

THE MANUFACTURING SIGNAL CHAIN

Using real-time signals and intelligent technologies to improve manufacturing operations



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Executive summary

Signal chain is an evolving concept in manufacturing that refers to the many “streams” of data coming into a manufacturer. Traditionally, manufacturers have received demand signals from transactions with sales orders across multiple channels - from sales teams, point-of-sale systems, ecommerce and more. They need to translate that demand into a capacity plan, taking into account supplier data points like material orders and promised delivery dates.

The problem is that while demand “signals” can be ingested continuously, the supply chain is not as well digitized, so important information does not come in signals. Often, the first signal you get from the supply chain is an expected order just not arriving on the date it was expected or at best a phone call warning of a delay. What is needed is a “signal chain” that can link the information from demand and supply to feed the calculation of a feasible capacity plan.

Progressive manufacturers are looking to move beyond evaluating mere data points and are continuously monitoring streams of data that can make dynamic adjustments to the plan for greater predictability of delivering orders as promised.

Manufacturers that harness the signal chain can leverage artificial intelligence (AI) to create a manufacturing “control tower” that acts as a decisioning platform to optimize sales and operations planning (S&OP) and related activities. The desired result is optimization across demand, capacity, supply, as well as financials for overall business growth and profitability.

Redefining manufacturing decision-making

- **S&OP, OR SALES AND OPERATIONS PLANNING**, is the business process of aligning the availability of production capacity to the projected future demand by year, quarter, month, or week.
- **SIGNAL CHAIN** is the stream of critical data from across demand-to-supply to give the manufacturing business continuous data to drive better operationalization of S&OP decisions.
- **DECISIONING PLATFORM** is the AI engine that sits on top of cloud ERP data developed on a flexible, integrated, composable platform that combines the signal chain with business intelligence data that is purpose-built for manufacturing “decisioning”.

Too much data, too few decisions

For decades, visionary leaders have been proclaiming something along the lines of, “All companies are technology companies.” It is true that companies in every industry, especially manufacturing, rely on technology more and more each year. Research has shown that the average company uses between 200 and 1,000 applications. Even for those using just a fraction of that number, the amount of data generated is overwhelming. That constant flood of data can add friction, indecision, and misleading indicators to decision-making processes.

Manufacturers continue to increase investments in technology, adding more data streams to the existing flood. A 2023 survey by research firm IDC found that “data to make sound decisions” was their number one impediment to their digital transformation initiatives. The entire sample further claimed that the “inability to utilize growing multitudes of disconnected data sources” is the number one risk if Manufacturers don’t digitally transform. But for those manufacturers that can effectively harness their data and separate the signals from the noise, there is a real opportunity to balance capacity planning against fast-changing demand and supply volatility resulting in increased profitability.

Reframing data overload as a constant stream of signals

Statistics, dashboards, and charts fill every presentation and report. But even as trends form, it is difficult to discern what is and is not a relevant signal, or what the signal means. Data must be contextualized and converted into actionable insights that can drive better decisions and produce business value. Manufacturers today have too much data and not enough actionable insights.

On the front end, years of digital transformation have improved manufacturing sales, quoting, order-to-cash, logistics, and other processes with powerful cloud-based platforms like Salesforce CRM. Customers can place orders online, receive digital invoices, pay electronically, and digitally monitor products as they make their way to a receiving dock. Along the way, those demand signals (e.g., a canceled order, delivery change, etc.) are captured, ready to help inform demand planning efforts and give operations an accurate estimate of required adjustments to production.

Unfortunately, supply planning is more challenging as manufacturers remain disconnected from the day-to-day activities of their suppliers—especially in the lower supply tiers—so reliable, real-time status signals remain elusive. This is especially true in the post-pandemic supply chain, that is still rebuilding itself. In the IDC survey mentioned above, nearly one-third of respondents say that they are concerned about the risk of unreliable or unpredictable suppliers and that optimizing supply chains and supplier collaboration is a top priority. If digital improvements on the supply side (e.g., integrated supply data, supplier portals, etc.) can mirror those on the demand side, manufacturers can expect even more real-time signals available to help operations planners make better decisions.



Planning is an inherently predictive exercise so the addition of AI will significantly help answer the many questions in S&OP. For example, funding procurement relies on cashflow so cashflow forecasting comes into focus. Without detailed and accurate signals from supply, demand, and financials, S&OP becomes a guessing game about capacity that can be fulfilled. Powerful solutions like [ketteQ Supply Chain Planning](#) already build on the supply side of S&OP to consolidate the dynamics of the supply chain for better predictions that feed the S&OP process.

Effective S&OP not only considers real-time signals, but combines with historical data, market trends, and promotional activities to form additional links in the manufacturing signal chain. This signal chain contains insights manufacturers can use to enrich the actionable data they have already collected.



Using the signal chain to deliver more confident decisions

A digital flow of signals from supply, demand, and finance sets up a perfect storm for answering the questions planners have in each of the dimensions of capacity planning. For example, when determining what materials to purchase and when, manufacturers use material requirements planning (MRP) engines to produce their supply plan. MRP is an ideal analog to a “control panel” that adds signals from demand and processes the many variables to produce a viable material plan. This “decisioning” captures incoming data, evaluates the signals using purpose-built rules, and leverages AI-driven predictive analytics to make informed, intelligent decisions. This elevates planning from gut-feel and experience to decisions based on historical data, real-time streams of new data, and predictions based on AI models.



Decisioning.

A technique that blends data, rules, and predictive analytics to make smart decisions at any given time

Without a robust analytics and data science infrastructure—which few manufacturers possess—most rely on spreadsheets, experience, and intuition to effectively balance demand, supply, and capacity. Coupled with insights gleaned from business intelligence and AI predictions, planners may have as many as 80% of their questions answered so they can “plan by exception” making decisions against the remaining 20%.

Using the manufacturing signal chain for decisioning helps manufacturing operations reach new levels of efficiency and enhances customer satisfaction. Examples of how manufacturers use a signal chain to make better decisions include:

- **DEMAND PLANNING** - Usually driven by growth plans, executives can state a desired percentage increase in sales and put tactics in place, such as promotions. But predictions as to trends in the marketplace that might influence ecommerce growth could benefit from signals coming from social media. Such signals are not easy to trend, so AI fits nicely into deciding on how much influence to give them.
- **PROCUREMENT** - Today, procuring raw materials relies on MRP that is a sophisticated “calculation engine” which collects the materials needed to produce orders in an ERP system based on bills-of-materials (BOMs) for orders that have been accepted. It will automatically produce purchase orders for the suppliers that have been approved for the materials needed. In a signal chain world, AI-enabled MRP could consider pre-buying for future orders to receive a volume discount. It could monitor the global commodities market for price fluctuation signals and suggest future cost changes for that class of materials.
- **FINANCE** - CFOs must make investment decisions to expand production capacity with additional equipment, facilities, and/or labor based on expected supply and demand. Monitoring payment signals from customers to predict cashflow at a future date could influence when the best time to make investments might be.



Decisioning Platform.

A decisioning platform connects incoming signals with the appropriate business processes to automate and augment decision-making using actionable data from the signal chain.

Harnessing the signals coming into the control tower such that the underlying decisioning platform can process the needs of manufacturing operations leads to better planning and other decisions because the decisioning platform can continuously deliver actionable insights to those who need them, when they need them.



The manufacturing signal chain at work

The signal chain is a constant flow of current information streaming from the market, the supply chain, and from your historical data to improve and optimize all aspects of production operations. Following are a few examples of how manufacturers are putting the signal chain to work.

Adjusting to demand changes

Manufacturers need to constantly adjust capacity plans to meet customer requirements. And customers change their needs often, whether by increasing the quantity of an order or escalating the delivery of it. But capacity is so much more than equipment and workers; it requires maintaining sufficient inventory levels or just-in-time deliveries while avoiding excess inventories that can tie up capital and lead to waste through spoilage. So, what happens when something changes such as an expedited, changed, or delayed order? The day-to-day production schedule, driven by the plan, needs to be re-evaluated with juggling of inventory, shuffling of production lines, and swapping out human resources to accommodate the change. Of course, the hard part is re-resourcing the production runs that were already scheduled. Which customer orders can be delayed without penalty in order to fulfill the escalated order?

A manufacturing ERP provides continuous visibility and integration with MRP and capacity planning to synchronize the right inventory levels to support production schedules in real-time. The signal chain delivers relevant and timely information to the decisioning platform so planners can keep demand, supply, and capacity continuously balanced in real-time.

Improving S&OP forecasts

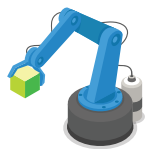
Accurate forecasting is critical for S&OP optimization. Forecasts can be dramatically improved by using historical data, market trends, and other factors along with AI-enabled planning engines to separate the meaningful signals from the noise. These intelligent insights create more accurate predictions of future demand and supply patterns.

Using better forecasts, S&OP can continuously feed the decisioning platform to optimize production schedules with accurate, real-time information instead of relying on plans and assumptions created days, weeks, or months earlier. ERP systems can also leverage the same signal chain to monitor real-time inventory data to ensure production will meet customer delivery expectations.

Minimizing lead times

Lead times are the time between order and receipt of raw materials or components to production. Optimizing, typically minimizing, lead times helps manufacturers avoid delays and stockouts, improve responsiveness to customer needs, and increase capacity utilization. Moreover, manufacturers want to minimize the time between purchasing materials and delivering finished goods. Reducing that time increases their cashflow which can be invested back into growth.

ERP systems capture real-time data on supplier deliveries, performance, inventory levels, and production schedules as well as the costs of materials including carrying costs (the cost of warehousing, environmental controls, etc.). Enriching this data with the signal chain can telegraph bottlenecks and inefficiencies in the supply chain so manufacturers can proactively improve lead times and ensure capacity is always available to meet production needs. Proactivity breeds an environment of responsiveness versus reactivity.



Challenges to assembling a manufacturing signal chain

Manufacturers have too much data from demand and capacity signals yet are lacking data from the supply side of the business. In other words, the signal chain is incomplete for many manufacturers. Building a successful decisioning platform requires capturing and connecting those signals from across the business and connecting them to their own internal signals resulting in the elusive “single source of truth” from which manufacturers can make better decisions.

Some common manufacturing decision platform challenges and their potential solutions are:

Incomplete supply-side signals

Demand signals based on new, historical, and seasonal influences are relatively easy to manage growth projections and are easy enough to predict with accuracy diminishing in the out-periods. Although demand may fluctuate, such as with a cancelled order, those changes are captured in the ERP in real-time. But there are not comparable signals from the supply side so it can be difficult to predict what resources will be available for the production schedule on a week-by-week basis. Lead times for raw materials to your suppliers may change without your knowing and increase the risk of a disruption interfering with production and delivery. Some supply signals come from the daily news such as a bottleneck in the Suez Canal or a tsunami in Japan. Unfortunately, most supply signals are phone calls from the supplier—often too late.

To overcome supply signal gaps, manufacturers can bring demand, capacity, and the supply 'chain' (multiple tiers) onto the same decisioning platform so available signals are shared, balanced, and interpreted in real-time. Combined with historical trend data like supplier delivery history, this centralized data platform evaluates the signals to provide predictive insights so schedules can be adjusted with greater levels of understanding as to any uncertainty.

Financial ramifications across manufacturing operations

With so many supply, demand, and capacity signals required for effective S&OP, a seemingly minor decision could have unforeseen financial implications. Major decisions such as adding new production lines to support predicted growth or buying more materials to account for uncertainty up the stakes and can impact overall profitability, or worse.

AI is ideally suited to identify, understand, and predict outcomes quickly to better inform decision-makers. Furthermore, AI can continuously re-analyze new and changing signals at near-limitless volumes and speeds to refine predictions exponentially faster than a spreadsheet-equipped human. The decisioning platform creates up-to-date analysis of resources, capacity, and demand to drive the best possible planning and scheduling decisions balanced across profitability, customer satisfaction, utilization, workforce, quality, and other goals and constraints.

Balancing profitability and uncertainty

The past two decades of demand-side digital transformation have created a model for what can be achieved for the capacity- and supply-side of manufacturing. Even with modernizations across capacity planning, there is still room for improvement to accurately predict and quickly find solutions for common occurrences such as worker absenteeism, unplanned downtime, and the impacts of weather, traffic, or other disruptions on short- and long-term corporate profitability.

A manufacturing decisioning platform gives planners the tools to interpret incoming signal flows, incorporate external market dynamics, financial status, weather patterns, and deliver AI-driven decisions that benefit the business. Results may suggest the need for a new supplier in a new region or partnering with a temporary employment agency to mitigate risks that protect manufacturing profits based on such business variables. Of course, these are the types of insights—the 80%—that empower humans to make the 20% judgment calls that only a human can make—today...

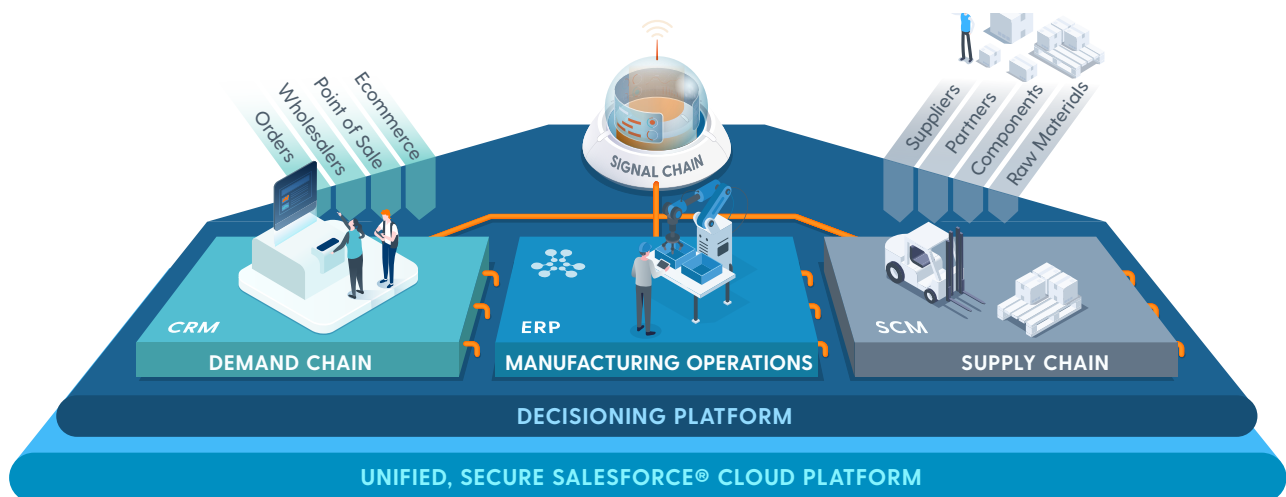


Using the signal chain to create a decisioning platform

Consider the inventory, production planning, purchasing, sales, quality control, logistics, financial management and thousands of other incoming signals and resulting decisions manufacturers must make every day—only to iterate the next day because of changes. Spreadsheets can only manage a superfluous level of data, so many manufacturers use analytics and business intelligence (BI) tools to glean insights from their mountains of data to help make more informed decisions. But these tools can only look at yesterday’s data, and for some manufacturers, that data may be days or weeks old before an analysis is complete. So more informed, but not really better, decisions.

Manufacturers have relied on ERP systems for decades. They are a critical tool for bringing demand, supply, and capacity planning together on a single platform. ERP is the centralized system manufacturers already use to capture and report on business data but with an AI-powered decisioning platform they can better interpret the uncertainties of the supply chain. Without modern capabilities built on a modern platform, legacy ERP cannot unlock the benefits of the signal chain.

Getting signals into the hands of planners faster helps them make more timely, more accurate, and more effective decisions based on much more “real-time” data. Cloud ERP brings those signals together with AI, collaboration, automation, systems integration, and other modern expectations that effectively predict the future with the most dependability and least risk. With cloud ERP as the control center, manufacturers gain a comprehensive, up-to-date view of the signal chain to automate and augment processes that can continuously improve the ultimate effectiveness of the S&OP plan no matter the volume or frequency of changes.





Rootstock Cloud ERP is the future of manufacturing decisioning

Harnessing the manufacturing signal chain is for manufacturers looking to optimize operations and improve overall manufacturing and financial efficiency. By capturing, interpreting, and balancing demand, supply, and capacity signals using a decisioning platform based on modern cloud ERP, manufacturers can greatly improve decisioning speed, forecasting accuracy, and operations to ensure the right capacity is always available to meet customer demand, overcome supply and capacity constraints, and achieve greater profitability.

Rootstock Cloud ERP is purpose-built for manufacturers to provide 360° visibility across demand, supply, and capacity signals, plus the broader quality, financial, and other signals necessary to drive manufacturing business growth. With Rootstock Cloud ERP, manufacturers can go beyond tactical planning to become a comprehensive signal chain company.

To learn more, [visit rootstock.com](https://www.rootstock.com)



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CONTACT US

-  888-524-0123
-  marketing@rootstock.com
-  5000 Executive Parkway,
Suite 150
San Ramon, CA, 94583

