The Amazon Effect on Scheduling
Quick-Turn On-Demand Manufacturing Operations

Introduction

In this white paper we look at the impact that the expectations created by Amazon for next day delivery of consumer products are having on scheduling production operations in quick-turn on-demand industrial manufacturing operations.

The Scheduling Problem

It used to be that most manufacturing plants made a small number of products in high volume, with long production runs. These products were stocked in distributor warehouses so they could be quickly shipped to customers. If a customer ordered a custom part then they could expect to wait weeks or months for delivery.

Today, customers expect delivery within days of a large number of products that are tailored to their specific needs. After all, if they go on Amazon, they can order from an incredible array of products and expect next day delivery by FedEx or UPS. So why cannot they order a small number of widgets in exactly the size, color, and shape they want and have them delivered in a couple of days?

To make this situation worse, industrial supply chains are becoming very lean. Everyone wants to stock the absolute minimum of product, with orders to distributors being sent as drop-ship orders to the manufacturers.

Manufacturers have responded to this situation by converting raw materials into a small set of intermediate products from which they can quickly make and ship a wide variety of products.

This brings with it a critical challenge in scheduling work orders to make intermediate and finished products such that customer orders, which may need multiple work orders processed through 25 or more work centers over a few days, get shipped on time.

Late shipments can cause loss of repeat business. With lean supply chains, retailer, distributors, and end-product manufacturers are all critically dependent on on-time delivery from their suppliers to avoid stock outs. If a manufacturer fails to deliver goods on time then customers will be lost as these customers will look elsewhere for suppliers who can deliver on time.

On the other hand, a reduction in delivery time can help win new business by reducing customers' inventory carrying costs and by giving them more flexibility in their production scheduling.

Scheduling Alternatives

Some of the common scheduling alternatives are:

1. Let the production supervisor decide what jobs to run and when.
2. Use an Excel spreadsheet maintained by the production planner
3. Use a scheduling white-board at a morning management meeting to schedule production for that day.
4. Use an MRP (Materials Resource Planning) algorithm, such as are embedded in most ERP (Enterprise Resource Planning) systems
5. Use a real-time rules-based scheduling algorithm, such as that embedded in the BellHawk operations tracking software.

Option 1 works really well for small shops where there are only a small number of customer orders being processed at any one time. A good supervisor will be able to run his or her shop to make sure everything gets done in the right order and is packed and shipped on time.

As the volume of work increases and the organization develops separate work centers with their own production supervisors then the organization needs to add a production scheduler, who typically keeps track of the jobs on an Excel spreadsheet and/or hold a daily meeting of work center supervisors to arrange the day's schedule.

This starts to break down as the delivery times shorten and the volume of work increases as plans change quickly after the end of the planning meeting as new orders arrive, machines break down, and other factors intervene.

As a result, manufacturing organizations typically try to use MRP as a scheduling tool (often at great expense for a new ERP system). MRP starts with order forecasts (typically for several weeks or months in the future) and then uses Item Master BOMs (Bills of Materials) to compute what materials will be needed and when. This can then be used to create purchase orders for raw materials and work orders to make intermediate and finished products.

MRP2 (resource constrained) algorithms can then use information about people, material, and machine availability to schedule when work orders should be processed in which work centers. This works well if you are an organization like Toyota, with production lines that have a given TAKT rate and a production schedule of cars to be made weeks ahead.

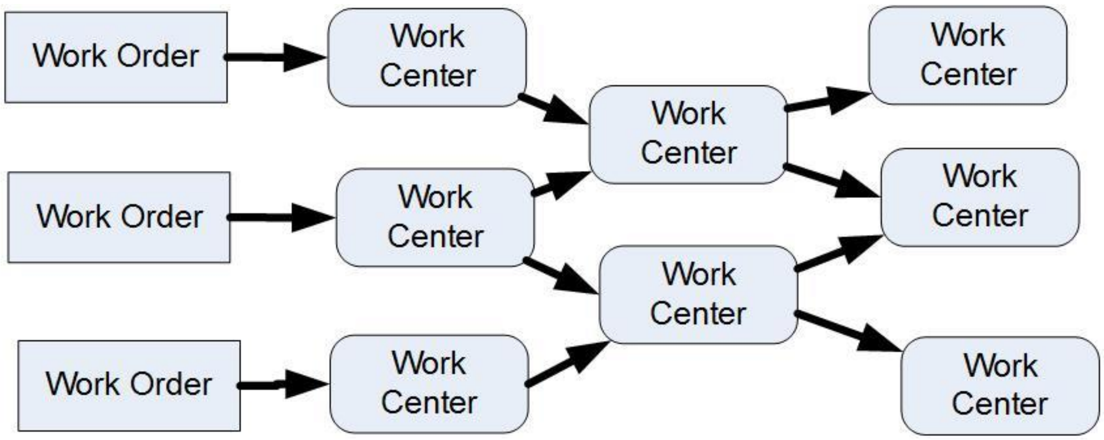
But in the typical make-to-order, semi-custom, rapid-turn manufacturing operation this does not work as orders arrive at random with just a few days lead time. Also machines break down, materials deliveries are late, and people are absent. As a result, any production schedule based on planned resource availability is almost always wrong.

MRP1 (not resource constrained) can predict the future demand for commonly used raw materials based on sales forecasts. This can be very useful in ordering long-lead time raw materials that have to be shipped long distances.

Typically MRP runs are done once a week because this is how often sales forecasts (if available) are updated. This precludes dynamically adding newly arriving customer orders to the work orders to be scheduled, which is necessary for turnaround times of a few days for new customer orders.

As a result, most quick turn, semi-custom manufacturers do not use their ERP systems for scheduling jobs.

The BellHawk Approach



1. As the customer orders arrive, BellHawk generates work orders from the orders for the making of finished products as well as work orders for the preparation of the intermediate products needed to support the making of the finished product. Note this is done in real-time incrementally without going back and re-planning, as in classic MRP systems. This can be done automatically, based on live order feeds from customers, websites, and supply chain systems. Alternately this planning can be done interactively by a production planner, if manual adjustment of work order quantities is required.

2. BellHawk then dynamically schedules work orders through each of the work centers taking into account factors such as delivery dates and the importance of each customer. Note that new work orders can be integrated in real-time into the schedule as these work orders are created.

The important thing is that this scheduling is totally dynamic so that work order priorities in each work center can change from second to second as new orders arrive and existing orders are completed or some work orders take longer than expected. This module makes the best use of available resources to ensure, as far as possible that orders get shipped on-time to customers.

In performing this real-time scheduling, the BellHawk software takes into account the real-time status of each job, when each operation is supposed to be completed, when the order is planned to be delivered, and the importance of the customer order. It can also use Artificial Intelligence (AI) rules to account for specific factors relative to the product being made.

This rules-based scheduling takes place dynamically, in real-time, advising employees in each work center what is the highest priority task for them to work on, without needing intervention from managers or supervisors. It automatically allocates resources to jobs that are likely to be delivered late or are more important to the organization.

The generation of work orders, and purchase orders if needed, is based on BellHawk predicting available inventory at future times. This algorithm takes into account current physical inventory, less materials allocated to other work orders and ship orders plus materials to be made by existing work orders and materials on order. It can also take into account product specific AI rules when generating the work orders. In this way, Work Orders for finished products and intermediate materials will only be created when needed and in quantities that are appropriate.

We have successfully used these techniques with the BellHawk software in a number of situations where the typical turn-around times from order to delivery are only a day or two, often with a large number of semi-custom orders. Some of these systems have used AI rules to assign work orders to specific plants, in a multi-plant organization, based on machine capabilities and geographic proximity to each customer.

Please see the Data Sheets link from www.BellHawk.com for further details about BellHawk and these planning and scheduling modules.

BellHawk, with these scheduling and planning capabilities, is available in the Cloud on a subscription basis or for rental for installation on each client's own Windows Server.

Commentary

With the advent of the Internet, manufacturing has changed dramatically from delivering standardized products made in large volume to delivering semi-custom products tailored to the individual needs of each customer. Also delivery time have shrunk from weeks to days with orders being won by manufacturers who can deliver in a couple of days. (Amazon Prime 2 day delivery please!)

This is presenting a tremendous challenge to manufacturers to deliver quality semi-custom goods with a few day turnaround from customer order to delivery. Those that master this challenge will take customers away from those organizations that do not, which will quickly fail and go out of business.

To achieve this goal, manufacturers need to switch from using legacy ERP/MRP methods, or existing spreadsheets and daily production meetings, to using real-time AI based planning and scheduling systems such as BellHawk.

Author

Dr. Peter Green is an expert in implementing real-time AI based operations tracking, planning and scheduling systems for manufacturing, food and pharmaceutical, and other industrial organizations. Dr. Green is the Technical Director for Milramco where he was responsible for the development of the BellHawk Software. He received his BSEE and Ph.D. from Leeds University in England and was previously a senior member of the research staff at MIT and a Professor at WPI as well as being involved in a number of early stage ventures.

