

Planning and scheduling in the 21st century

How Infor Advanced Planning and Scheduling systems deliver a lean and agile environment for today's manufacturers.



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Executive summary

For many manufacturers the demands of meeting rising customer expectations and lowering production costs in an environment of more products, more complexity and more choice is placing great stress on the effectiveness of their planning and scheduling processes.

Organizations have already adopted ERP solutions with varying degrees of planning and scheduling capabilities. Yet, operations executives acknowledge that these same systems are becoming outdated, lacking the speed, flexibility and responsiveness to manage their increasingly complex production environments.

They know too that as the business grows its operations, expands its product range and adopts a global manufacturing supply chain – they must seek alternatives to the current ways of doing things if they are to remain competitive and responsive to customer needs.

But to what extent can technology make a difference? And what choices do business executives have? Should they be taking the latest upgrade from their ERP system or are there benefits in “best of breed” planning and scheduling technologies? Are there differences if the manufacturing operation bakes cookies or builds the ovens that the cookies are baked in? And how does it all fit in with the drive to be demand-driven and lean?

In this paper, Infor examines planning and scheduling options for boosting the productivity of manufacturing plants, how solutions vary according to manufacturing style and some of the additional benefits that come with advanced applications – such as more accurate order promising and more effective ‘what-if’ scenario planning.

The origins of production planning and scheduling

Traditional planning and scheduling systems originated in the 1960s with the advent of Material Requirements Planning (MRP) which evolved into Manufacturing Resource Planning (MRP II) and finally into Enterprise Resource Planning (ERP), where a financial component was introduced.

In those days the demands placed on manufacturers were very different from today. The principle objective of planning was to synchronize all levels of production backwards from the customer due date, aligning all work orders according to date order and providing a target date for bought-in purchased parts. The primary inputs to the planning process were bills of material, bills of routing orders, inventory and work-in-process.

With these planning and scheduling capabilities built into ERP systems, manufacturers were able to meet business demands as they were at the time. Since then, ERP systems have been refined, but they are still based on the same concepts and iterative processes as they once were. The planning engine in an ERP system is essentially the same today as it was in the 1970s.

In an ERP system, a Master Production Schedule (MPS) is used to establish a plan for the factory, balancing off sales demand (orders, forecasts or some combination of the two) with inventory and planned supply. The resulting MPS plan becomes the input for the MRP calculation which explodes through all bills of material to synchronize manufacturing and purchased orders to the master plan. It is a proven and efficient process and has led to many documented benefits for manufacturers worldwide.

Since the MRP calculation assumes infinite production capacity, additional capabilities have been added into the planning process including Rough Cut Capacity Planning (RCCP) and Capacity Requirements Planning (CRP). While it added something to the planning process, traditional CRP is a bit of a blunt instrument. The results tell the production manager whether the factory is over-capacity, even to the point of which work centers and work orders are causing the problem. But it is left to the production planners to juggle orders around to solve the problem and there are few, if any, 'what-if' scenario capabilities.

Comparative costs of alternative plans are never considered and the calculations ignore other things that limit capacity such as labor skills, preferred production sequences, start-up and shut-down losses and industry-specific scheduling problems such as shelf-life. However, among the primary deficiencies of traditional ERP planning is the iterative nature demanded by the process and the time taken to make adjustments in the face of change.

The planning processes of MPS, RCCP, MRP and CRP are all separate, sequential and iterative. It is a time-consuming task to investigate capacity shortfalls, make changes – often manually – and then repeat all the processes to re-check feasibility. Fundamentally, the systems identify problem areas rather than solving the problems for you. Overlay the frequency with which new orders are introduced into the plan and it is easy to see why yesterday's reactive planning methods are no longer sufficient for today's dynamic supply chain challenges.

Planning and scheduling in the 21st century

The planning and scheduling functionality of years past no longer provides the responsiveness and agility businesses need in order to prevail in today's competitive, demand-driven environment.

Today manufacturers must contend with globalization and meet steadily increasing customer demands for more choice, lower prices, faster delivery and higher quality. A typical production environment must now contend with increasing levels of product variation, faster new product introductions, shorter production runs, longer supply lines, and it must be prepared to work collaboratively with customers, suppliers and co-manufacturers.

Manufacturers are responding by moving increasingly to demand-driven production strategies, employing a number of techniques to more closely align supply with customer demand, with techniques that vary according to the industry. These include make-to-order, configure-to-order, collaborative demand planning and other demand sensing methods.

As the world of manufacturing has moved on, new manufacturing concepts such as lean manufacturing, six sigma, just-in-time, theory of constraints, agile manufacturing and demand-driven supply networks have arisen.

A "lean" manufacturing strategy is favored by many executives who see simplifying their manufacturing as the best response to changing customer requirements. The simplification brought about by "going lean" usually changes the requirements for planning and scheduling, but even the leanest operations still need to plan ahead and schedule production resources and associated activities.

So what new planning processes, techniques and technologies are employed to support modern manufacturing planning?

Advanced Planning and Scheduling Systems (APS)

To overcome the limitations of traditional MRP II planning engines and to support a more agile responsive production environment a new breed of planning and scheduling techniques have emerged known collectively as Advanced Planning and Scheduling Systems (APS).

APS works differently to MRP. It still uses orders, inventory and bills of material but recognizes the importance of capacity in the planning process from first principles. There is no point in recommending a plan which is known to be infeasible, due to capacity or known material constraints. Most APS are 'constrained-capacity planning systems', meaning that they recognize the limitations of machine and labor capacity and plan within these constraints to meet customer demand. This means a more realistic and achievable plan from the first planning run.

The massive increases in affordable computing power that came in parallel with the evolution of APS mean that much more sophisticated algorithms can be used in determining the optimal plan and can do so in a single planning run, without the multiple iterations of former solutions. This effectively compresses the RCCP, MRP and CRP to a single pass.

Amongst the criteria that an APS will address in determining the optimal production schedule is:

- Capacity of machines and labor
- Labor skills – if only a few resources can operate a particular machine the systems will recognize this as a capacity limitation
- Special tools
- Material availability – if delivered materials are known to be due on a certain date, there is no point in planning production as if the materials would be available – which is what most systems do.
- Production sequence – APS can recognize the optimal sequence of production (eg: “light-to-dark” or “can size”) which will minimize lost time due to change-over’s and clean-downs. This capability alone can boost productivity by as much as 25% without any investment in new equipment.

Lean, agile and responsive

The differences in APS planning to traditional ERP planning stretches beyond the mathematical wizardry captured in the algorithms. Their real power is in new and different approaches to planning which are better aligned to meet today's production challenges.

Minute-by-Minute: ERP systems of the past operated in daily buckets and lead-times on materials were expressed in days. As long as purchase orders were delivered on the expected date it was considered 'on-time'. Today's APS systems are much more granular. Everything from dispatch orders to production schedules to purchase orders is scheduled to the minute to encourage and support the concepts of lean manufacturing.

Backward and Forward Scheduling: Traditional ERP always approached plans from a customer date order and worked backwards from that date. The variability of lead-times almost inevitably resulted in a high proportion of "past-due" orders and unrealistic system requests to deliver goods "last week" in order to meet planned schedules. APS systems combine back-scheduling with forward scheduling, recognizing that if you need to start today – when is the earliest the product will be available to ship, recognizing capacity constraints. These additional techniques provide enormous benefit for accurate order promising.

Visibility of Orders: APS systems know the critical path of each and every order in the system. If there is a fixed relationship between a customer order and a production process as in a 'make-to-order' environment, that order progress can be constantly monitored and the customers can be kept informed.

Capable-to-Promise: Many ERP systems have an available-to-promise capability where unreserved stock can be promised and allocated to customer orders. However, where there is no stock or planned production, how do you give a realistic promise date to customers? APS systems are able to examine the whole supply plan including any gaps in capacity and realistically assess the completion date of a new customer order added into the system. This is a huge customer service advantage to companies who compete on product availability and reliability of delivery.

Multi-Site Planning: Many organizations comprise multiple factories in their total supply chain. Often, these need to be planned together particularly where product is part-produced in one factory then shipped to another for finishing or packing. APS solutions recognize the interdependencies of product moving between manufacturing locations including transfer times and accommodate this in their planning logic.

Cost Optimization: Since one of the objectives of an operations executive is to deliver outstanding customer service at a minimal production cost, it is often a surprise how limiting are the capabilities of many ERP systems to adequately cost a production plan, or to answer the question “is there a more cost efficient way of achieving the plan?” There are always multiple ways in which a given set of customer orders can be achieved and it is usually left to the skill of the Planner to choose the best way for the factory. Modern APS can incorporate costs of all the alternative routes to complete production. Which plant? What machine? Should I use over-time? And provide the planner with the least-cost plan. Sometimes, this involves millions of permutations – but this presents little trouble to the computing power available in today’s desktops.

Scenario Planning: Production planning and scheduling is no longer a static exercise undertaken at the start of the week and frozen until the next planning run. New customer orders are taken daily, forecasts are re-assessed as new trends detected. New products or product variations are launched every week. Today’s planners need to offer a responsive service to people inside and outside the organization and answer the questions that start “What-if we?” or “Can we?” The immense speed and flexibility of a modern APS are able to answer these questions often in minutes and provide the responsiveness to change that today’s business climate demands.

Industry differences matter

When it comes to the planning and scheduling challenges faced by today's manufacturers, industry differences play an enormous part in the techniques and technologies used.

Industrial equipment manufacturers are characterized by complex manufacturing, long production lead-times, batch-sizes of one and operate in a make-to-order or configure-to-order environment. Here, the production challenges start with accurate order promising and include all the aforementioned issues of capacity management in a high capital-intensive business. Utilization of plant and equipment is a critical aspect of production planning as is the synchronization of multiple production operations to complete the finished product.

Consumer products manufacturers on the other hand are typically dealing with faster moving, repeatable products. Products are sold from stock and the customer expectation is 'always available'. In such environments, effective planning may need to consider stock-build programs, whether to make-or-buy and how to manage a large and variable product range. Labor costs and utilization often take on larger importance in these environments and the APS needs the flexibility to assess all areas of capacity utilization in the optimal plan.

Food & beverage producers occupy a place at the sharp end of production. Fresh foods in particular deny the manufacturer the opportunity to stock while consumer choice also precludes the use of a make-to-order strategy. In these organizations, production based on forecast is rapidly changed to align with retailer orders when received – often hours before dispatch is due – and consideration in the planning process is given to available shelf-life of the product or bulk ingredients.

And some industries are just not well served by MRP logic at all, namely those whose production processes can best be described as 'dis-assembly' – for example; meat and poultry producers that deliver multiple products from a single raw material. Such planning processes are poorly served by MRP logic, having an inverted bill-of-material and high incidence of by-product and re-cycled product. These industries were among the first to embrace APS engines for their ability to offer a different type of planning engine.

Similar industry characteristics are found in dairy producers, seasonal crop products, chemicals and pharmaceutical preparations – essentially anything that mixes, cooks, brews, blends reacts or distills as opposed to assembling components to make a finished product.

The examples above are just a few of the wide spectrum of production environments that distinguish one industry from another and it should therefore be of no surprise that there is no single APS that spans all these environments. In fact, one would have to wonder what compromises had been made if a system was generic as to span not just the peculiarities of these environments, but the very approach to planning and scheduling techniques employed here.

Summary: Comparison of ERP and APS capabilities

ERP Planning	Advanced Planning & Scheduling (APS)
Separate, iterative planning processes for MPS, RCCP, MRP, CRP	Single, holistic planning run in a single pass - faster
Planning assumes infinite production capacity	APS uses capacity as a known limitation and plans accordingly
Planning assumes materials will be delivered on time	APS can operate to constrain production plan based on material availability
Plan assumes production on “primary” work center or machine only	APS will use all permitted alternatives of how a product can be made and select the ones which optimize overall use of plant capacity
ERP can “cost” a plan – but can’t suggest the lowest cost plan	APS can use the costs of alternative production methods to recommend a cost-optimal plan
Single site planning	Multi-site, enterprise-wide planning
Identifies problem areas and highlights them for users to solve	Solves planning issues by recognizing capacity and material constraints
Supports “available-to-promise” from known stock and planned production	Supports “capable-to-promise” to support accurate order promising
Limited or no scenario planning	Full support of what-if scenario modeling and rapid solve times makes this an accepted practice
Limited to planning only the production areas where the ERP system is installed	APS solutions can connect to multiple systems inside and outside the organization for global planning
No industry specific differences in planning processes	Infor APS solutions dedicated to the industries for which they were designed

Infor's vision for planning and scheduling

As a long-time leader in enterprise software solutions for manufacturers, Infor has deep insight into how planning and scheduling functionality has evolved over time and a vision for what companies need today and in the future.

Building on an impressive track record in delivering solutions required in a wide variety of manufacturing scenarios, Infor offers state-of-the-art ERP solutions and complimentary APS applications to provide customers with that next stage of production responsiveness when their business demands it.

Infor's APS solutions are dedicated to the industries for which they were designed and do not compromise their deep business and industry capabilities by trying to be "all things to all people."

Within the portfolio, customers will find solutions that schedule liquids in tanks, shelf-life, re-cycles and split batch optimization, essential for food, beverage, chemical and pharmaceutical companies.

Equally, there are dedicated solutions that offer available-to-promise, capable-to-promise, critical path analysis and multi-factory planning to support the needs of complex engineering or assembly led industries.

The strength of the Infor solution portfolio is validated by implementations at many of the world's leading manufacturing companies and is recognized by Industry Analysts as providing world class leading solutions.

Infor customers reap the rewards of these solutions in ways which deliver real value to the business:

- Boosting manufacturing productivity and capacity utilization by between 10-40%
- Reducing work-in-process by up to 20%
- Minimizing finished goods inventory by up to 40%
- Improving on-time delivery performance by up to 25%

About Infor

Infor delivers business-specific software to enterprising organizations. With experience built in, Infor's solutions enable businesses of all sizes to be more enterprising and adapt to the rapid changes of a global marketplace. With more than 70,000 customers, Infor is changing what businesses expect from an enterprise software provider. For additional information, visit www.infor.com.

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