

Advanced Electronics Practice

Building a flexible supply chain in low-volume, high-mix industrials

Industrial companies can optimize their supply chains—and improve their bottom lines—by using a new approach.

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For many industrial companies, supply-chain problems are a fact of life. Although these businesses have attempted to simplify their product portfolios, customers increasingly want freedom to configure appliances, commercial vehicles, aircraft equipment, and other goods. But industrials often have difficulty getting the parts they need to support low-volume, high-mix manufacturing when needed for production. The requested quantities can be relatively small, and suppliers often prioritize their larger customers when fulfilling orders.

Part delays can have dire consequences. Consider the case of an industrial company that won a large order for devices with customer-specific requirements for size, engine strength, and several other features. The industrial's suppliers could not provide the required parts when needed. What's more, the company's leaders did not have visibility into supply-chain issues and thus could not adapt the ordering process. These issues delayed the industrial's promised shipment to its client by six months, putting its contract in jeopardy.

Adding to such problems, several external events—including global political tensions, increased protectionism and tariffs, the recent novel coronavirus outbreak, and shifts in ownership of raw materials—have made it more difficult to maintain an efficient supply chain. These constraints, combined with the recent rise in customization, can complicate even the most efficient supply chains.

Industrial companies often try to improve their supply-chain performance by investing in new enterprise-resource-planning (ERP) and forecasting systems. The results may be disappointing, however, since industrials typically struggle to program these systems to follow a customized ordering logic based on their unique business models and requirements. Many companies combat these limitations with manual overrides to increase inventory and ensure that materials are always available. Unfortunately, this approach produces few gains and causes a sharp rise in working capital. Frustrated companies may then blame suppliers and their perceived lack

of performance, when their own forecasting and planning approach is truly the root cause.

Although their past efforts to improve forecasting and planning have often fallen short, industrials may now find greater success by implementing a new approach, which we call “segment, stock, and plan” (SSP), for low-volume, high-mix companies. As its name suggests, the approach focuses on three elements: improving part segmentation, increasing the accuracy of stocking algorithms, and building flexibility into the planning process. One major change is that the SSP approach calls for manufacturers to create virtual kits that contain the parts needed for specialized products.

The new approach does not require investment in tools or platforms, and it produces rapid improvement. While it will not entirely eliminate supply-chain problems, companies typically reduce part shortages by 50 to 90 percent while shrinking inventory by 15 to 35 percent below historical levels. These benefits translate into greater on-time delivery, lower inventory costs, and increased flexibility.

This article provides a step-by-step description of the approach (see sidebar, “Case study: Better supply-chain management in action,” for an example of the entire process).

Improved part segmentation

When purchasing and stocking parts, most companies do not follow a set methodology. Instead, they ask their sales organization to estimate product demand and translate that prediction into a needed quantity of parts. But salespeople focus on customers, not suppliers, and may also be tempted to overestimate demand to ensure product availability. They also have little insight into supply-chain capabilities or constraints—most importantly, the lead time required to obtain parts. If companies do not factor this lead time into their stocking decisions, they might discover that critical parts are unavailable when required for production.

Case study: Better supply-chain management in action

A global leader in the industrial-vehicles sector had great-quality products but was struggling to deliver them on time, making it vulnerable to competitors. Several problems, including the following, contributed to the inefficiency:

- lack of synchronization among sales, procurement, and manufacturing operations
- gaps in tools and capabilities, which made it difficult to move products seamlessly along the supply chain

— unknown or misplaced accountability

Delivery times were 20 to 50 percent longer than promised because of these issues. The company lost around 5 percent of its revenue as customers canceled orders and refused to work with it in the future.

Following the approach described in the article, the company analyzed which parts were buy to order and which were buy to stock. It determined that 40 percent of the parts needed to be reclassified. The company also reduced the inventory on hand by

15 percent, partly by eliminating obsolete parts. It then implemented a new algorithm that improved forecasting and reduced shortages by 50 percent. Finally, the company created a new planning approach that gave the business more flexibility on orders. In turn, this allowed more flexibility within the supply chain.

The new approach almost entirely eliminated part shortages. It also helped the company achieve an on-time delivery rate of more than 90 percent.

Other forecasting errors relate to customers and suppliers themselves. It is easy to assume that a reliable vendor will always be able to make timely shipments or that suppliers with performance issues will never improve. As with any business, however, supplier performance is dynamic, not static. Likewise, customer demand and market trends could shift in unexpected directions, and companies that rely only on historical data when stocking parts may find themselves with excess inventory or shortages. Consider commercial cooking equipment, such as ovens. Some specialized models are now Wi-Fi enabled and require different components. If demand for them surges, manufacturers may be caught off guard.

To avoid these problems, industrial companies with high product customization should segment parts into two categories: bought to stock and bought to order. When done correctly, segmentation can significantly reduce part shortages while minimizing the volume of parts held in inventory. Three metrics are critical to the segmentation:

- customer lead time, defined as the period between receipt of an order and the promised delivery date
- supplier lead time, both contractual and actual
- cutoff time, calculated as customer lead time less the number of days required to manufacture, process, and deliver a product

If the supplier lead time for a part is greater than the cutoff time, the part must usually be bought to stock (at least temporarily, until metrics improve or get updated). Otherwise, it can be bought to order. The lower the cutoff time, the higher the amount of parts to stock—and the higher the inventory-holding cost.

The exceptions to this rule are based on cost and quality. Companies may refrain from stocking very costly items, even if the algorithm points in that direction, because they lack sufficient cash or want to limit expenditures. Likewise, companies might

choose to stock products that have traditionally suffered from quality issues, even if the algorithm says they can be bought to order. This strategy helps eliminate the production delays that can occur if a supplier ships a poor-quality part that must be returned.

Exhibit 1 shows how segmentation works (cost and quality are not factors in the example). For parts A and B, the supplier lead time is longer than the cutoff time, meaning they must be bought to stock. Part C, for which supplier lead time is shorter than the cutoff time, can be bought to order.

Segmentation must be dynamic. Ideally, companies should refresh it frequently to account for changes at suppliers (including productivity improvements that decrease delivery timeframes) and shifting market conditions (such as the introduction of tariffs or global shortages). For best results, companies should refresh their segmentation algorithms every 15 to 20 days, since supplier lead times often change. (Of course, they should also conduct ad hoc updates if they become aware of major changes, such as declining supplier quality or on-time delivery).

Initially, the tools used for segmentation will be very basic models that can be updated with the click of a button, minimizing costs and IT involvement. After a few years, when companies are certain they have all the required people, systems, and historical data, they can move to a fully automated approach

that will require more complex IT upgrades. Such systems cost more but also improve productivity.

One company that applied the SSP approach during segmentation recategorized almost 50 percent of its products (Exhibit 2). Others have found that even greater changes were needed. Overall, businesses that take the new approach see a 10 to 15 percent improvement in the number of on-time deliveries through only that lever (part segmentation). Inventory levels may also fall if companies discover that many parts classified as buy to stock can be re-categorized as buy to order.

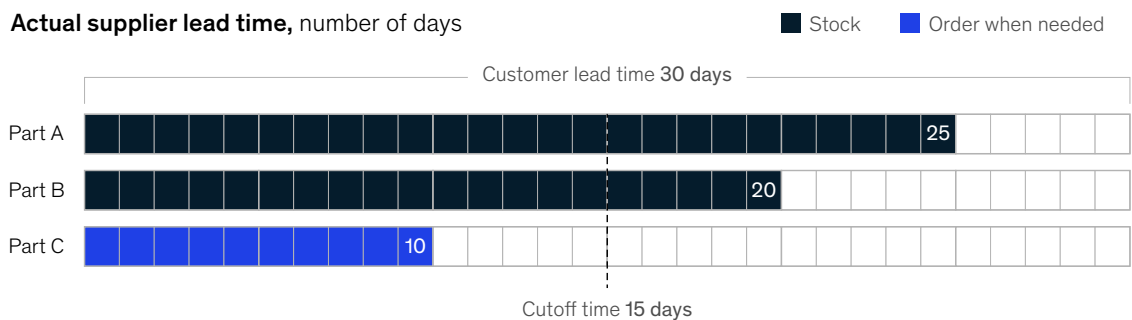
Enhanced stocking-algorithm accuracy

When deciding how many parts to keep in stock, most companies use an algorithm based solely on historical demand. While this method typically works well for businesses with low customization and high volume, it is much less suited to industrials with lower volumes and multiple product options—particularly those for which history is not a great predictor of future demand.

And it's not just the algorithm that is problematic. As noted previously, current ERP and forecasting tools are often challenging to program and rely on specialized skills. Making manual overrides is time consuming and dependent on a handful of company experts, making frequent changes nearly impossible for businesses that stock thousands of

Exhibit 1

With the segment, stock, and plan approach, companies can make better decisions about part segmentation.

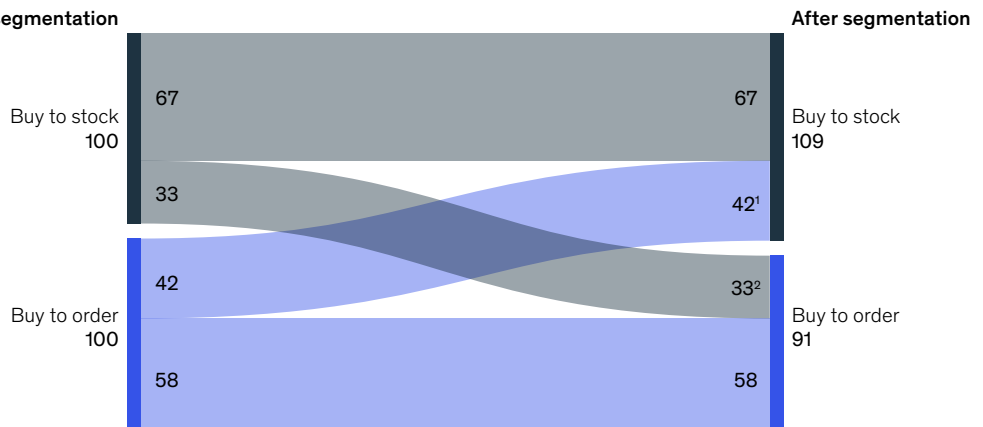


Note: In this example, time required for processing, manufacturing, and delivery was 15 days.

Exhibit 2

Under the new segment, stock, and plan approach, many parts may be reclassified as buy to order or buy to stock.

Order reclassification, illustrative, % of total parts



¹42% of buy-to-order components were consistently causing shortages, since lead time from suppliers was outside the required cutoff time; these were moved to buy to stock.

²33% of buy-to-stock components were able to be moved to buy to order and no longer held in inventory, since supplier lead times were less than required cutoff times.

different parts.

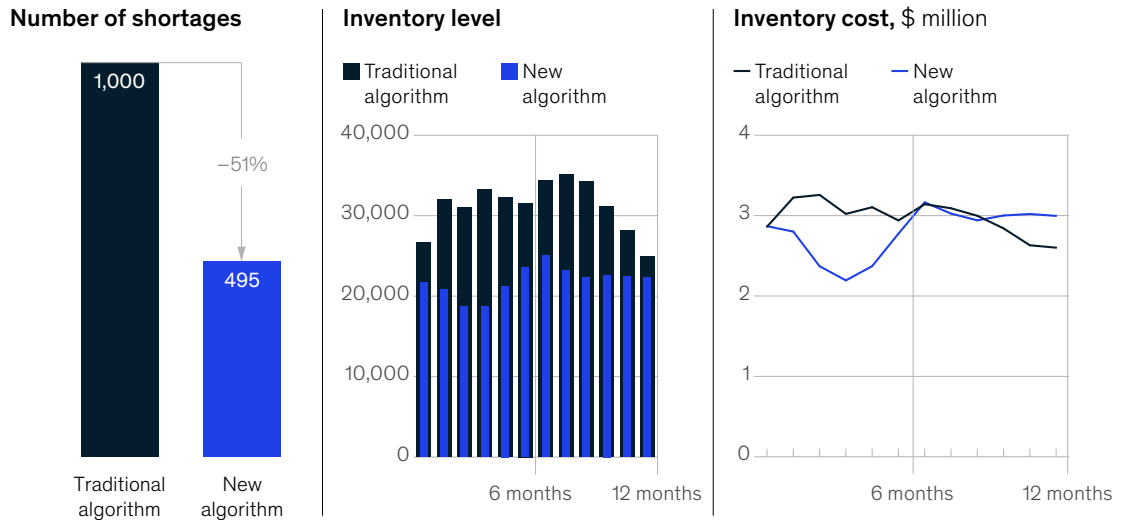
The SSP approach works to eliminate the issues that complicated past stocking methods by incorporating the following elements:

- **A limited forecast period.** Every order cycle contains a period, called “known time,” in which a company cannot accept new orders or changes because it would not be able to meet the customer’s desired delivery date. Despite these limits, most stocking algorithms attempt to project potential new orders during known time. Under the SSP approach, the stocking algorithm only creates forecasts for later time periods—a strategy that minimizes errors and assumptions while increasing the accuracy of order quantities.
- **An embedded mechanism for scaling.** If the sales forecast unexpectedly changes, the SSP stocking algorithm will automatically predict the necessary increases or decreases to the order level for all parts. Other algorithms do not typically make such adjustments, so employees must calculate changes manually for each product.

- **More accurate historical data.** Unlike past algorithms, the new stocking algorithm does not measure historical demand and consumption by using an average across a few lead-time segments. For example, if the lead time is 30 days, typical algorithms will use 12 increments to cover a year’s worth of history (12 x 30 = 360 days). The new approach would suggest using daily increments of lead time; this is almost the same as looking at 360 increments and taking the average. In this example, the new algorithm would be 30 times more accurate than traditional algorithms, because it considers 360 increments rather than 12.

One company that switched from a traditional stocking algorithm to the SSP approach reduced the annual number of part shortages from 1000 to 495—around 51 percent—because it more accurately predicted the necessary stocking levels (Exhibit 3). For the same reason, it reduced inventory levels by around 42 percent and associated costs by around 6 percent.

The new stocking algorithm can reduce shortages, inventory costs, and inventory levels.



Refined planning

At most companies, supply-chain planning works backward from customer demand. First, companies examine customer order volume or promised delivery dates. They then estimate the quantity of parts required. While this approach may work well for high-volume manufacturers with predictable demand, it is inherently reactive rather than proactive and does not consider supply-chain capabilities or constraints. For instance, an industrial-vehicle manufacturer might face higher-than-expected demand for nonstandard frames, only to find that supplies are limited or require a substantial time to manufacture. Lead times may then extend past those quoted to the customer.

The traditional planning approach also limits flexibility. If customer demand changes, or if the market shifts in other ways, companies will have to recalculate their purchase orders, and they may not be able to make timely changes. For industrials, where customization is common, the number of parts and raw materials involved in production may be higher than usual, making the task even more burdensome.

Under the new SSP approach, planning is a much more dynamic process that involves three steps: categorizing parts, creating flexible kits with the parts needed for specialized products, and developing a build plan. These three steps, in combination, allow companies to make better decisions about inventory levels and production targets.

Step 1: Categorizing parts

Companies are accustomed to classifying parts as buy to stock or buy to order. They then segment these classifications further into three categories within the inventory-management system:

- standard parts suitable for any model, such as tires found on every vehicle
- options for specialized models, such as an enhanced control system for a specific vehicle type
- parts only used rarely for one-off requests and typically not stocked, such as customer-specific colors for the bumpers and front grille

While most companies only review these part categories annually, the SSP approach calls for frequent updates to account for changes in demand, part supply, and business strategy. One company that followed the new approach found that it had to recategorize many parts (Exhibit 4). After this shift, it was better prepared to build specialized and one-off products.

Step 2: Creating flexible kits to improve decision making

The second step of the planning process involves classifying parts needed for specialized models into flexible kits. Initially, these kits will exist only as virtual categories within the inventory-control system. With a highly customized vehicle, for instance, a flexible kit might contain most standard parts plus 30 additional parts required for custom features not included in the base model. Companies should enlist engineers to help create the kit specifications because they often have the greatest familiarity with the bills of materials for different products.

Flexible kits will reduce the likelihood of shortages or excess inventory, since they show companies exactly what parts are necessary to create specialized models, as well as the lead time for each. These kits also help companies instantly determine their immediate production capacity. If the current

inventory contains the parts needed to assemble only one flexible kit, companies can create only one specialized product.

Companies should incorporate the information about flexible kits into a decision-making tool that also contains data on current inventory levels and manufacturing schedules (ongoing and planned). The resulting insights will allow them to create more specialized products without incurring the costs traditionally associated with complexity.

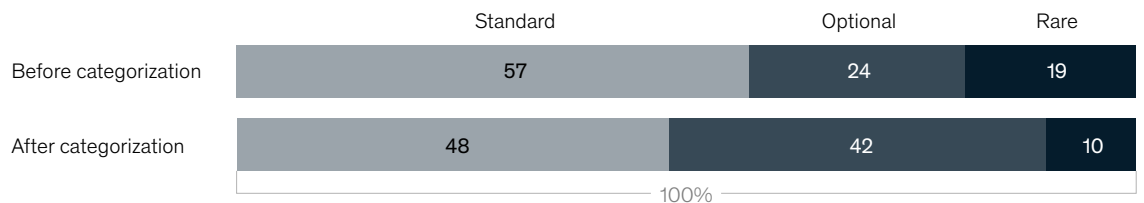
Step 3: Creating a build plan

The third step involves setting production targets and creating a build plan. Leaders from all relevant departments—for instance, operations, engineering, sales, material planning, and sourcing—should meet at least monthly, under the guidance of the site general manager or business president, to set the base targets for the units that it would like to build. This target will include demand for all potential models—standard, specialized, and one-off requests. The team will establish these targets by reviewing the insights obtained from new and historical data. It must also establish an understanding of the company’s supply-chain capabilities, including clear visibility about how the accuracy of other decisions—for instance, sales forecasts—will affect performance.

Exhibit 4

Companies must frequently recategorize parts as standard, optional, or rare.

Part type, % of total parts



This information will help the sales group clearly understand what the company can actually commit to building, based on the existing supply-chain capabilities. Without these insights, the sales group might overestimate what is possible

To determine the period required to create a standard product, teams should look at the supplier lead times for all high-cost parts. The building period will be equal or similar to the longest lead time for any part in the group. Teams must also determine how many flexible kits they need (or else revise their past estimates to reflect changing circumstances).

If companies must order multiple parts to complete a kit, they should be strategic. Rather than ordering everything at once, they should use a staggered approach that considers supplier lead times, at least for high-cost parts. For instance, one part might have a supplier lead time of six months, while others require only three or four months. In this case, it would not make fiscal sense for a company to order every part six months in advance, because there is always a risk that a specialized order might get canceled, leaving excess parts on hand. The more parts sitting in inventory, the higher the holding costs.

Consider a team that has to set production targets for both standard and specialized vehicles, as shown in Exhibit 5. At the initial meeting, it decides how

many standard vehicles it wants to build and looks at the lead times for obtaining the most high-cost parts. The team discovers that the longest lead time for obtaining one of those parts is seven months, so that is the period over which it will plan to build standard models.

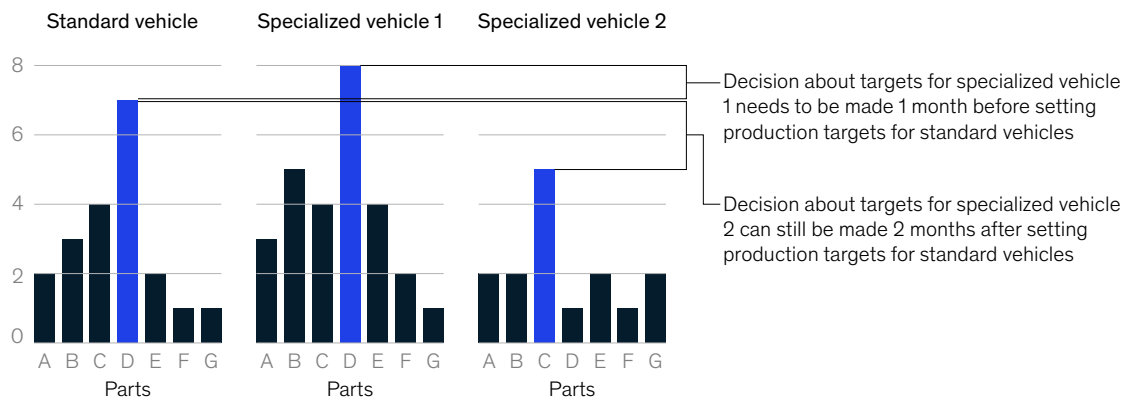
For specialized vehicles, the lead times might be longer or shorter than seven months, depending on the parts required. (Remember, specialized vehicles may not contain all parts required for a standard model.) In the example in Exhibit 5, the longest lead time for a high-cost part in specialized vehicle 1 is eight months—and that means the team must decide how many flexible kits it needs to assemble for this model at least one month before it sets targets for standard vehicles. With specialized vehicle 2, the longest lead time for a high-cost part is only five months—and that means the team can decide how many flexible kits to assemble two months after it sets targets for the standard model. The shorter the decision time to production, the more accurate the forecast.

At most companies, the supply chain is shrouded in mystery, despite its importance to every group within the organization. Buyers charged with ordering parts have imperfect information, approaches, and tools, often resulting in shortages, excess inventory, and late customer deliveries. For

Exhibit 5

When creating a build plan, it is critical to consider supplier lead time for parts.

Part lead time, number of months



While no forecast will ever be entirely accurate, companies can improve their predictions and achieve greater flexibility by following the ‘segment, stock, and plan’ approach.

industrials, these problems are especially severe. While no forecast will ever be entirely accurate, companies can improve their predictions and achieve greater flexibility by following the SSP approach to part segmentation, stocking, and

planning. With supply-chain challenges becoming more intense each year, and with the demand for configured-to-order products increasing, high-mix, low-volume industrials should lead the way in implementation.

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