SyteLine (CloudSuite Industrial)

Advanced Planning and Scheduling

Executive Brief

LOGICDATA®

Precision Engineered ERP Implementation

MRP and Advanced Planning and Scheduling

The term Advanced Planning & Scheduling (APS) has been applied to a category of software that performs the planning function within a manufacturing management application suite and is the next generation of planning after Material Requirements Planning (MRP) and Manufacturing Resources Planning (MRP II).

APS represents a fundamental departure from traditional planning methods in that it plans both material AND capacity requirements simultaneously. The present commonly accepted method of planning in most manufacturing plants around the world is Material Requirements Planning (MRP), which provides limited tools for management of the supply chain.

Early inventory replenishment was based on some form of order point, in which material was ordered to replace what had been used. These simple methods were adequate in simpler times when excess inventory was tolerated and even thought to be a positive, as it appeared as an asset on the company financials. Computerized inventory and order point systems did not change the approach and offered only marginal improvement.

During the 1960s, MRP changed the entire approach***. It improved planning and scheduling by tying acquisition of materials directly to customer orders and forecasts.*** By looking forward to expected need rather than replacing past usage, MRP was able to lower inventory and reduce shortages at the same time - a real breakthrough.

MRP was the first technique devised to help manufacturers plan for the future, rather than react to the past by applying new algorithms, or calculations, to the materials replenishment problem. Thus, it was a major advancement and so successful that it became the definitive manufacturing planning methodology through the 1980s and into the 21st century.

Still, there has been some measure of dissatisfaction with MRP through that time. While a large number of companies have been able to apply MRP and successfully manage inventories and schedules, others have found its logic limited and ineffective for their fast-changing businesses. Yet a number of attempts to supplant MRP have failed because none was able to provide even the limited applicability and effectiveness of MRP. Imperfect as it was, it was still the best solution available.

APS systems are now changing conventional wisdom and even manufacturing practices. They are evolving the planning function in many significant ways.

- **APS plans materials and capacity simultaneously.**
  A major shortcoming of MRP is that it plans material first, while assuming that plant and resource capacity will always be available (the “Infinite Loading” assumption). Separate scheduling and capacity planning programs must be executed after the material plan. Because material planning and resource planning run serially – in a linear progression – any interaction or potential conflict is ignored. As a result, material planning can cause capacity problems which, when resolved, can invalidate the material plan, thereby necessitating that MRP be calculated

again, after the scheduling and capacity algorithms have created their plans. Thus, a circular logic is created and has euphemistically been referred to as "Closed Loop MRP".

- ***APS is fast***.
  An MRP "run" (recalculation) can take several hours to complete. Even with today's more powerful processors, it is rare to find an MRP generation that is finished in less than two hours. In contrast, APS runs are frequently measured in minutes and sometimes in seconds.
- ***APS removes unrealistic planning assumptions.***
  Because capacity is not considered during the material planning process of traditional MRP, lead time is assumed to be fixed and definable. Lead times are not fixed, they vary with load, product mix, resource availability changes and other factors. And because lead times vary widely, they cannot be predetermined and still generate a dynamic, accurate schedule. In contrast, APS systems match reality because they accommodate flexible lead times. They determine lead times on-the-fly by scheduling each production activity during the planning process, moving the activity in or out based on the *actual* availability of the needed resources.
- ***APS applies advanced logic.***
  The MRP process is very straightforward, mathematically simplistic and logical: multiply, subtract, apply lot size rules and use a bit of date calculation. APS systems apply rules-based logic, optimization, heuristics, artificial intelligence and other modern-day methodologies to resolve order conflicts and apply "reasoning" to resolve a problem using an array of options, much like a human being will consider many alternatives before deciding on the "best" solution. The resulting plan offers a realistic and holistic view of the dynamics of the plant floor and how they can be exploited to achieve the desired results.

Why is this significant? APS provides speed, accuracy and ultimately superior customer service. APS grants the ability to schedule an order or potential demand on-the-spot. For the first time, manufacturers have a real-time decision support tool that makes it possible to quote shipment dates confidently based on a thorough analysis of the current situation – the availability of real resources (people, machines, uncommitted capacity, available inventory, open purchase orders and material lead times) and the demands of other orders and commitments. The ship date is not a guess arrived at using questionable assumptions. It is real, calculated using a realistic model of the plant, its resources and its other demands. Bottom line: APS enables manufacturers to commit now. The customer can be given a real and realistic ship date immediately. Furthermore, since the original promise date is based on an accurate assessment of all pertinent factors, it is very likely that the product will ship as promised – allowing manufacturers to deliver on time.

MRP's limitations are a product of the early Information Age; computer technology was not sufficient to handle any more than what MRP presented to it at the time. Even MRP's simplistic approach taxed the computers of its day with the regeneration of a plan often taking 20 to 30 hours to complete.

But times have changed, and technology has advanced spectacularly. There is more computing power in the average laptop PC than could be had for millions of dollars in 1975. The desktop computers and servers of today offer computational speed and memory capacity that was almost unimaginable ten years ago. The ready availability of such tremendous power opens the door to a world of computing possibilities.

The sophistication of mathematical models and algorithms has also grown, taking advantage of expanded computer resources. Match technical and mathematical advances with the development of

new management theories and approaches and the stage is set for a new generation of business planning – Advanced Planning Systems.

What is APS?

Fundamentally, APS represents a radical change in the way material and resource planning is executed in a manufacturing company. Traditional planning, MRP, is a step-by-step sequential process. Material is planned without regard to capacity constraints, then the capacity plan is devised and matched to the materials plan. But the process is often not as streamlined as the designers intended. The MRP sequence encompasses multiple steps (Fig 1).

1. Enter Customer Demand – consolidating similar demand requirements.
2. Create a Master Production Schedule (MPS) – develop a first-cut production schedule.
3. Create a Rough Cut Capacity Plan (RCCP) – test the production schedule for feasibility against available plan capacity prior to gauging the materials available.
4. Validate – determine whether or not the RCCP plan is feasible and start over again if capacity is in question. Make adjustments, retest the production schedule and rough capacity plan, and evaluate feasibility.
5. Create a Material Requirements Plan – once a realistic schedule and rough capacity plan are finally derived, create a detailed materials plan to determine the feasibility for all levels of the Bill of Materials (BOM) for ALL demands. MRP examines all demands looking at each level of their BOMs in aggregate and netting together similar requirements.
6. Create a detailed planned schedule for the manufactured goods required in the material plan.
7. Create a Capacity Requirements Plan (CRP) – once the materials plan is developed and scheduled, develop the capacity plan.
8. Validate – check once again for feasibility and adjust as necessary if material and capacity plans are inadequate; start over again at the beginning with the Master Production Schedule; make adjustments, retest, and if entire process is finally acceptable…
9. Create the Final Production Plan.

MRP, as you can see, is a top-down, single-direction, sequential process involving many potential restarts prior to resolving the final plan. During this often lengthy process, adjustments made to accommodate capacity problems may cause material problems and vice-versa. It is sometimes necessary to cycle through this process several times before a complete, balanced plan results. Time and resource limitations often leave the planning process incomplete or not fully resolved.

Before APS – One Week
Planning and scheduling required a lengthy, circular combination of starts, tests and restarts.

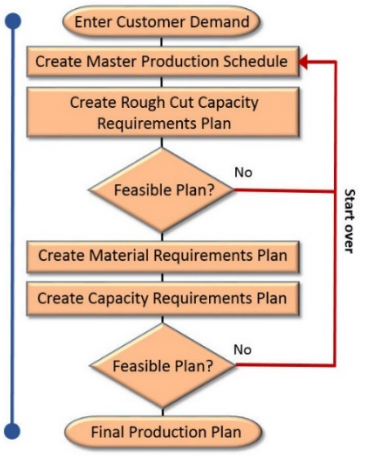

Figure 1

APS, by contrast, plans all material and capacity resources at the same time. Each individual demand is planned in priority sequence down through its corresponding BOM and the routing steps required, reserving materials and capacity throughout. This allows you to plan a *single* demand without having to re-plan all demand.

Stated in the same terms as the previous MRP example, the APS process is designed as follows (Fig 2).

1. Enter New Customer Demand – capture demand information and define the resources, constraints and priorities (rules).
2. Create the Final Production Plan for that demand – generate a realistic, fully synchronized production, material and capacity plan by simultaneously calculating material requirements, testing resource availability and gauging capacity resources.

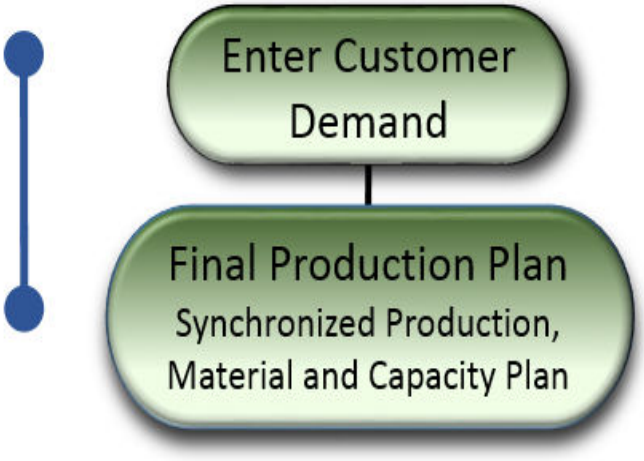

Figure 2

With APS – One Minute
A generation apart from MRP, Advanced Planning and Scheduling permits one-step planning with all the previous MRP steps conducted simultaneously and transparently.

APS uses Finite Capacity or constraint-based approach, meaning the plan will not overcommit finite manufacturing resources beyond available capacity. Because resources are planned at the same time as materials, there is no need to make unjustified assumptions about resource availability. Each activity is fully planned and coordinated with other demands on work centers, people, machines, etc. to generate schedules that are based on reality, not based on fixed lead time estimates and cavalier assumptions about resource availability. Flexible, not static, data is used to build the plan.

APS is fast. Exploiting recent advanced in computer technology, the APS planning cycle for a new demand is typically carried out immediately – and measured in minutes or even seconds – as opposed to being generated slowly and after business hours or over the weekend. A full regeneration of the APS plan across all orders typically takes from 10 to 30 minutes. The significance of this point is that planning now becomes a decision support tool, not simply a reporting tool. Resource availability questions can be answered, alternatives immediately explored, and the impact of disruptions – and your proposed solutions – can be identified without delay.

Companies utilizing APS are recognizing that whatever it takes manufacturing can be accomplished without increased manpower or inventory growth. Many are drastically reducing inventory and manpower and improving business metrics. APS can make whatever it takes a very profitable and competitive strategy.

Predicting the Future

Curiously, MRP only provides backward planning, meaning it looks at the due date of a demand and plans production and materials that would be needed earlier than that date. The result is that MRP will give you recommended actions *in the past*, such as release this purchase order *last week* in order to meet the due date of a customer order tomorrow.

In contrast, Advanced Planning and Scheduling plans backward *and forward*. If APS sees the Purchase Order should have been released last week, it switches to forward planning and assumes you will release the PO today. It then *predicts* for you the customer order due tomorrow will be seven days late.

So, the result? MRP doesn't warn you that you will miss your due dates; it just gives you unusable action messages that you should have released a PO in the past. APS will warn you that a future order will miss its deadline and will tell you what the constraint is that is causing the delay.

The Power to Commit

Companies that benefit the most from APS technology are those facing intense competition, particularly where customers demand short lead times and plant capacity is a constraint. These situations and challenges offer particularly good environments for Advanced Planning and Scheduling:

- Dynamic environment: lots of customer orders, many with short lead times; constant changing of the plant schedule to accommodate fluctuating customer demand
- Rapid response build-to-order or configure-to-order situations
- Capital intensive industries, in which idle machinery and equipment can be costly
- Situations in which one or a few critical resources control plant throughput – and all plant schedules must be coordinated around these constraining resources
- Continuous run manufacturing where run sequence is important (changeover time varies depending on which product is run before and after the change)
- "Campaign" production situations where products are grouped to run together according to a predetermined constraint (i.e., all red items run on Tuesday, five gallon cans are filled only on Friday)

In conclusion, when a manufacturing company's planning and execution are in sync using Advanced Planning and Scheduling, the resultant increase in business efficiency, custom retention, sales revenue and long-run profitability is virtually guaranteed.

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With acknowledgement to David Turbide

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