DIGITAL INDUSTRIES SOFTWARE

Production planning in a complex supply chain

How advanced planning and scheduling can improve the performance of your supply chain

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Executive summary

Production planning and scheduling even in flawless conditions is challenging for manufacturers today because of shrinking lot sizes, growing product and process complexity and extensive supply chains. What’s more, flawless conditions are rarely available. The pandemic, while unprecedented in its pervasive impact on the global manufacturing ecosystem, represents only the most recent disruptive event that manufacturers have faced. These intensifying challenges to the supply chain have prompted proactive companies to implement new, holistic supply chain management strategies. Users must be able to support these strategies by leveraging planning and scheduling tools with considerably more firepower than spreadsheets and other homegrown systems possess. Collaborative planning across the supply chain in these uncertain times demands new capabilities – the kind offered by advanced planning and scheduling (APS) systems.
Although recent disruptive events have exposed numerous vulnerabilities of the manufacturing enterprise, the supply chain has emerged as being among the most vulnerable. Restricted mobility has affected the way people live and work. As a result, the availability of goods and products has suffered, and this has caused supply chain disruptions, an increase in bottlenecks and extensive adverse impacts on the marketplace. Consumer products and retail industries have been affected the most; however, discrete industries such as automotive and electronics have been harmed as well.

Manufacturers and suppliers are experiencing pressure due to shortages of raw materials and final products. In some cases, such as semiconductors, these shortages can quickly bring businesses to a standstill.

With supply chain demand now recovering to pre-2020 levels, many companies are struggling even to meet the demand they were previously able to satisfy. Continuing supply chain disruptions have sent these manufacturers scrambling to find reliable production and workflow planning solutions.

Manufacturers and suppliers are experiencing pressure due to shortages of raw materials and final products.
Supply chain management strategy: the “control tower” model

What solutions have discrete manufacturers identified to address current and future supply chain disruptions? For starters, they are adopting strategies such as local sourcing instead of global sourcing, changes in supplier networks and ramping up inventories. These changes necessitate a reimagining of supply chain management.

According to a research study conducted by the McKinsey Institute (MGI), companies that succeed during a supply chain crisis use it as an opportunity to embrace a transformational journey to a new supply chain model. The transformation is holistic, involving all major sectors from the supplier network to distribution, as well as involving customer service, transportation and manufacturing operations.

This new supply chain model implements the so-called “control tower approach,” which is based on three pillars:

• Establishing a cross-functional team to quickly make important decisions
• Providing the team with the level of information needed to establish a data-enabled decision-making process
• Empowering the team to promptly conduct scenarios planning on a regular basis

Because today’s supply chain is more extended and complex than in the past, to attain a decision-making process it is necessary to have full visibility into each one of the segments that compose it. It’s no longer just optional to have fast and effective access to all relevant data. It is not enough to capture frequent snapshots of your supply chain status and trends. Patterns are dynamic, evolutionary and complex. All stakeholders must have resources at their fingertips to successfully answer planning and scheduling questions: How will my distribution network react to a supply delay? How will a bottleneck in the transportation of semi-finished product(s) among my production facilities affect my service rate? Having the ability to quickly answer such questions is a key differentiator for successful supply chain management.

<table>
<thead>
<tr>
<th>Supply-chain tier</th>
<th>Organization has visibility into this supply-chain tier, % of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>11</td>
</tr>
<tr>
<td>Tier 1</td>
<td>48</td>
</tr>
<tr>
<td>Tier 2</td>
<td>21</td>
</tr>
<tr>
<td>Tier 3</td>
<td>2</td>
</tr>
</tbody>
</table>

Note: Companies surveyed manufacture smart appliances. Source: McKinsey survey of global supply-chain leaders (May 4–June 16, 2021, n=71)

However, this key to success is currently lacking in most supply chains. In a recent survey conducted by the MGI, less than half of respondents claimed to have visibility into their first-tier supplier base – and that number dropped to 21 percent regarding visibility into the second-tier supplier base and only two percent for the third-tier supplier base. The effect of this lack of visibility is extremely important, since many of today’s critical supply shortages, such as semiconductors, occur with tier-2 and tier-3 suppliers.
Implementing a reality-based supply chain management strategy

To successfully sell your products today, you naturally must consider how raw materials are supplied, how shipment takes place, how customer sentiment and usage patterns trend and fluctuate and many other well-known aspects of the manufacturing enterprise. One central point to these factors is how the product is built – the manufacturing operations on the factory floor. Here, all of these aspects interact and generate a complex and sometimes volatile mix of correlations and dependencies that are often hard to master.

The manufacturing operations segment, as shown in the figure above, is affected by disturbances arising in any of the other segments. Production planning and scheduling are also affected by internal disturbances, such as breakdown, strikes, inefficiencies and more. This segment is also affected by competitive pressures that led many companies to reduce inventories and buffers, or the so-called decoupling points that could limit the aftermath of these disturbances in time of crisis. Considering all these factors, manufacturing operations is arguably the linchpin for supply chain management.

In the midst of these considerations, and with inevitable disruptive events always on the horizon, implementing a control tower model or other holistic approaches to supply chain management is a strategically urgent need. For the control tower to work reliably, both in normal times and during disruptions, up-to-date information that represents the reality of supply chain and production conditions is essential.

This is true for large enterprises where production is geographically distributed, suppliers are located far away from production facilities or the target market is global. Even small and medium companies face the intrinsic complexity of production and supply chain interaction, for example, when preparation areas, machine shops, assembly lines, intermediate buffers and warehouses interact in complex value chains.

To master the supply chain in today’s volatile and uncertain climate, efficient production planning centered around manufacturing operations is essential for small and large enterprises alike – and modern planning technology is an indispensable tool for achieving needed efficiencies. Why? Because homegrown spreadsheets and other labor-intensive planning approaches cannot keep up with today’s demands for extended supply chain and production planning. Spreadsheets are naturally disconnected, making data-enabled decision-making by the control tower’s cross-functional team unattainable. Spreadsheets also rapidly become dated quickly, and it is nearly impossible for exhaustive and time-consuming manual update processes to provide timely data that reflects accurate production status.

Conversely, APS can largely contribute to the success of the control tower strategy. APS supports each of the control tower’s three main pillars, which are summarized as the capability to perform data-enabled decisions using rapid and regular scenarios evaluation.

Let’s consider how.
How APS systems support an effective supply chain management strategy

Modern APS software is designed to support holistic supply chain management strategies like the control tower approach. Below are the three primary functions of an APS system that support critical decision-making on production plans:

1. **Modeling complex relationships and interactions of manufacturing environments**
   Production environments consist of resources, such as machines, people, materials and operations. Each of these environments introduces constraints to the planning process. For example, machine availability is limited, warehouse space is finite, departments have a maximum work capacity or limited energy consumption and time is a pervasive and constant constraint on operations. An APS system can be used to model all of these factors and understand how they interact with each other; how each operation consumes resources and energy, and how it occupies operators and equipment. The APS system facilitates a step-by-step approach, starting from the basic element (resources, operations and materials) and then building in relevant parameters up to the most complex constraints. The system then enables you to fine-tune your model by iterations of model-and-verify.

2. **Rapidly evaluating different scenarios**
   APS systems can run multiple production configurations, allowing you to test changes to specific details or boundary conditions. You can vary individual conditions and analyze the impact on relevant data and key performance indicators (KPIs). These what-if scenarios are useful to evaluate the impact of supply chain disturbances on complex, dynamic interactions within manufacturing facilities. For example what if:
   - Materials are delayed by three days
   - I can get the part from only one of my suppliers
   - I need to expedite a customer order

3. **Facilitating cross-functional collaboration, interaction and breaking down communication silos**
   Production planners adopting APS systems can effectively manage inquiries from various departments, such as sales, procurement, maintenance, shop floor and finance, by running what-if scenarios. They can also support the control tower to proactively drive the supply chain. Modern APS systems can connect to the shop floor, enterprise resource planning (ERP), manufacturing execution systems (MES) and warehouse and logistics to provide planners with up-to-date information and enable them to make reliable predictions. They can also represent multiple facilities or areas simultaneously and allow planners from different areas or plants to collaborate.

   As an example, let’s consider the case of one production site with several different production departments. This type of production is usually managed by a team handling the mid-to-long-term planning and several schedulers handling the short-term planning.

   Each department is different in terms of resources, operations, materials and constraints; therefore, they will need different schedulers. Key drivers determining feasible scheduling for a computer numerical control (CNC) department may be completely different from the ones for a metal extrusion department.

   Situations like this or companies with multiple plants require an assessment to understand factors such as production flow and dependencies to design the best production planning and scheduling approach.
Let’s see another example regarding personalized flexible plastic packaging for food.

In this case, the production flow may look like this:

The production process starts as soon as a customer order comes in, such as custom bags for food. But how should it be scheduled? First, you can schedule the printing area and subsequent steps and then use the printing schedule as input for plastic extrusion and cylinder making. After finding out when the plastic is extruded and when the cylinder will be available, you may need to reschedule the printing area and its subsequent steps.

Scheduling strategies may be different so you may need to take a collaborative scheduling approach. This could include having one scheduler dedicated to all processes starting from printing and another scheduler for the two previous steps.

Despite the forward-backward-forward approach, this is the best method for this kind of production because you can optimize each production step according to its demand, capacities and material availability.

Let’s consider a case where a global company makes auto parts and has several plants around the world. Does it make sense to have one centralized scheduler?

Suppose a company makes the same finished product in the U.S., India and Brazil. The logistics, labor and other cost factors may determine the U.S. plant will supply the North American market, India the Asia market and Brazil the South America market. Because the schedules are quite independent, the best practice would be to have a scheduler for each plant.

If each plant has several departments, a vast amount of resources and constraints and scheduling approaches, then you may need to have a collaborative scheduling approach, similar to the example with the custom plastic bags.
Opcenter™ software includes a range of advanced planning and scheduling software that uses complex algorithms to analyze, simulate and calculate production schedules within minutes. Opcenter APS is part of the Xcelerator portfolio, the comprehensive and integrated portfolio of software and services from Siemens Digital Industries Software.

By implementing one of the collaborative scenarios represented in the figure above it is possible to address the need for collaboration and synchronization for most production scenarios.

### Conclusion

By facilitating collaboration and communication among entities across the supply chain, the control tower supported by holistic advanced planning and scheduling approaches, break down departmental and supplier silos — a necessary feature of supply chain management in today’s complex and volatile manufacturing environment.

APS systems such as Opcenter empower your supply chain with the modeling capabilities and flexibility in testing many different scenarios and visibility needed for efficient and effective production planning throughout your supply chain.


**References**

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