MRP vs. APS
If You Don’t Have a Time Machine, You Probably Need APS!

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In this article we will look at Advanced Planning & Scheduling (APS) logic and contrast it with Material Requirements Planning (MRP). We are going to discuss the planning logic - how APS actually "thinks". If you need capacity planning, we will look at how that is set up, defined, and used as part of the overall system set-up. We will also cover the keys to success - management actions that are required to make an APS implementation successful.

Contrasting APS and MRP

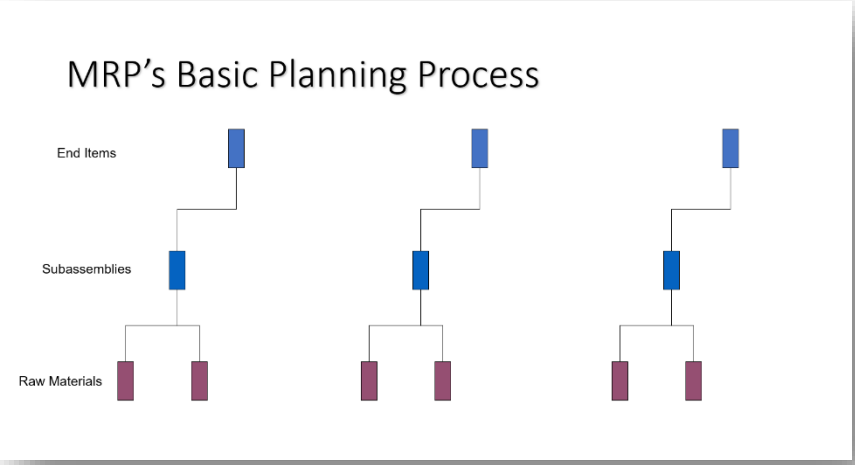
First, what is MRP? This is the definition from the APICS dictionary:

"A set of techniques that uses Bill of Material data, inventory data, and the

master production schedule to calculate requirements for materials."

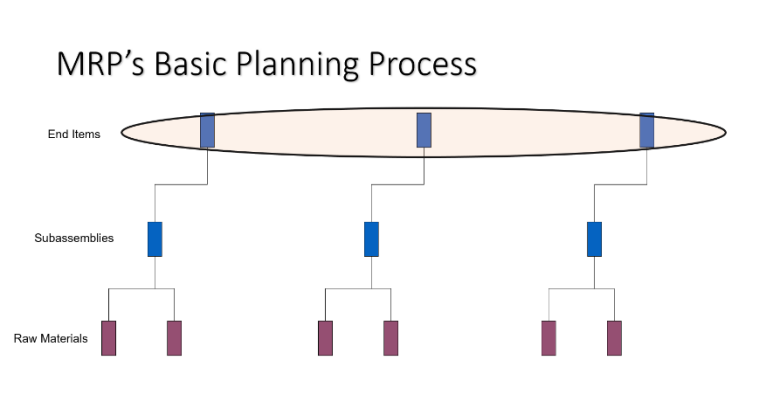
MRP was developed in the late 1950's and early 1960's to help plan inventory replenishments to satisfy customer demand.

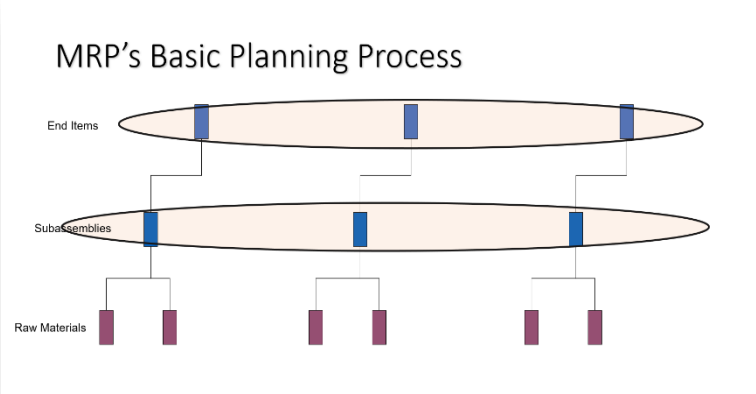
MRP has a very basic, simple algorithm. Below is a series of diagrams that will give you a sense of what we mean by that.



The above diagram depicts three customer orders, or three "End Items". Each End Item has a different due date. Each one also has an indented Bill of Material and a routing.

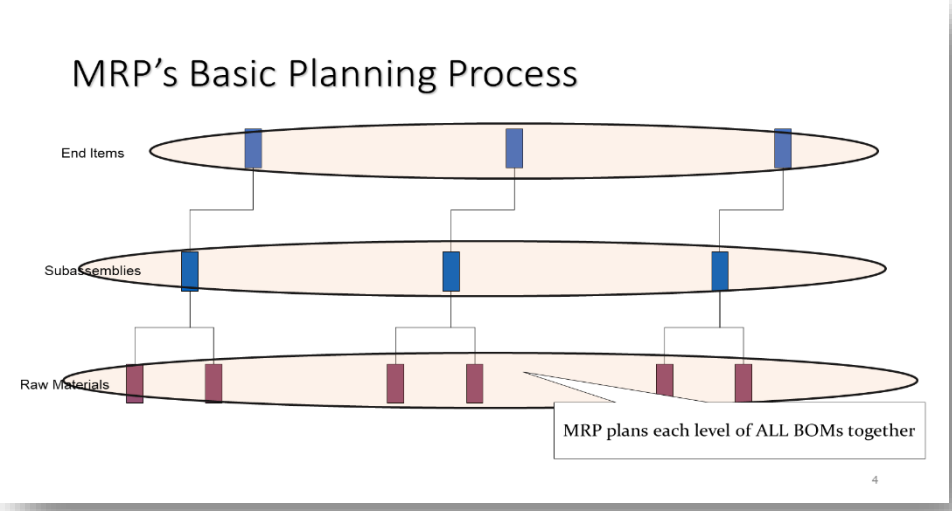
When MRP looks at these demands it starts at the top-most level and nets together all the similar requirements to figure out what it needs to build or buy at this top level.





Then, MRP blows down into the second tier of the Bill of Material based on the requirements of the first tier, and again, nets similar requirements together.

This carries on to the lowest level.



MRP's planning goes level-by-level across all items of your Bill of Material.

It seems simple! But what is wrong with this picture?

MRP has some fundamental flaws – some things it just cannot do because it has limited logic.

Firstly, MRP will ofttimes tell you that you should have done something in the past. It may recommend a purchase order that should have been released last week; or a job that should have been put out on the floor for manufacturing last month.

Second, MRP does not consider the capacity of your plant. So MRP's planning assumes infinite capacity. In other words, MRP assumes you have all the machines and people available to do the jobs based on the routings you've defined.

Third, if you have constraints and something really cannot be done, MRP won't be able to predict when it can be done in the future. If you have a glitch in your supply chain such as purchase orders coming in late or a machine going down, that means that the order associated with that event is going to be late. However, MRP does not have the logic to tell you that your order will be late, much less tell you how late it will be.

So, the basic difficulties with MRP are:

- MRP provides action items in the past.
- MRP ignores capacity.
- MRP will not tell you when you can get it done.
- MRP will not tell you when you will be late.

So, what is APS and how is this different? Here is a nice quote from Maryland Vanek,

"APS is a new revolutionary step in enterprise and inter-enterprise planning. It is revolutionary due to the technology and because APS utilizes planning and scheduling techniques that consider a wide range of constraints to produce an optimized plan."

This is a very nice statement about APS. It says APS is a powerful system and it will do a lot for you. But let's take a look at what makes this truly possible.

Keep in mind that APS is a replacement for MRP. You don't run MRP and APS concurrently. There are some MRP systems out there that call themselves APS, but they are not a true APS environment.

APS was initially developed in the 1990's. At that point in time, it took very powerful and expensive computers to run an APS environment. Now that we have much more advanced technology, we can even run APS on a desktop computer. Computers have gotten more powerful and less expensive.

Rather than netting level-by-level like MRP does, APS plans the replenishment of each demand individually. It looks at each customer order, each forecast, each supply chain transfer one-by-one and plans and prioritizes the fulfillment of that demand individually.

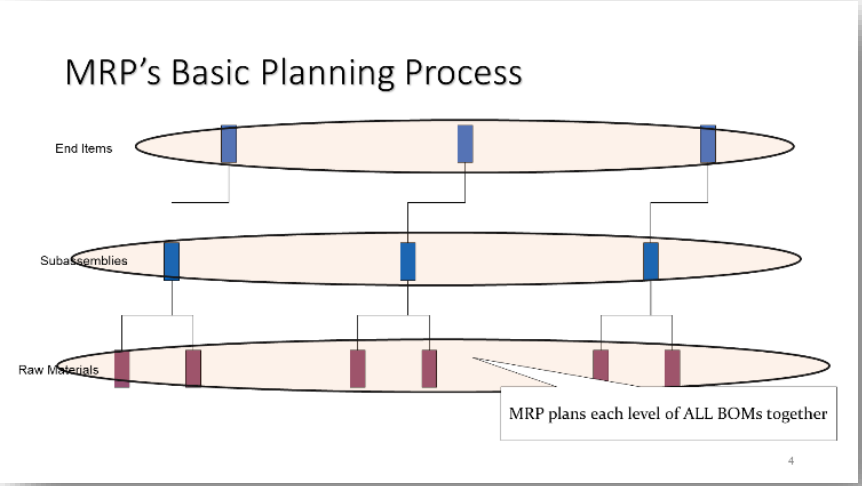
Simultaneously, APS can look at your actual capacities and constrain the plan based on your available resources. In doing so, APS can tell you how much capacity is required to meet your

plan and show you any bottlenecks that are preventing demands from being met in a timely fashion.

It then projects when that requirement can be replenished. This enables it to tell you that this customer order, which the customer wants you to ship on Wednesday, can't really ship until Friday based on material constraints or shop floor resource constraints. This allows you to plan for when each order can be delivered and what needs to be done to deliver on time.

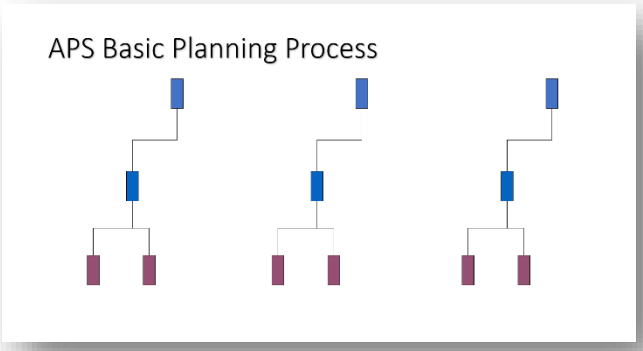
APS reserves the inventory, the purchase order supply, the jobs on the floor, the machines, and the people necessary to do the work and locks them in against that promise.

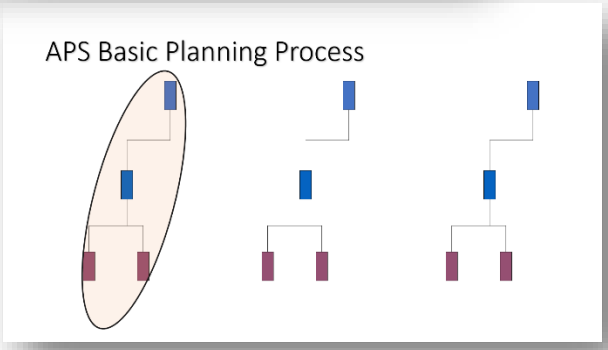
This gives you the confidence that when you tell the customer you can ship an item on a given date, you really can.

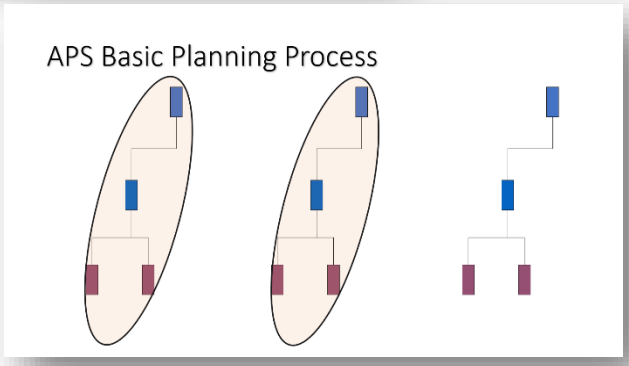


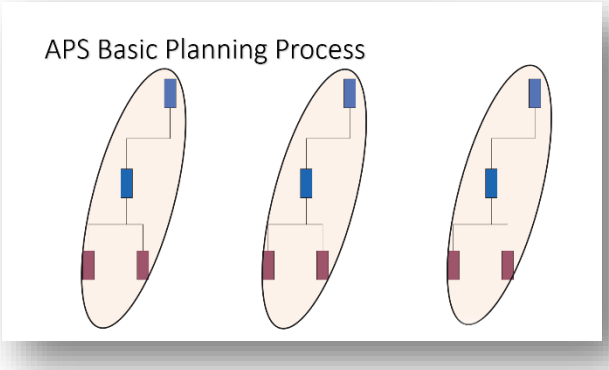
So back to our simple diagram - how is this different from MRP? If you recall, MRP took the three top-level requirements and planned them all together. Then it went down level by level.

APS on the other hand looks at the earliest, most important requirement based on the priorities you established, then crawls down its routing and Bill of Material, ascertains where the materials are going to come from, what equipment and people are required, and locks that in before it moves on to the next priority demand.

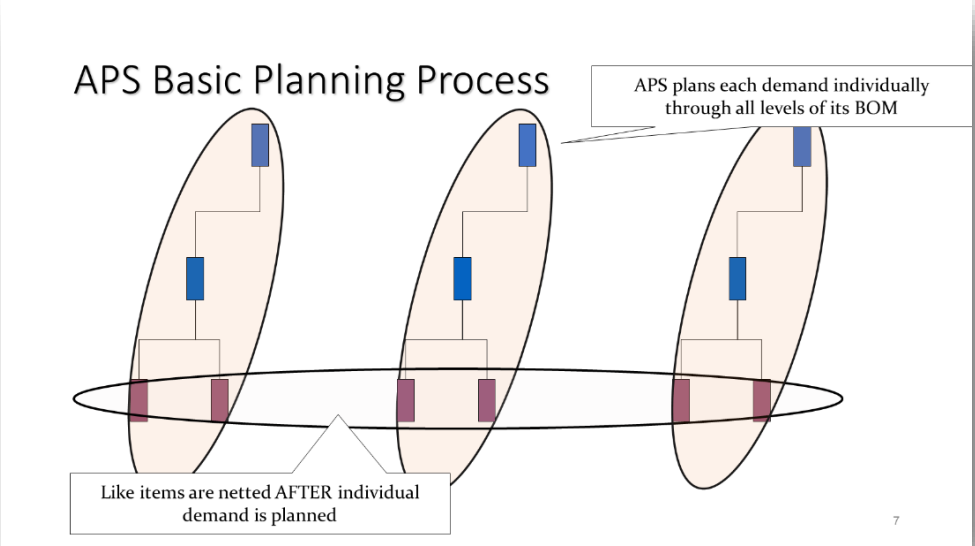






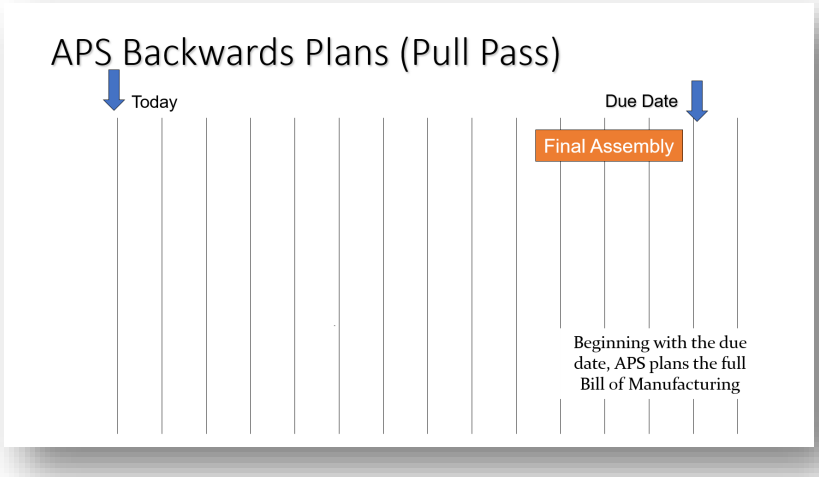


It moves across all the demands, one by one, in priority order, calculating each demand through all the levels of the BOM's. When it's done, it then nets together similar requirements for efficiency purposes. So, you might get one purchase order for a common component across all three demands.



How APS "Thinks"

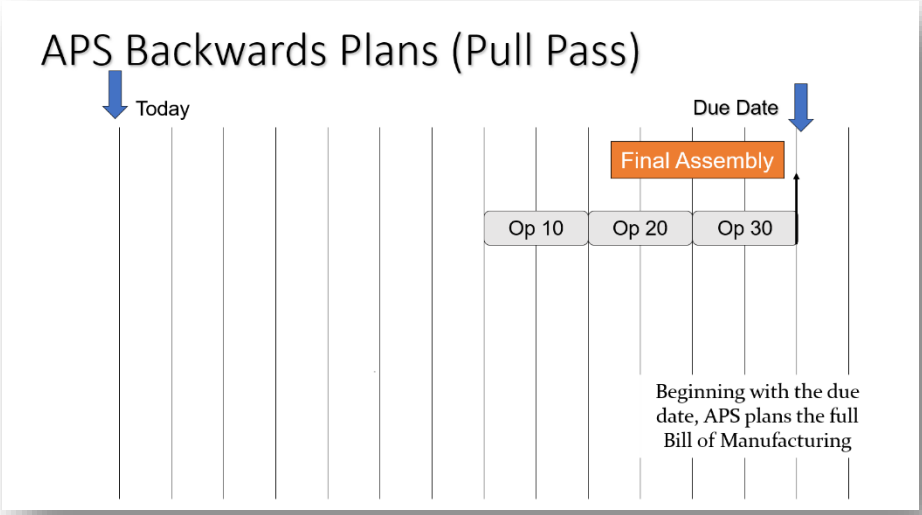
Let's look at some examples of how APS actually "thinks". We have a customer order that was placed with a future due date, as shown below.



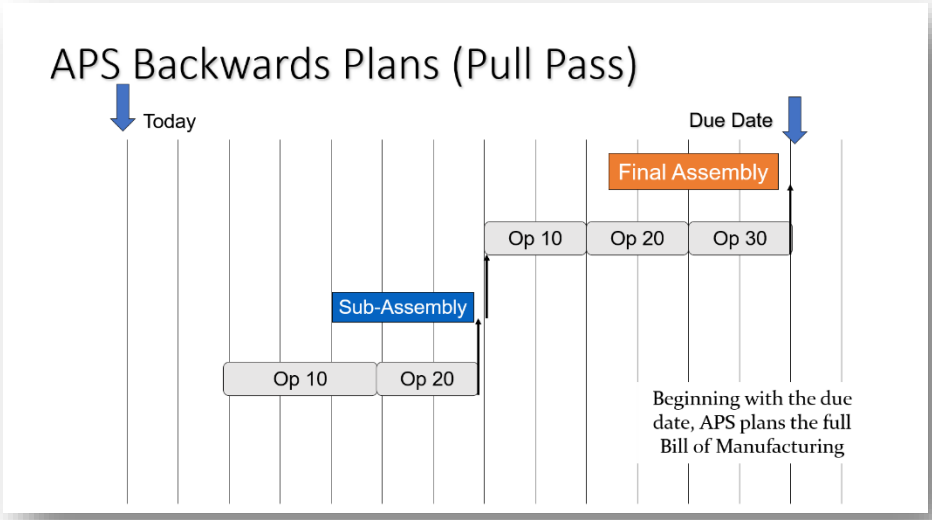
Each of the vertical lines represents one day.

The final assembly must be manufactured to meet that customer order. The final assembly has a routing with operations 10, 20 and 30, each of which will take two days to complete.

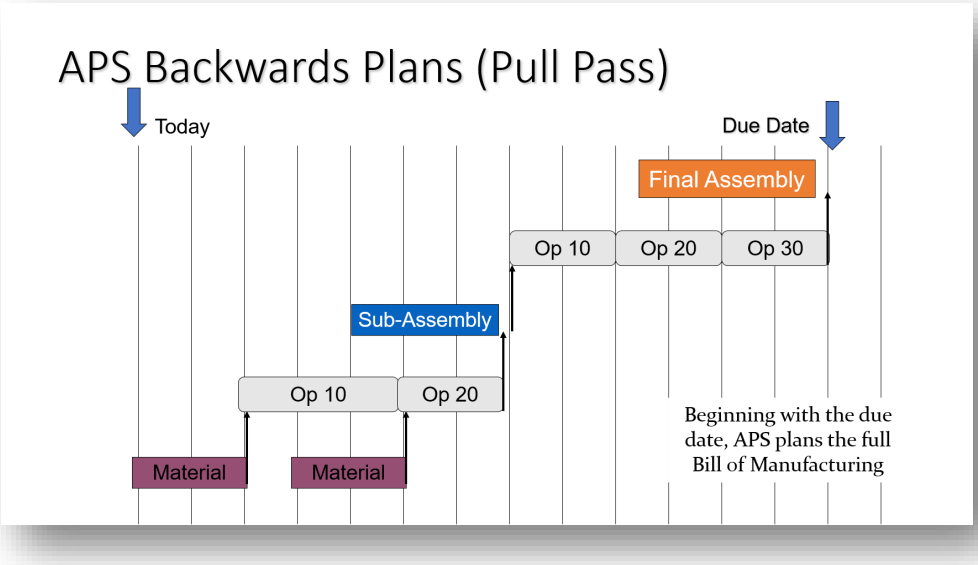
APS backwards plans the routing of each of these steps in a Just-In-Time fashion, scheduling when each step will be done and when the routing must start to meet the due date.



In the Bill of Material for the final assembly, there is sub-assembly. APS sees the date when the sub-assembly is required and plans the routing for the sub-assembly: two days for operation 20 and 3 days for operation 10 beneath these.

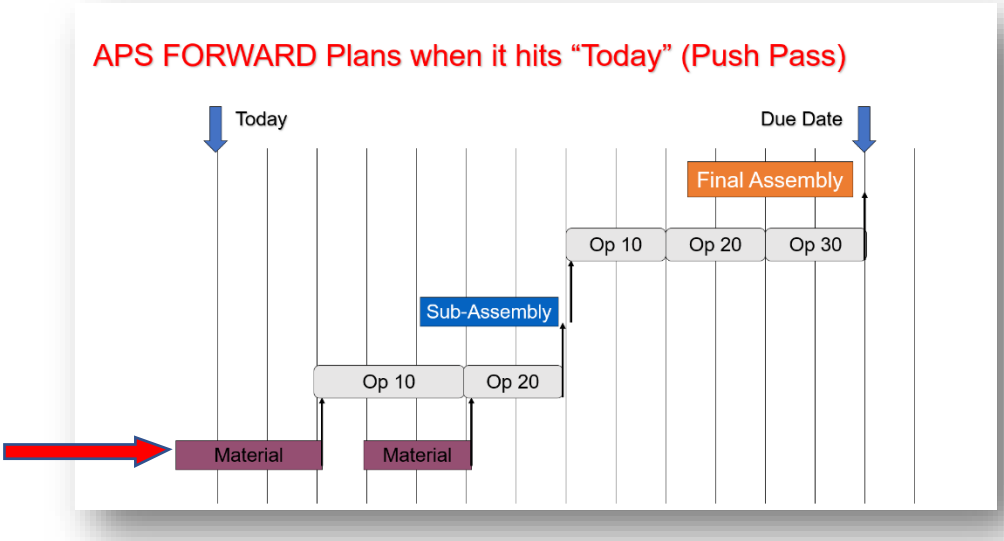


Purchased material is needed for operation 20 and that material has a 2-day lead time. We also need to purchase material for operation 10, also with a 2-day lead time. APS plans the purchases of these materials as shown below, and the resulting calculations show that we can start today by ordering the material and will successfully complete everything in time for the customer due date.



Material Constraints

But what happens if, in our backward planning, APS hits today and can't get materials in time? In our example, let's increase the last material's lead time from 2 days to 3 days, which means it would have to have been ordered yesterday to make our delivery date. One of the benefits of

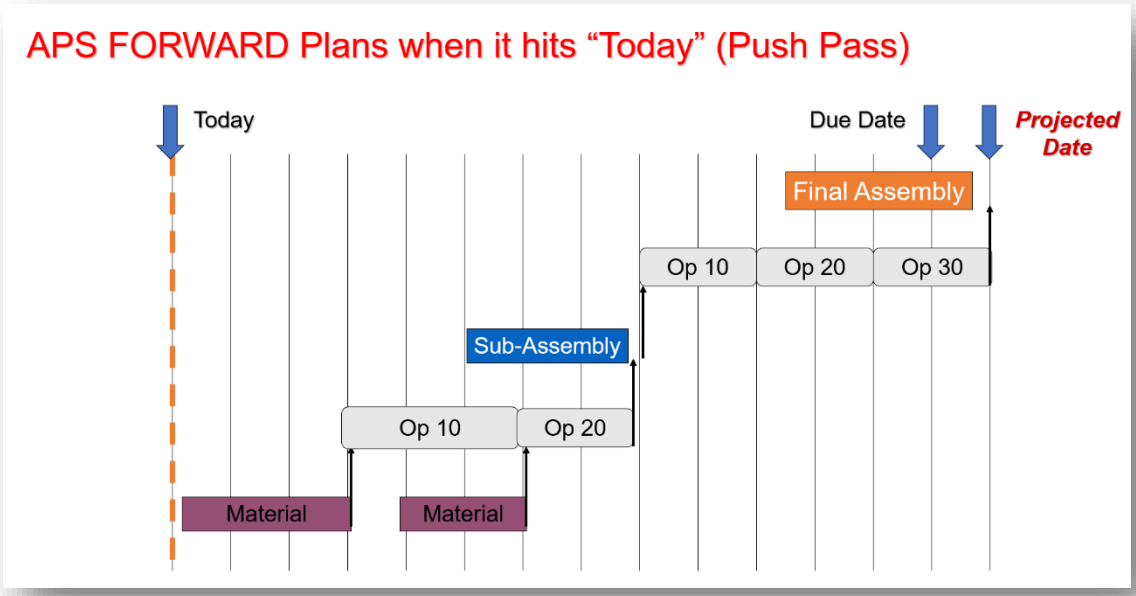


APS is that it knows you don't have a time machine; therefore, it's not going to try to make you travel back to yesterday to place that purchase order.

Instead, APS is going to look at the problem and switch to *forward planning*.

APS will plan the purchase of the material today, and then move out operation 10 of the sub-assembly to start a day later when the material arrives. This necessitates that the second operation gets moved out and it pushes the whole sub-assembly out a day. So, as a result, the final assembly must also move out a day.

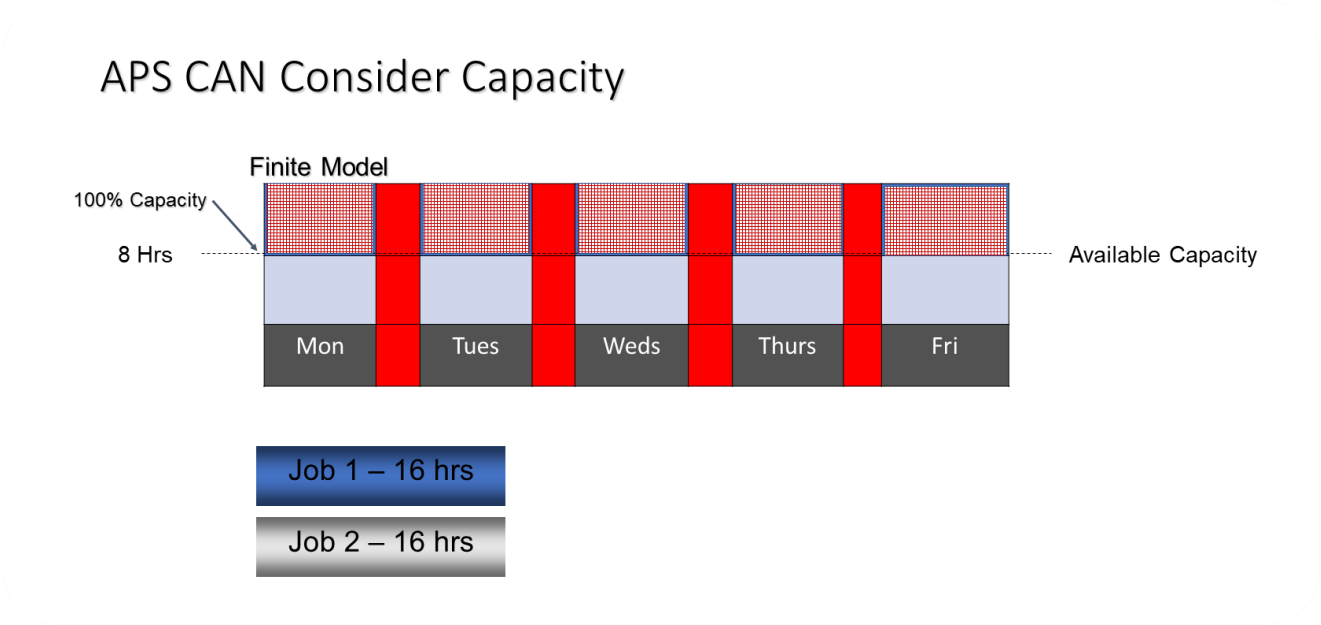
APS will then return a projected date of one day past the due date – now you know when you can honestly get this work done.



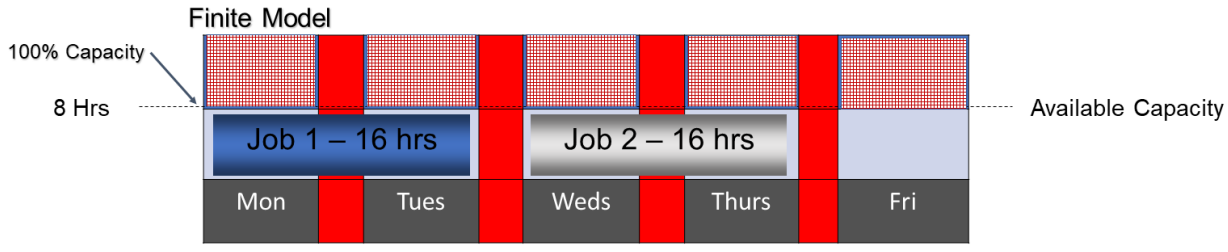
APS Can Consider Capacity

The above example considered only material constraints and assumed that capacity was available for each operation. APS does consider capacity and it always loads your capacity whether you're using a finite or infinite model. But let's take a look at the difference between **finite capacity planning** and **infinite capacity planning.**

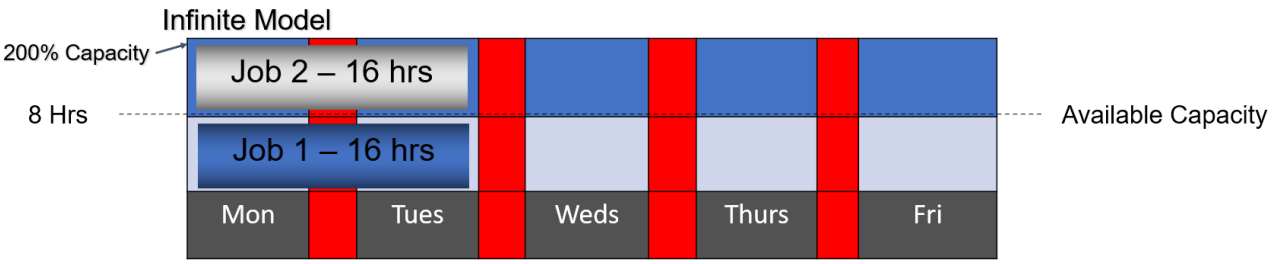
In this example, we have a work center open eight hours a day, five days a week. We have two jobs that both need to run through that work center and they both take 16 hours of work.



When APS plans this in a finite model, it will look at the highest priority job (Job 1) and load it starting Monday (assuming that's tomorrow) and will run it through Tuesday. It then looks at Job 2 which is also due on Tuesday. But we are at a hundred percent of capacity, so APS will level load, meaning it won't try to force that job into the same work center on Monday and Tuesday. Instead, it sees it can't go above a hundred percent capacity and it places Job 2 on Wednesday and Thursday. The job will be two days late, but that is all the capacity that you have.



But what happens if you want to use an infinite capacity model? We take the same two jobs, and we ask APS to load them. APS loads Job 1 on the same two days as we did before, but then when it comes to loading Job 2, APS knows you have infinite capacity, so it loads Job 2 on top of Job 1 during the same two days. That resource, that work center, that machine, that person is now booked at 200% of capacity.



There are some advantages to this. If you have flexible capacity, APS tells you where and when you need to increase your capacity. Perhaps that means adding another person, a second shift, or outsourcing to a vendor.

Whereas when you look at a finite model, you see the job is late, which leaves the task to you to figure out where you are going to add resources to make it happen on time.

So, an infinite model is a good model if you are **driven by customer due dates no matter what** and you will have your shop work the extra time get the jobs done somehow.

Defining Capacity

When you define your capacity there are four key points you need to consider and set up in the system so that it "thinks" for you:

1. You must define your resources.
    - People
    - Machines
    - Tools and Fixtures
2. You must define the resource groups to which these people, machines, and tools belong. Resource groups include:
    - CNC operators
    - Welders
    - Painters
    - Quality inspectors
    - CNC machines
    - Paint booths
    - CNC fixture
3. Define your shifts.
    - What hours and days does each shift operate?

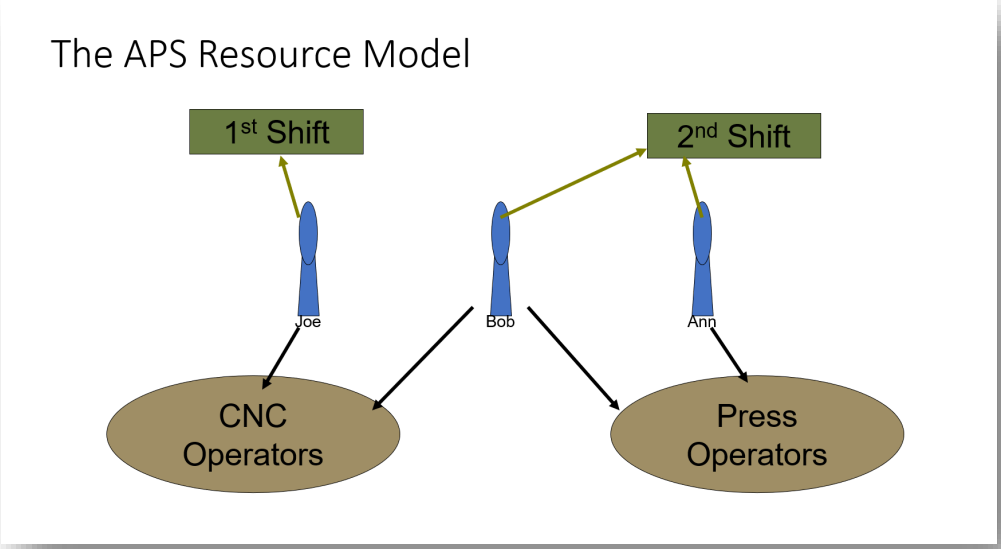
- Do you have equipment that runs 24/7 unattended?
- Do some resources work on multiple shifts?
- How is your overtime defined?

These Items are needed so APS knows who and what is available to do what work when.

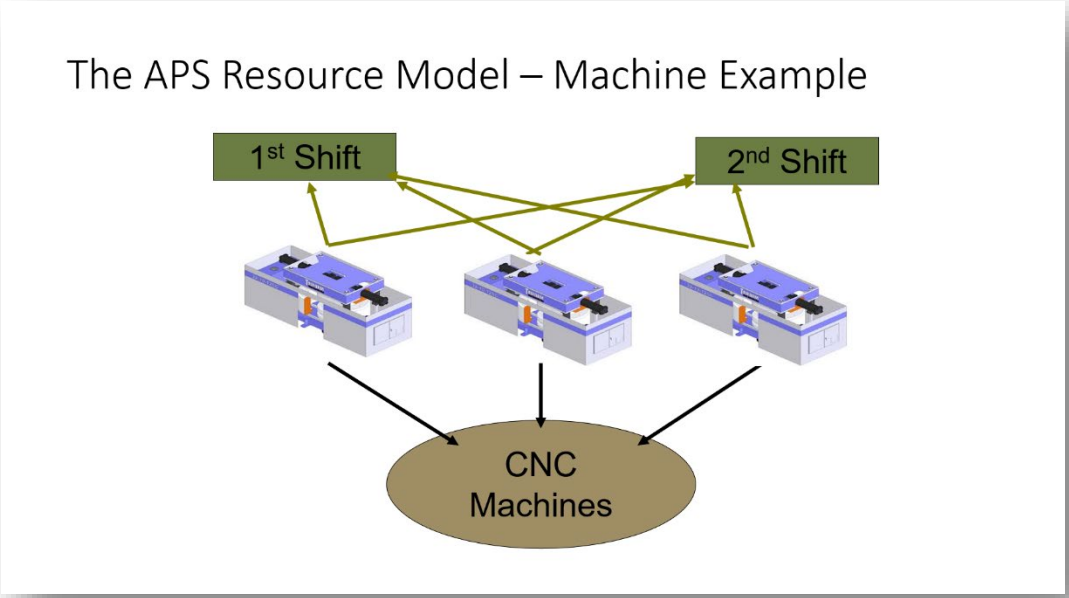
4. Then, as you define your products you, must set up your routings.
    - What is each operation step of the routing?
    - What Resource Groups are required to do the operation, and how many resources from that group are needed?
    - Time standards – does it take one hour per piece, a day per piece, or can you make a thousand pieces a day?

When we look at a resource, we also have to take into account that we're talking about people. People can have multiple skill sets so potentially, we can associate people with different resource groups.

For example, we may say Joe is a CNC operator and Anne is on the brake press, but Bob has been trained for both, so we make Bob a member of both groups. APS can then select the resources available based on the training and availability of those individuals.



By the same token, you would do this with your machines. You might have three similar CNC machines. They work both shifts because we don't have to give them time off. So, we make all three machines a member of the same CNC group. APS then sees it needs one CNC machine to run an operation and it will pick one out of the appropriate group.



Keys to Success in Managing Your APS

If you embark on a project to deploy APS, we would like to give you some management pointers that are important to your success.

In telling APS how to plan your production, the data you feed it is ***critical*** to the accuracy of its output. It is important that you dedicate the appropriate personnel to maintaining these data elements so you can act on the output of APS with confidence.

APS needs to know what materials are required to make something, so your Bill of Materials need to be highly accurate.

Your inventory accuracy is equally important so that APS does not think a material is on hand when it is not. We recommend a formal cycle counting program be in place to ensure inventory quantities are correct.

You should periodically analyze your lead times from your vendors as well as your routings and runtimes and make sure those data elements are accurate. It should be noted that this applies to both APS and MRP. Whether you are running one or the other, the same data elements are needed. A little more data is required for APS, as resources and resource groups are necessary, but both need routings and Bill of Materials to be highly accurate.

Additionally, as a manager, be aware of these fundamental points:

1. First, do not expect that people will understand APS just because they know MRP. Give them the opportunity to be educated in the new system and extend their education to all areas of the manufacturing process. The American Production and Inventory Control Society has a wonderful set of courses for manufacturing managers that will cover capacity planning, scheduling, just-in-time, Kanban inventory control, and so forth.
2. Going through the materials one time is not enough. If you attend one education class, you are basically familiar, but you are **not** an expert. Make sure people recognize that it takes time to really grasp this. They should read and reread the manuals once the system is deployed.
3. Insist that the APS system is to be used. Do not tolerate outside systems such as spreadsheets, as that indicates something was not set up correctly in your system and it allows people to ignore the problem.
4. Adding to that point, if you find a problem in the system, fix it. If a buyer sees that APS is recommending a purchase order too late, make sure he finds the correct lead time and fixes the problem. Everybody touches the system, so it is everybody's job. You would not borrow someone's car and notice that it was almost out of gas but ignore it. You would take care of it, just like you would not look at an inventory record that was incorrect and ignore it. You should fix it. It is everyone's job to make sure the software works.

Thank you so much for reading our eBook. We sincerely hope it was useful in gaining a deeper understanding of MRP and APS. If you have questions, feel free to contact us at the number shown below or at webrequests@LogicData.com. Have a great day.

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