becomes Unavailable

Let's envision a business which ships grain by barge from various ports along the upper Mississippi to New Orleans for export. Suppose a planner in late 2011 had had enough foresight to recognize that drought might close down most or all barge traffic along the Mississippi in mid-2012 because of record low-water. This is the sort of strategic, "out of the box" thinking that can prove invaluable when done early enough to allow a business to plan for a worst-case scenario. Once the idea has been recognized, the modeling steps for "what-if planning" can be handled very simply, given a properly structured optimization model.

The transportation section of an optimization model is generally set up in tables containing information such as:

- Mode(s) of transportation available from A to B
- Capacity of each mode of transportation available in each modeling period
- Transit time from A to B for each transportation mode

In order to model a closure on the Mississippi, the planner will make the following changes:

1. Ensure that railcars are an allowed mode of transportation for each location normally shipping by barge
2. Set barge capacity to zero from each such location for each anticipated river closure period (month)
3. Set the available railcar capacity for each normally-barge location/period to a number large enough to handle the normal barge volume (The model will tell you the exact railcar capacity you will need)
4. Set the transit time for each ship-from location to New Orleans to the appropriate time for the rail car transit

Note that many versions of this problem/solution can be run by varying the length of time of the low water and even the section of the river that might be closed. In addition, tanker trucks could be added as an additional transportation mode from some or all locations.

Having run these scenarios and followed through with the necessary logistical arrangements in advance would have saved this business a great deal of scrambling and delay versus dealing with the issue only once it was upon them.

Which Straw Broke The Camel's Back?

One of the most vexing questions about what-if planning is how many changes can or should be modeled at once. Some things are obvious – when you have a whole new monthly demand forecast, it is obviously necessary to model all those changes together. Similarly, if at the same time you now know that a shutdown must be moved from June to July, it should be part of the same modeling run. The problem comes with the subtle cases.

Suppose further, within a month, there have been several disruptive changes in capacity. The management wants to know how much sales it would lose as a result. Also, it wants to know how early we should start building up inventory for a seasonal demand that is anticipated to be heavier than usual. How many scenarios must a planner run to answer these questions?

This is the sort of conundrum faced by planners every day. There are no pat, easy answers. The key is that the planner needs to be able to explain to those asking the questions and/or to the S&OP team the reasons for the outputs he produces. While any optimization program makes hundreds of thousands of decisions, the planner still needs to be able to make sense of the results to "laymen."

In the situation outlined here, the minimum scenario runs will be two, though more may be required. First, consider that the anticipated disruption to the capacity is now confirmed. The new (reduced) capacity should, therefore, be incorporated in all new scenarios. Further, let us assume that the reduced capacity will necessitate an inventory build if the demand is as expected. Since the business is anticipating the possibility of a higher than usual demand, the next set of questions will then be twofold: When should the inventory build begin if the heavier than anticipated demand

a. Does not happen?

b. Does happen?

The answers to these two questions will be provided via two scenario runs. One scenario run will assume that the business gets the extra demand and determine when the inventory build must start in that event, while a second scenario run will determine when the inventory build must start if the business does not get the extra demand. All sorts of permutations, however, may require additional scenarios, including when the new demand is expected to begin, with what if any other demand it will displace, and whether we will lose the rest of those customers' business (see Case 3, item 3) beyond the orders we cannot fill.

Bringing The Change To The S&OP

The role of the S&OP meeting is to summarize alternatives and seek management decisions. This requires concise presentation backed up by detail as needed, quickly taken to an offline meeting if too much depth is required. For example, the anticipation of low water in the Mississippi months in the future might be presented briefly in the S&OP, with a separate meeting set up for those who need more detail in order to make decisions and to set triggering events (e.g., water levels at specific points) for contingencies.

The only thing certain in business is change and uncertainty. If there were no change, there would be no need for planning beyond the back of an envelope. Wherever there has been what-if planning done above, the results should be brought into the S&OP process. Whether an immediate short-cycling of S&OP is required depends

on the immediacy of the need for change and should be clear to the planners involved. Indeed, part of the skill of the planner (and of the S&OP coordinator who should be kept in the loop on all issues rising to the level of what-if planning) is to know what is critical and what can wait for the usual monthly meeting.

Conclusion

What-if scenario planning is a powerful tool that gives a business the agility in dealing with uncertainty. A business that does meaningful what-ifs as part of the planning process is better prepared to prioritize and develop contingency plans should the various scenarios unfold. This is because the very act of going through the what-if planning forces the stakeholders to consider contingencies and ways to deal with the situations should they arise. In addition, it makes them more aware of the different possibilities and the constraints within the network. In today's ever changing business world, it is the tool that can make a supply chain a competitive differentiator for a business. Doing it well requires both an evolved thought process as well as supporting software tools.

If you would like to learn more about the Anatomy of the What-if please download our What-If Infographic and watch our What-If Video Series:

- What-If Planning Part 1: What-If Scenarios
- What-If Planning Part 2: A Successful What-If Planner
- What- If Planning Part 3: Evaluating a What-If

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