

ATP, AATP, CTP, and PTP: Order Commitment Alphabet Soup

By Donald Shobrys

Available To Promise, Able To Promise, Advanced Able to Promise, Capable to Promise, Profitable to Promise: all are catch phrases describing different offerings that support the order commitment process. Such a proliferation of jargon makes it harder to understand the various levels of support for order commitment and the tools and technologies available to deliver them.

Why the interest in order commitment? First, synchronizing procurement, manufacturing and distribution with customer demand reduces the working capital tied up in inventory for both supplier and customer. Second, improved customer service generates new business and protects existing accounts. Finally, product companies increasingly use services to differentiate themselves from their competitors.

This article traces the evolution of support for the order commitment process, examines the components making up the currently available solutions, discusses performance issues, and touches on future directions.

Evolution

In the beginning, there was a single number for each product – uncommitted stock. The customer service representative (CSR) would check to see if the order quantity was less than or equal to the uncommitted stock. If so, the order was accepted with the requested due date. If not, the CSR used a standard lead-time for that product or family of products to determine the due date. For large orders or in highly make-to-order environments, the CSR might consult manufacturing. Occasionally, it could take days to get a response from manufacturing, and the reply was often a combination of standard lead times and intuition.

Uncommitted stock is equal to (inventory on hand) minus (orders on hand). It is reduced

by orders due the next day and by orders due in 6 weeks so it is possible to have zero uncommitted inventory but no place to store additional production.

There were obvious problems with this approach. Because it worked off an inventory buffer between manufacturing and distribution and encouraged accumulation of inventory, customer service and capacity utilization fluctuated with the level of demand. When demand was high, capacity utilization was high, but customer service was low because the standard lead times were inadequate. When demand was low, capacity utilization was low because the standard lead times delayed shipments unnecessarily. Even though due-date performance was good in periods of low demand, the business was capable of being even more responsive.

Over time, many businesses expanded their product slates dramatically. This expansion compounded problems with inventory, capacity, and customer service. More products meant more inventory. It was very cumbersome to define or revise standard lead times for products, although many companies did this as a sales or marketing exercise without considering manufacturing capabilities. As a result, capacity shortages occurred for some products while there was excess capacity for other products. Therefore, capacity utilization and customer service performance varied with product mix as well as with level of demand.

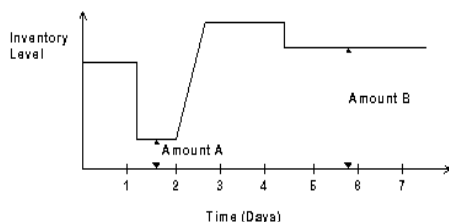
Inventory and Scheduled Production

In response, companies made information on scheduled production available to CSRs in a variety of forms. Production schedules were given to the CSRs, and they mentally integrated them with inventory data. Order Management Systems (OMS) were modified to display scheduled production. ERP

systems automated bookkeeping for the CSRs on orders vs. inventory and scheduled production. Today, most ERP systems support an automated order commitment analysis process, Available To Promise (ATP), which considers inventory and scheduled production.

Incorporation of production has created a shift from using a single number to looking at inventory over time since the CSR (or the ATP process) needs to know when the additional production will be available. This is illustrated in Figure 1.

Figure 1. Inventory Profile



The amount the CSR can commit to depends on the due date. If a customer requests next-day shipment, Amount A is available. If the ship date is 4 or more days later, Amount B is available.

If no inventory is available and production has not been scheduled, then the CSRs usually revert to standard lead times.

Although ATP is a step forward from the use of a single number for uncommitted stock, there are still problems. While this approach supports a make-to-stock business model driven by forecast or replenishment strategies, it offers no improvement for make-to-order products, and many businesses produce both make-to-stock and make-to-order products.

Not surprisingly, the use of standard lead times creates the potential for poor customer service for make-to-order customers, making it possible for more responsive competitors to steal business.

Inventory, Scheduled Production, and Buckets of Capacity

Over time, companies began adding consideration of capacity, initially in monthly or weekly buckets. Orders consumed capacity as they were accepted.

A number of different approaches were used in attempts to consider how orders consumed capacity. For simpler manufacturing applications, the CSRs used spreadsheets to track consumption of capacity directly. In a variation of this approach, production planners converted available capacity into budgets of production volumes for products or product families, based on forecasts or history. The CSRs accepted orders as long as the amounts stayed within the budgeted quantities, using spreadsheets to track consumption of the budgeted production. Sometimes the planners did the analysis and posted memos to the CSRs on a daily or weekly basis, giving them directions on accepting orders.

It is difficult to use a spreadsheet-based approach for businesses of any size or complexity. The spreadsheets proliferate rapidly, and it becomes difficult to keep them synchronized as changes and upsets occur both with orders and with production.

Another approach—employed by businesses with make-to-order product—utilized a regular cycle of interactions between CSRs and production planners or schedulers. The CSRs cycled batches of tentative orders to the planners, often on a daily basis, and the planners provided feedback on acceptable due dates and quantities. This approach, unfortunately, had several flaws. Response time was poor. It typically took one or more days to accept orders. In addition, orders went into limbo if the planners were unable to find production slots for the required products. Companies addressed these flaws with some success by putting the CSRs in the immediate vicinity of the planners.

As companies acquired planning engines, they gave CSRs access to them, initially either with hard copy reports or by access to screens of planning information. After each planning cycle the engine defines available capacity by time bucket. The CSRs can then query the engine online, and the planning engine does the bookkeeping on consumption

of bucketed capacity as the CSRs make commitments. Today, a number of vendors offer the ability to connect the CSR to a planning engine under the headings of Able To Promise, Advanced Able To Promise, and Capable To Promise.

Consideration of capacity on a bucketed basis falls short in several areas. In some businesses the sequence of production activities has a large impact on cost. Product changeovers, transitions, or setups range from painless to extremely painful, and the costs of painful transitions can be tens of thousands or even hundreds of thousands of dollars. Such transitions often create downtimes ranging from hours to days, thereby reducing effective capacity. A bucketed view of capacity precludes consideration of these sequence dependent costs.

The size of the time bucket limits the ability to control finished goods inventories. Since there is no visibility as to when production occurs within a bucket, finished goods must be on hand at the start of the bucket to satisfy any orders due within the bucket. For example, if a company commits to orders from plans developed in monthly buckets, then the required finished goods are available from 1 to 31 days before they are needed. On average, the finished goods are on hand two weeks before they are needed.

Inventory, Scheduled Production, Buckets of Capacity, and Materials

Once a planning engine is linked to order commitment, it is often possible to check on the availability of intermediates and raw materials as well as on capacity.

Consideration of capacity and materials, even only on a bucketed basis, is too complicated to do manually or with spreadsheets, unless the business is simple. The success of a spreadsheet based approach for considering capacity often hinges on the ability to assign each CSR their own unique subset of capacity or available production volumes. Each CSR is responsible for a different group of production lines or products. This eliminates the need to coordinate or synchronize the spreadsheets used by the CSRs. The consideration of material requirements often means that the CSRs can no longer act

independently because their different production lines or products use common raw materials. The material requirements portions of their spreadsheets must be synchronized to reflect the impact on shared raw materials. This synchronization is difficult to sustain. As a result, the different spreadsheets often contain significantly different views of material availability. The net result is that the business carries excess inventory so that it can function despite the inconsistent views of material availability.

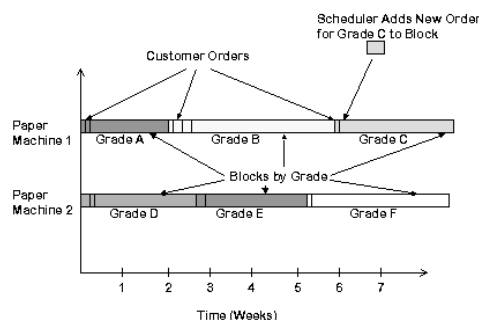
The drawback to checking for intermediates and raw materials on a bucketed basis is that the planning engine only sees the overall material balance for the time bucket. It cannot see any short-term material shortages and so cannot address the synchronization of material flows within a time period.

Inventory, Scheduled Production, and Current Production Schedules

Linking scheduling to order commitment allows analysis to be done in greater detail. Since scheduling views time in a continuous fashion, it considers sequencing of production activities and synchronization of material flows.

The paper and chemical industries have a history of tying order commitment to the scheduling of key pieces of production equipment. For instance, many paper companies have a process called Block Master Scheduling, illustrated below in Figure 2.

Figure 2. Block Master Scheduling



Master schedulers block out runs of different grades of paper on paper machines for weeks in advance. The subsequent stages of

production are handled by schedulers in the mills. Customer orders specify color and basis weight in addition to the desired grade of paper. When an order comes in, the master scheduler assigns it to the block with available capacity closest to the requested due date. Within a block, the orders are then sequenced by color and basis weight to ease transitions on the paper machines. The master schedulers adjust the size of the grade blocks in response to the orders they receive. There are similar processes in the chemical industry.

The current technology for committing from scheduling applications takes this process several steps further.

- It considers multiple stages of production instead of just one.
- It also considers raw materials and intermediate products.
- It is an automated process that responds to online queries from the CSRs.

Please note that the same catch phrases (ATP, AATP, CTP, etc.) used to describe commitment support from a planning engine are also used to describe commitment support from scheduling tools.

The commit process looks at inventory profiles over time as well as at the utilization of production equipment. This is illustrated in Figure 3.

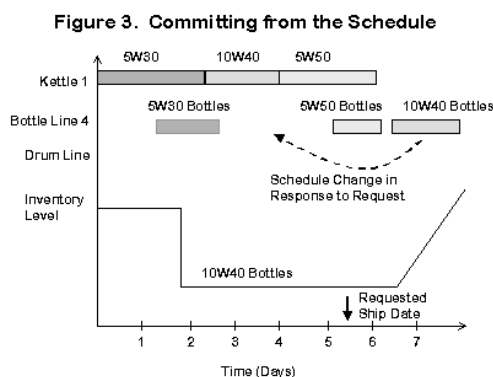


Figure 3 shows the production schedule and inventory profiles for part of a plant that blends and packages motor oil for cars. Kettle 1 makes batches of lubricant (5W30, 10W40, 5W50) that are packaged in plastic

bottles on Line 4, or in drums or other containers on the Drum Line. The inventory profile of 10W40 in bottles is also shown.

This business gets a request for a large quantity of 10W40 in bottles to ship within 5 days. Based on the existing production schedule, the bottles of 10W40 are not available until Day 7. However, there is enough unused capacity on Bottle Line 4 in Days 3 and 4 to meet the request if the 10W40 bottling run on Day 6 is moved to Day 3.

The next step is to check that enough plastic bottles and bulk (unpackaged) 10W40 are available on Day 3 to supply a bottling run on that date. If the bulk 10W40 is not available on Day 3, the process checks to see if there is enough capacity to blend the required amount of 10W40 on Days 1 and 2. It also checks to see if the ingredients required to make 10W40 are available. The process could work its way back across each stage of production and across each level in the Bill of Materials.

With a make-to-stock product, the commit process often finds that the required materials are available at some stage of production. With a make-to-order product, the commit process will actually create all of the activities required to fill the order, subject to raw material lead times and the availability of capacity.

Note that, in this example, the intent is to satisfy a new order without disturbing existing commitments. On the other hand, the business can prevent changes in schedule that are too expensive. For example, changing the sequence of production on the bottling line could increase production costs by creating a bad transition. The commit process may decide not to meet the order on the requested date if the cost of this transition is too high. The phrase Profitable to Promise (PTP) is sometimes applied to automated order commitment processes that consider the financial impact of an order.

Some businesses will change existing commitments if the changes are consistent with business priorities. Often, semiconductor companies have well defined priority structures for their customers and sacrifice sales to low priority customers in order to meet requests from high priority customers. Similarly, a business may cut production of a

low margin product and use the capacity to fill an additional request for a high margin product.

Inventory, Scheduled Production, Production Schedules, and Transportation

- As companies reduce finished goods inventory levels, manufacturing and distribution become more closely coupled. At the same time, customers want a quicker response. As a result, it is no longer safe for businesses shipping large volumes to assume that transport resources will be available when the product is ready to ship (unless the business is willing to incur the cost of keeping a buffer of transport resources on hand).

In response, companies have extended the commit process to consider transport resources. Some have extended their scheduling functions so that the scheduling tools can see the availability of transport resources and expected travel times. In addition to scheduling production, these tools also select the resource that fits best with customer priorities and schedules loadings based on the availability of leading spots and the requested delivery date.

Other companies follow a query to the planning or scheduling engine with a query to the Transportation Management System (TMS) and let that system confirm the ability to move product to the customer by the desired date.

Solution Components

The components used to provide support for the commit process fall into four different areas of functionality.

- CSR Interfaces
- Connectivity to Order Management
- Scripting Language
- Analysis Engine

The options available in these areas are briefly discussed below.

CSR Interfaces

The interfaces presented to the CSRs have evolved from static displays of planning or scheduling information to dynamic interactive query capabilities.

Static displays of planning and scheduling information occur in at least 3 different forms.

- Printed reports given to the CSR.
- Additional fields of data in the Order Management System (OMS) used by the CSRs.
- Planning or scheduling screens that the CSRs view.

Dynamic interfaces that allow interactions between the CSRs and planning and scheduling tools include the following.

- Planning or scheduling applications that the CSRs use. These include spreadsheets as well as more complex tools.
- Intermediate applications connected to both the planning/scheduling engines and the OMS. For example, one company built intermediate applications to act as a "CSR's Work Bench" using a relational database product. These applications downloaded current orders at the start of the day, let the CSRs issue queries to scheduling engines and view replies as orders came in during the day, recorded the orders accepted by the CSRs, and updated the OMS via batch transfers during the day. In other words, it was easier to build this intermediate application than to modify the OMS.
- Dialogs floating on the CSRs terminals let the CSRs issue queries to and view responses from planning/scheduling engines. The CSRs have these dialogs on their screens as they work with the OMS. While these dialogs create some redundant keyboard entry when the CSRs enter order information in both the dialog and the OMS, it does not require any changes to the OMS.
- Native screens in the OMS portion of ERP systems. If the ATP analysis in the ERP system says no to an order, then the requested order goes to a planning or

scheduling engine for further analysis. The order is accepted if the engine determines that it is feasible. The ERP system typically considers product availability defined by both the current inventory and the current production schedule. The planning or scheduling engine may make changes to the plan or schedule to make the order feasible. These changes occur in the background and are transparent to the CSR. Minor modifications of the ERP system may be needed to allow these dynamic interactions with the planning or scheduling engine.

Some businesses combine the roles of CSR and planner or scheduler, so the same person works with both the OMS and the planning/scheduling engine. However, combining these responsibilities is not feasible in a business with a large volume of customer orders.

The selection of a dynamic interface depends heavily on the ability to make changes to the ERP system. If modifications are difficult or expensive, then the intermediate application or the floating dialog is the preferred approach. Even when changes are feasible (in some cases only a single additional line of code is needed), some companies prefer not to modify their ERP applications.

Connectivity to Order Management

The nature of the link between the CSR and planning or scheduling depends heavily on the interface to the CSR.

For example, the static displays rely on batch updates. Then, the CSR gets a freshly printed report. A file transfer updates information in the OMS. The CSR gets access to a revised version of the plan or schedule.

The dynamic interfaces require network communications between the CSR interface and the planning or scheduling applications so the CSR interface and the planning or scheduling applications must have compatible capabilities to send and receive data. These communications can take place across a private WAN or intranet as well as the Internet. Vendors can use client server or messaging architectures to provide this connectivity.

Communication across a network is the fast part of the process. Well-designed queries and replies contain small volumes of information, and transmission times are measured in tenths of a second or less.

Scripting Language

The type of language defines the logic used for order commitment. It may be a programming language like C++ or a higher-level language like an expert system.

Ideally this language is flexible since this logic is application specific. Also, within an application, it may vary by product, customer, and level of demand. In addition to capacity and material availability, the commitment logic may consider customer priorities and product priorities or margins. The degrees of freedom in responding to potential shortages can include alternate operations, product substitutions, taking product from low priority customers, taking capacity from low margin products, changing sourcing in the distribution system, outside purchases, and a host of other options.

The amount of plan or schedule degradation, such as the increase in cost, that a business is willing to incur to accept an order will also vary.

There are two key concerns about the scripting language. The first is the tradeoff between ease of use and goodness of fit. Languages that are easiest to work will typically be more restrictive and less flexible. A product that only allows you to select from a predefined set of alternatives is easy to work with, but none of the alternatives may fit your business. Therefore, the benefits to business often depend on the ability to capture relevant issues in commitment logic.

The second concern is speed of execution, and this is determined by key aspects of design such as whether the underlying data structures are efficient and whether the language can be precompiled or interpreted when executed.

Analysis Engine

The analysis engine is the planning or scheduling application, or it can be derived from the planning or scheduling applications. High volumes of queries can be disruptive to

planners or schedulers if the queries are hitting the tool they are working with because the analytical capabilities used by the planner or scheduler are diverted by each query. The solution is to put an image of a planning/scheduling engine between the CSR and the tool actually used by the planner or scheduler. The planner/scheduler can then replay commits made by the image on demand to synchronize the tool with the current demand picture. The planner/scheduler can also update the image with plans or schedules that changed due to production upsets, unexpected material shortages, or quality problems.

Performance Issues

Performance issues are rarely related to the CSR interface or network connectivity. Performance is largely determined by the implementation of scripting language and the speed of the analysis engine. Speed of response will vary by vendor.

As mentioned previously, the speed of execution for the scripting language is largely determined by the design of the language, the efficiency of any predefined underlying data structures, and the ability to define data structures tailored to an application.

The speed of the analysis engine is important because queries against the same capacity and materials must be handled in a serial fashion. Distributing queries across multiple analysis engines requires preallocation of any shared capacity or materials.

It is usually faster to look up information than to “reoptimize.” If the analysis engine is based on a planning tool, it should provide the ability to first inspect the existing plan to see if adding the requested order will violate a constraint. If no constraints are violated, the order is accepted and the plan is updated. If the planning tool has to reoptimize the plan, it should not overwrite the entire problem definition. Instead, it should only add the new demand and then solve, starting with the previous solution. Problems that take hours to solve “from scratch” may solve in seconds or less with this type of incremental approach.

Analysis engines based on scheduling tools are more sensitive to the size of the application than are those based on planning

engines. This is because the scheduling tools work with individual activities rather than with summaries by time bucket. Performance also declines as the numbers of alternate routings, alternate operations and as product substitutions increase since these factors also increase the number of alternatives that the scheduling tool must consider. The speed of analysis with scheduling tools is largely determined by the design of the tool, both in the efficiency of the internal data structures and in the intelligence of the search techniques. The range of analysis may have to be limited to control the time required for analysis.

The technology currently exists, with both planning and scheduling engines, to do analysis of capacity and material issues around multiple stages of production in less than a second.

Future Extensions

Extensions of the commitment processes described above can support Vendor Managed Inventory (VMI) programs or bid-based interactions across the Internet. Extension of the commitment logic used to evaluate requested orders can respond to changes in the customer's demand forecasts, production schedules, or inventory position. In VMI programs, the supplier assumes responsibility for ensuring that adequate inventories of products are always on hand at the customer's locations. VMI reduces the effort the customer expends on managing inventories and is another example of differentiating your products from those of your competitors by offering a higher level of associated services. VMI also gives the supplier better visibility into customer requirements, which translates into more efficient use of manufacturing and transport resources by the supplier.

The commitment logic can also support bid-based interactions across the Internet with business partners. For example, a company distributes requirements to qualified vendors via the Internet and asks for bids. The vendors develop bids and respond, again via the Internet. The purchaser evaluates the bids and accepts, rejects, or proposes revisions. Currently, this is happening between companies that provide or assemble electrical and mechanical components. For

such a system to work, the supporting tools must consider financial measures such as costs and margins in their analysis.

What This Means to You

The most cost-effective approach to supporting order commitment in a business depends on a host of factors, including:

- manufacturing and distribution lead times
- sources and amount of variability
- sensitivity to sequence dependent issues
- data quality and availability

A variety of configurations have been successful in meeting the varied needs of different businesses. Companies have attained high levels of customer service by supporting order commitment from planning as well as scheduling, using either batch or online connectivity to order management.

The fundamental requirement is a planning or scheduling engine. The table below indicates how the previously listed factors would drive a business towards using planning or scheduling to support order commitment. Longer lead times, higher variability, or data quality issues suggest committing off

planning. Short lead times, moderate to low variability, good data, or significant cost sensitivity to sequence dependent issues suggest supporting order commitment with scheduling.

Considerations	Support CSRs from Scheduling	Support CSRs from Planning
Lead Times	Short	Long
Variability	Low	High
Data quality	Good	Poor
Sensitivity to sequencing	High	Low

The most important lesson is that improvement of order commitment is an evolutionary process. The leading-edge companies migrated through different levels of order support. As they implemented APS technology, improved data quality, and took advantage of improved computer performance, their support for order commitment became more responsive and more accurate.

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