Supply chain analytics: Harness uncertainty with smarter bets

In volatile environments, supply-chain planning is a high-stakes game. The coolest head in the room might belong to a machine.

by Ali Sankur and Joris Wijpkema

Supply-chain-planning decisions make the news for two main reasons— both of them bad. Too little inventory means lost sales and frustrated customers. Too much inventory means costly write-downs, eroded profits, and frustrated shareholders. Expensive mistakes are all too common: overstocks in some lines and stock-outs in others cost the global retail industry an estimated $1.1 trillion in lost revenue.

Getting planning decisions right can create huge value, especially when five characteristics are present in a business: a make-to-forecast model; significant uncertainty (in demand, supply, or both); long lead times that make plans hard to change; short, specific sales windows; and high costs when decision-makers get it wrong. Those are traits that plenty of businesses share, from pharmaceuticals companies producing seasonal flu vaccines to consumer-electronics makers, fashion brands, and agricultural producers.

It's no surprise that better management of supply-chain uncertainty is a top priority for many executives: companies that get their bets right can boost revenues by about 3 percent, thanks to fewer stock outs and lost sales, while reducing cost of goods sold by a similar amount, through lower demand for expedited logistics or overtime production. And the right bets reduce write-downs by 30 to 45 percent, while cutting working-capital needs by 10 percent and capex requirements by 5 percent as excess capacity falls.

Changing the game

The best companies are already working hard to minimize risk and maximize the agility of their production processes—reducing complexity in product designs and portfolios, changing the timing for final assembly and configuration, and shaping demand through pricing and promotion activities. These measures all help change the rules— sometimes even the game the company is playing.

But in the end, winning the highly uncertain supply-chain game usually requires companies to place intelligent bets. That means thinking to some degree like a professional poker player (Exhibit 1). Supply-chain leaders need the best possible understanding of the odds and underlying economics. And, knowing that not every bet will pay off, they need strategies that minimize the impact of unfavorable outcomes.

It is here that technology has created opportunities for a step-change in performance. Many organizations already have access to much richer data on customer demographics and purchasing behavior than ever before, as well as mountains of untapped internal data. Modern advanced-modelling techniques have the analytical horsepower to put that data to improve odds of winning.

Exhibit 1

Managing high-uncertainty supply chains means placing intelligent bets, grounded in five principles.

1	Change the game in your favor	Change the probabilities (eg, agility, postponement)
2	Understand the odds	Forecast what can be meaningfully forecast; understand the underlying drivers of volatility and distribution of demand/supply scenarios
3	Make intelligent bets	Learn the economics of being over or under; make scientifically informed decisions to optimize outcomes
4	Minimize the damage	When you don't win, still minimize the "damage" by proactively addressing unfavorable outcomes (eg, shortage or excess)
5	Change the mind-set	Acknowledge you cannot win every time, but you can win over multiple rounds

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Understanding your odds

Forecasting is typically as much art as science. Traditional forecasting starts from aggregated historical sales data, which is manually tweaked and adjusted, often by multiple stakeholders. That fiddling is as likely to make forecasts worse as better, combining inherent uncertainty with the various sources of error and bias that afflict human decision making.

Today, machines offer a smarter way to forecast. Machine learning systems, for example, can crunch more data than technologies available in the past. That lets them extract useful information from previously underused data, tap into new external data sources, and process all that data in a much more granular way. Doing so exposes the hidden relationships between sales and hundreds of influencing factors, from the day of the month or the demographic profile of customers in a region to competitors' timing of promotions.

When based on more-accurate causal drivers of demand such as these, forecasts become hugely powerful. By understanding the precise factors that have driven, or impeded, sales in the past, companies can adjust their forecasts to account for known changes in these factors over time. At one consumer-goods maker, applying machine-learning techniques to a more comprehensive dataset increased demand-forecast accuracy to more than 90 percent from an already-good 83 percent. When the company added data from retailers' loyalty-card records, forecast accuracy climbed to some 95 percent.

Moreover, when an algorithm performs so well, stakeholders are more willing to accept its results. They're less likely to make the overly-cautious adjustments to manufacturing and inventory plans, moves that can increase waste or volatility rather than controlling them. Machine learning can also uncover demand-influencing factors that marketing and forecasting teams didn't know about, such as a tendency for

married couples to shop on certain days of the week, for example. That can help in tailoring future offerings or promotional strategies.

Placing your bets

Advanced-analytics techniques can also help companies understand and manage the complex and uncertain economic trade-offs inherent in their inventory bets. The costs associated with too much inventory, for example, are driven by a host of factors, including the cost of making, shipping, storing, and ultimately writing off that product. Some of these can be mitigated by carrying over excess stock into future sales periods, selling it off at a discount, or even reworking component parts into alternative products.

The loss of incremental margins due to shortages, meanwhile, is compounded by basket effects—customers won't buy blades if they can't get the razors that take them—and mitigated by customer willingness to substitute alternative products from the company's portfolio.

Testing many scenarios

These complexities are now much easier to handle. Advanced models can pinpoint the precise cost implications of any inventory and sales scenario at the click of a mouse. Even more powerfully, they can use simulation systems to rapidly evaluate thousands of different possible outcomes. That allows them to assess the sensitivity of different strategies and zero in on the ones likely to prove most profitable.

Simulations such as these also allow companies to assess the financial impact of other measures they might use to improve supply-chain performance, from better forecasting to higher manufacturing agility. That helps them plan and prioritize future investments.

Understanding lifecycle effects

For example, the culture at one agricultural-products company encouraged executives to avoid lost sales at almost any cost, leading to large inventories and write-downs of unsold product. At one point, this risk-averse mind-set meant one in five of the company's plants was producing products that would ultimately be thrown away.

Analyzing historical sales data revealed that different products' sales volumes varied in markedly different ways across their lifecycle. Some products sold rapidly in their first few seasons before tailing off, while others took a while to build momentum. A few were deliberately introduced as "gap fillers," serving a purpose in the market for only a short time before the introduction of a replacement (Exhibit 2).
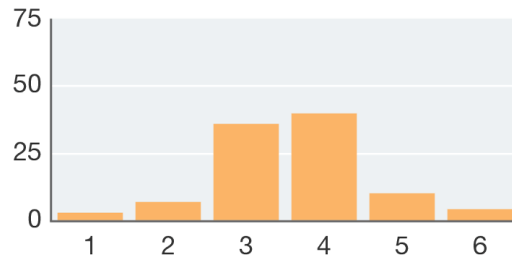
Exhibit 2

Life cycle profiles reveal a product's odds for future sales— or future write-offs.
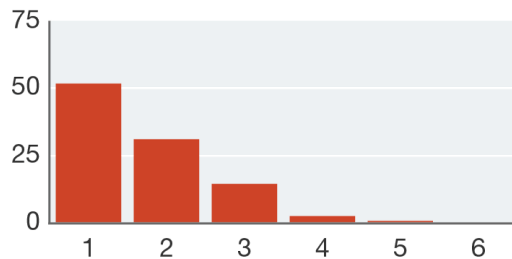
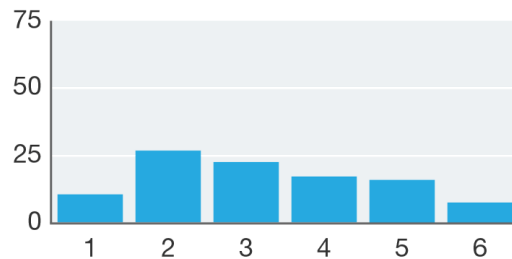% of sales over 6 periods

Life cycle profile #1: *"Gap filler"*
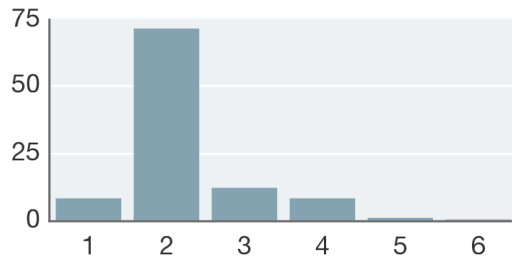
Life cycle profile #2: *"Late bloomer"*

Life cycle profile #3: *"Never made it"*

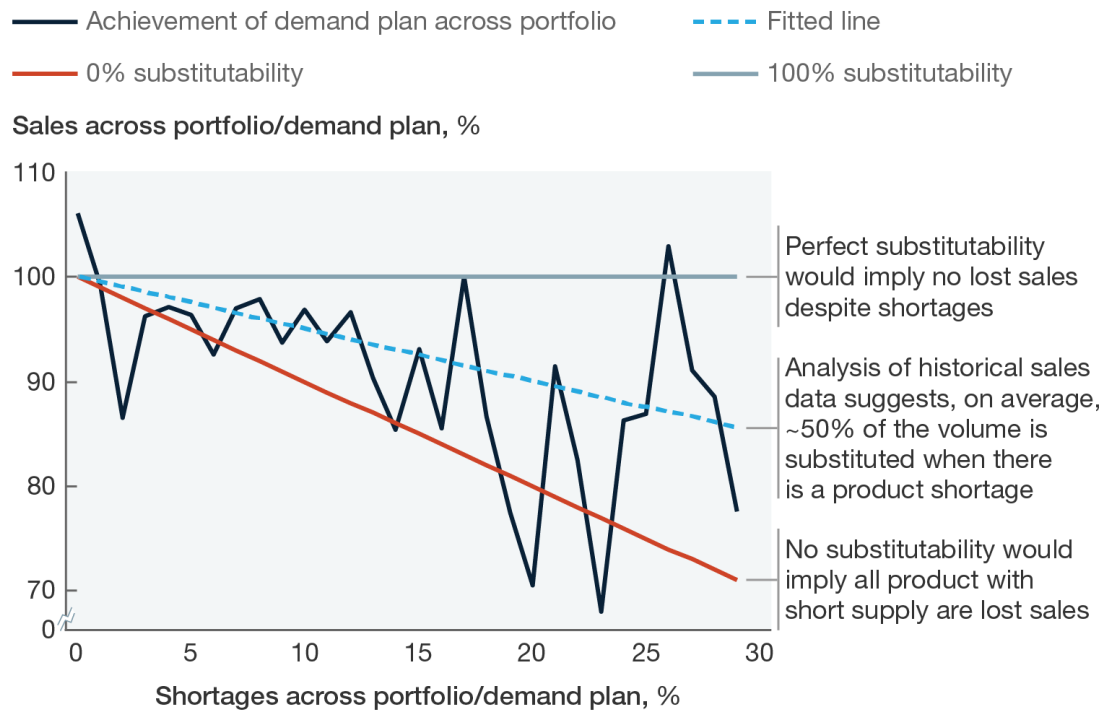Life cycle profile #4: *"Steady"*

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Yet even though the lifecycle trajectory of any individual project was uncertain, decisions of the company's supply chain, commercial, portfolio, and R&D teams meant that most products fit one of small number of clear lifecycle "profiles." The trouble was that the company lacked cross-functional bridges to incorporate those decisions into inventory planning: its models made no attempt to account for different lifecycle profiles, or where products were within the lifecycles.

Furthermore, executives had always assumed that the non-availability of a product meant a lost sale, especially in a competitive environment. Analysis of historical sales, however, revealed that many customers were happy to accept substitutes in certain product categories: even when shortages of products occurred, sales across the portfolio proved more resilient than might be expected (Exhibit 3). By building lifecycle, product, age, and substitutability into a new analytical model, the company greatly improved its understanding of its actual inventory requirements. The change helped it reduce write-downs by an average of 50 percent, with no impact on overall service levels.

Exhibit 3

Understanding substitutability across a portfolio can help in placing inventory bets more intelligently.

Sales across portfolio/demand plan, %

Shortages across portfolio/demand plan, %

Legend:
— Achievement of demand plan across portfolio
- - - Fitted line
— 0% substitutability
— 100% substitutability

Perfect substitutability would imply no lost sales despite shortages

Analysis of historical sales data suggests, on average, ~50% of the volume is substituted when there is a product shortage

No substitutability would imply all product with short supply are lost sales

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Cutting your losses

High-uncertainty supply chains differ from other types of bets in one crucial respect: the result isn't fixed once the bets are placed. After uncertainties become certainties, there are still plenty of levers companies can pull to improve the overall outcome—even when things didn't go exactly to plan.

Digital and advanced-analytical techniques have transformed the way this part of the game is played. Companies can now continually monitor sales and operations data in real time and update their predictive models. With advanced-analytical tools, they can evaluate different scenarios and run what-if simulations using the most up-to-date data. The resulting insights enable much faster, more effective decision making. If a product is in short supply, for example, the available inventory can be allocated to the markets and customers that offer the highest margins. If overstocks look likely, companies can adjust their pricing, promotion, and disposal strategies to minimize losses before it is too late.

Good data can't do that alone, however. Effective execution in uncertain environments requires cross-functional decision making and willingness to take rapid action. Some companies have found that the best way to achieve that is by establishing digitally-enabled supply-chain control towers—staffed by stakeholders from across the business, equipped with smart analytical tools, and provided with the authority and accountability to run the supply chain.

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High-uncertainty supply chains are a fact of life in many industries. Managing them requires planners to place big supply chain bets. Advanced-analytical tools have titled the table in their favor, however, providing a far more accurate and detailed picture of the underlying odds and economics, and guiding players toward the strategies that will provide the highest payoff over the long term. Even if they can't win every time, players can win over time—if they make the right investments ■

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