

# ADVANCED PLANNING AND SCHEDULING TECHNOLOGY PAPER



## **Advanced Planning and Scheduling Improves Customer Service**

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### **Introduction**

In today's highly competitive environment, product manufacturing companies are continually looking for an edge. One way to gain an edge is to outsource production to vendors. Developing outsourcing relationships can give the company technology, cost, quality and delivery advantages it might otherwise not have. These relationships can begin early in the life cycle of the outsourced product or component and take on different characteristics as the product matures.

This paper focuses on one key area in the outsourcing relationship, delivery.

1. How companies can ensure that their vendors are able to handle their outsourced delivery requirements.
2. How vendors can keep their delivery performance at acceptable levels throughout the product life cycle.

This paper proposes the method of advanced finite capacity planning and scheduling for handling the delivery problem. The method explicitly considers the limited capacity of a company and its vendors and also the demands placed upon that capacity. The paper discusses:

1. How demands change over the life cycle of an outsourced product.
2. How various groups, both inside and outside the company, influence the availability of capacity and impact delivery.
3. How advanced finite capacity planning and scheduling can help and the resulting benefits.

Advanced finite capacity planning and scheduling can model available capacity and order demands. Its what-if features show the impact of dynamic changes and proposed actions on delivery. Its visibility features provide insight so that the best management actions are taken to improve delivery and company-vendor relationships.

### **Why outsource?**

Companies outsource, purely and simply, because it makes them more successful. Successful companies develop and manage business relationships with vendors, which over certain time periods can perform some aspect of manufacturing better than they can. There are two trends in today's climate influencing companies to increase their level of outsourcing.

1. The first is the existence of increasingly fierce global competition in most manufacturing markets.
2. The second is better management techniques that make it easier to manage an outsourcing relationship.

Companies tend to outsource more in the face of stiff competition to gain an edge on their rivals. If outsourcing can benefit a company, chances are it can benefit its competitors. If a competitor can outsource sooner and more effectively than other firms in its industry, it stands to significantly improve its profitability and market share.

Current technology and management techniques have increased the frequency of outsourcing because they make it easier to execute and increase the odds of its success. For example, techniques such as JIT and vendor participation in concurrent engineering have helped companies understand the mutual responsibilities and potential benefits of closer company-vendor partnerships. Programs such as Total Quality Management and Statistical Process Control have helped companies manage the quality issues that are one of the keys in company-vendor relationships. Technologies such as Electronic Data Interchange have helped vendors and companies better communicate. Other new technologies, such as finite capacity management discussed later in this paper, draw vendors and companies closer together and make outsourcing even more widespread.

### **How do companies choose vendors?**

A company chooses to outsource because it can get a competitive advantage through improving its technology, cost, quality or delivery. The company chooses to outsource to a particular vendor, because that vendor can do better than it in at least one of these four key areas. However, the vendor's advantage in one of the key areas is meaningless if it doesn't perform at least at market levels in the other areas. The company should continuously monitor the vendor and take action if it slips in technology, cost, quality or delivery. The ultimate and final corrective action is for the company to take its business elsewhere.

### **The role of product life cycle**

The task of managing vendors is complicated by the evolution of a product throughout its life cycle. This evolution can have an impact on which vendors are chosen and managed.

For instance, early in a product's life cycle, production volumes are typically low. Many adjustments are usually made to get the product in a form that will gain widespread market acceptance. In the early stages, the company needs vendors who can help with technology and who have the flexibility to react to numerous engineering changes while still meeting quality and delivery commitments. Vendors who specialize in job shop style production might make the best partners for the company early in a product's life cycle.

As a product matures, typically technological problems are worked out. The product then gains market acceptance and production volumes rise. At this stage, the company needs vendors who can provide competitive lead-times and meet their delivery commitments. These vendors also need to deliver the product at low cost and with consistently high quality. Vendors who produce in a repetitive mode might make the best partners for the company later in the product's life cycle.

### ***Where's the company-vendor risk?***

The risk in any outsourcing relationship is that a vendor will hurt a company through poor technology, cost, quality or delivery, before problems are fixed or before the company can re-source the business.

Of the four key variables, cost is the easiest to manage and is usually handled contractually. The vendor usually eats cost overruns until the contract is renegotiated. The time frames are such that the company usually has sufficient chance to react to cost problems.

Vendor technology, quality and delivery problems are much harder to deal with. They can crop up on a daily basis and can severely disrupt the company's business. The only way to deal with such problems is proactively. Only vendors who are capable of meeting company requirements should be chosen.

Procedures and management mechanisms must be put in place to ensure that as business conditions change, including changes brought about by changes in the product's life cycle, vendors can still meet their commitments.

In the area of technology and quality, much has already been done. Vendor's design and production processes are certified to ensure that they are capable of producing product that conforms to company requirements. Procedures such as concurrent engineering and statistical process control help monitor design and production processes to make sure that they remain in control over time.

In the author's opinion, much work remains to be done in the area of delivery. Strides have been made through JIT, which has enhanced expectations that vendors should provide competitive lead times and then deliver on time. Supplier certification programs have also helped companies understand, at least initially, their vendor's capacity. However, companies are still plagued by long vendor lead-time and on-time delivery problems. In addition, these problems seem to crop up at a moments notice and can have a ripple affect on a company's own on-time delivery and lead-time.

### ***Why is delivery a problem?***

Delivery will always be a problem because change always occurs, sometimes very rapidly, in a manufacturing environment. A vendor that has sufficient capacity today to meet a company's needs may not have sufficient capacity a few weeks from now. These changes occur both in the availability of capacity and in the production requirements that consume capacity.

Capacity varies based on factors such as machine breakdowns, labor availability, material availability and quality problems. While much can be done to reduce the variability in manufacturing processes, to some degree, these problems will always be with us.

Production requirements vary due to changes in both order quantity and order mix. A vendor may have adequate capacity early in a product's life cycle but insufficient capacity as volumes increase over time. In the short term, a vendor may receive a new order or have delivery requirements suddenly moved up. A vendor may see its mix of orders change from those that require little capacity in an area of the plant where capacity is tight, to those that require large amounts of scarce capacity resources.

Changes in company requirements are something over which most vendors have little control. Consequently, all organizations must learn to effectively manage the impact of changing conditions on delivery.

Effective management of delivery is crucial both for vendors looking to keep their delivery at acceptable levels, and for companies looking to ensure that vendors are able to meet lead-time and on time delivery requirements. The first step in managing the delivery problem is in understanding it.

### ***Understanding delivery***

Understanding delivery requires understanding available capacity and the loads placed upon that capacity. Key to this process is in understanding that capacity is limited or finite. If production requirements are accepted that exceeds available capacity, delivery will be pushed out in time.

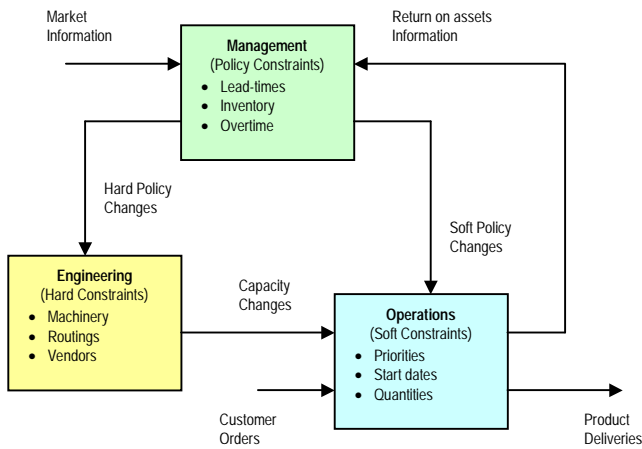
Understanding available capacity is a relatively simple task. It involves understanding when resources are available to add value to product and how much of the resource's time each product requires. Specifically, the time periods (shop calendars and shifts) when production capacity is available should be understood.

Understanding the loads placed upon capacity requires knowledge of current and projected orders. It also requires understanding the paths that individual products or product types take through a plant (routings), and how much time on production resources these products consume at each operation step (operation standards).

### ***Managing delivery***

Managing delivery requires an understanding of the dynamics of the organization and its business. This situation is described in the diagram below.

The diagram depicts the three broad divisions within the organization, management, engineering, and operations, which influence delivery. It also depicts orders entering into and out of the organization. Finally, it shows the changes and constraints that affect delivery within the organization over time.



The operations group takes in orders. In the short term, it has the responsibility of judiciously managing existing capacity so that delivery requirements are met. To perform this task, the operations group must develop good production schedules. This type of scheduling involves determining the sequence or priority that orders will start running, the dates that production will commence, and the quantities to produce.

The operations group is also responsible for managing around the problems that can rob the operation of its available capacity. These problems include new orders, order changes, material shortages, breakdowns, labor problems, vendor problems, and quality problems. Three factors or constraints influence how the operations group performs its function and ultimately meets or misses delivery requirements.

1. The operations group is influenced by the demands placed on it by orders. These orders will undoubtedly fluctuate in terms of quantity, mix, and priority. These fluctuations will have an affect on the capacity required to meet delivery.
2. The operations group is influenced by the policy constraints set by the management group. These constraints are termed “soft” because they can be varied in the short term.

The management group determines what kinds of lead times will be quoted, inventory levels, overtime and other labor policies, and sets the general guidelines that influence how the operation’s shop floor is run. They use market information and feedback on performance in setting these policies. All these policies influence available capacity and therefore delivery.

3. The operations group is influenced by the constraints set by the engineering group. These constraints are termed “hard” because they are typically fixed in the short term.

The engineering group determines the levels of machinery, tooling, and equipment that will be available to the operations group. They build and maintain the standards and routings that determine how product flows through the plant and also control the plant processes. The engineering group typically certifies vendors and determines to whom work can be outsourced.

## **Visibility is the key**

The key to better managing delivery is visibility. Changing conditions require that the plans of management, engineering and operations be constantly modified. Every modification and accompanying action has a cost and a result. Unfortunately, costs are not always as small as anticipated and results are not always as good as desired. Increased visibility helps companies predict, with greater certainty, the costs and results of their actions, thus ensuring that the best decisions are made.

In today’s complex and dynamic manufacturing plants, this visibility is almost impossible to obtain manually. For instance, no company or vendor has the time to manually calculate the amount of capacity for production requirement and the effect on delivery of multiple requirements competing for limited capacity. No company or vendor has the time to factor in all unforeseen events affecting available capacity or to consider multiple alternatives to improve delivery.

## **Advanced planning and scheduling provides visibility**

The solution to the visibility dilemma is to harness the computer’s power to do multiple calculations quickly and to show results in easily understandable formats. There are now commercially available advanced finite capacity planning and scheduling systems that let companies and vendors see the impact of planning and scheduling decisions made today on their plants tomorrow.

Advanced finite capacity planning and scheduling starts with a detailed model of a manufacturing plant. The model includes resources, routings and standards, and production requirements, and it explicitly considers the limited capacity and material of the plant on an operation-by-operation basis. If capacity is unavailable to perform a particular operation, that operation is pushed out in time and the resulting violations shown. Therefore, both the impact of capacity constraints on a company’s requirements and the inability of a vendor to meet delivery dates become clear. In addition, advanced finite capacity planning and scheduling is used to perform what-if’s, which show the ramifications of proposed actions to generate more capacity or to better manage existing capacity under changing business and market conditions.

## **Advanced planning and scheduling provides benefits**

Because advanced planning and scheduling can show the impact of changes in capacity and requirements on delivery, the various groups within the organization, and also companies and vendors, can use it to see the impact of proposed actions.

Advanced planning and scheduling provides the management group a way to judge the impact of changing market conditions on delivery, a method for seeing the impact of changing soft policy constraints, and a method to evaluate the impact of hard policy constraints. Management can use it to help answer the following types of questions:

- If demand for a product takes off over the next three months, what can we do to meet requirements?
- If a competitor has just shortened quoted lead times, can we match them? If so, what do we have to do?
- Will simply working more overtime solve delivery problems or do we need to hire more people or invest in more capital equipment?
- How much can delivery be improved through cellular manufacturing and set up reduction programs?

Advanced planning and scheduling provides the engineering group a way to test the impact of changes in hard policy constraints on delivery. Engineering can use it to help answer the following types of questions:

- Can we justify the purchase of a new machine or the cost of modifying tooling given current order requirements?
- Will changing routings to specify alternative production resources result in improved delivery?
- Should we certify new vendors given current order requirements?
- How can we structure a preventative maintenance program for the maximum positive effect on delivery?

Advanced planning and scheduling provides the operations group a way to manage the company's resources in the short term to meet delivery requirements. The operations group can use it to help answer the following types of questions:

- How should we prioritize or sequence orders to make sure order requirements are met?
- Should we start running an order today or can we delay it until tomorrow?
- What order quantities should we run to meet delivery requirements?
- Should we split orders to make delivery?
- Should we reallocate labor to increase efficiency in a particular area of the plant?
- Will working overtime this weekend help us make our due dates?
- When should we schedule preventative maintenance so that it has a minimal impact on due dates?
- When should we schedule prototype production so that it has a minimal impact on regular orders?
- If we accept this "hot" order, what other orders will it make late?
- What kind of delivery promises should we make?
- What if we rob Peter's material and give it to Paul?

Advanced planning and scheduling provides companies a way to manage vendor deliveries. Companies can use it to help answer the following types of questions:

- If we source work to this vendor, will the vendor have the long-term capacity to meet our needs?
- This vendor is slipping on delivery, is it time in the product's life cycle to find another vendor?
- In the short term, this vendor is running late on work that we have sourced to it. How will the lateness affect the rest of our plant, including ultimate delivery to our customer?
- At what volumes can we realistically expect a vendor to change its procedures to better meet our delivery needs?
- At what order volumes can we realistically expect a vendor to add capital equipment to better meet our delivery needs?

## **Summary**

Delivery is one of the most crucial aspects of the company-vendor relationship. The first step toward managing company-vendor delivery is in understanding how available capacity and order requirements are influenced within the organization.

Once the impact of capacity and orders on company-vendor delivery is understood, it can be modeled with advanced planning and scheduling technology. The technology can show the impact of changes on delivery and can be a very valuable tool in managing and improving outsourced delivery. Readers are urged to learn specifically how the technology can be applied and can be of benefit to their organizations.

## **About the author**

Charles J. Murgiano is a principal with Waterloo Manufacturing Software. He has had more than ten years experience helping clients apply manufacturing decision support software. Mr. Murgiano received his MBA, Masters in Engineering in Operations Research and BS in Mechanical Engineering from Cornell University. He is active in the American Production and Inventory Control Society and is certified in production and inventory management by this organization.

## **More information**

This SME Technical Paper, MS92-349, was presented at the AUTOFACT Conference. It is being provided with compliments from Waterloo Manufacturing Software. For more information about Waterloo Manufacturing Software's advanced finite capacity planning and scheduling system, TACTIC, or Mr. Murgiano's other papers, contact:

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