MPS VS Heijunka

Different or Semantics?

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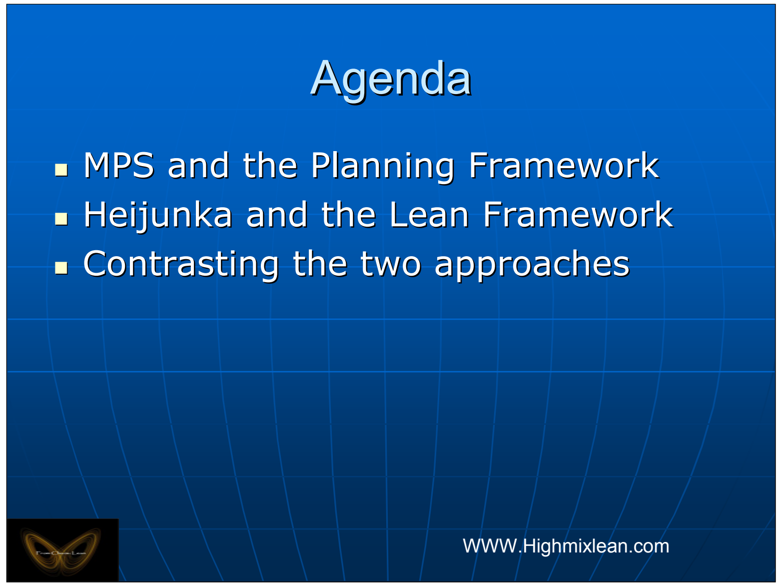
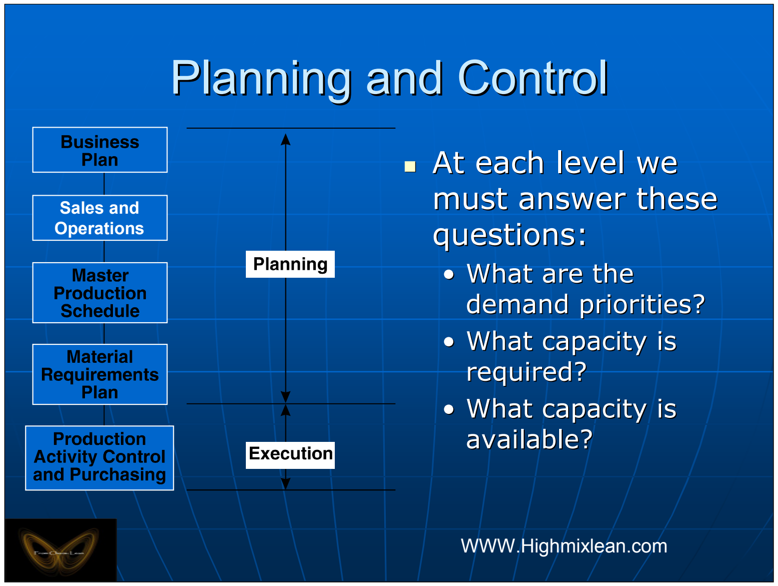


The overall agenda for this talk is a fairly simple one, which is to simply try to explain two distinctly different approaches to how to connect customer demand with production. We will start by explaining the environment in which the two approaches operate and then we will contrast those two approaches to see how they differ and where they are the same.



This is a flow chart depicting a normal planning and control system as described by APICS. It starts with a high level business plan which typically covers an overall statement of the direction of the business, which is then broken down into a sales and operations plan, which states sales and production rates by product family. This is then broken down further into the SKU level, again stating expected sales and production rate. Material requirements planning is a calculation designed to use up extra inventories during the production process, and finally production activity control is a detailed scheduling activity designed to place work on the actual factory floor.

At right is a set of questions which this flow attempts to answer, namely how will we balance supply and capacity in the production facility.

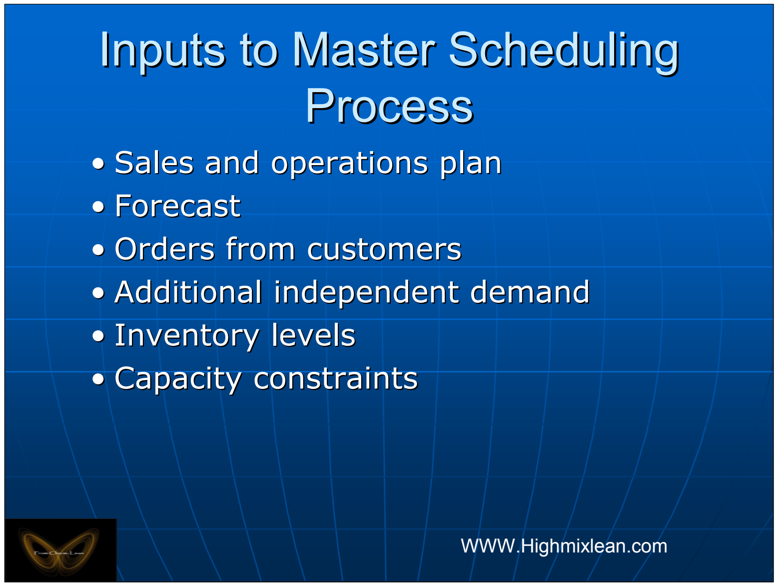
On a personal note to you, the presenter: if you can't make an entire hour long speech using this one single slide, perhaps you shouldn't be taking on this topic. Just being snarky…

The slide simply tries to give a bit more explanation of what the master production schedule actually is. You should emphasize that the master schedule is the real point at which supply and demand are matched up at the mix level, meaning that in the planning hierarchy up to this point we have simply been dealing with aggregate production rates, or rates by product family.

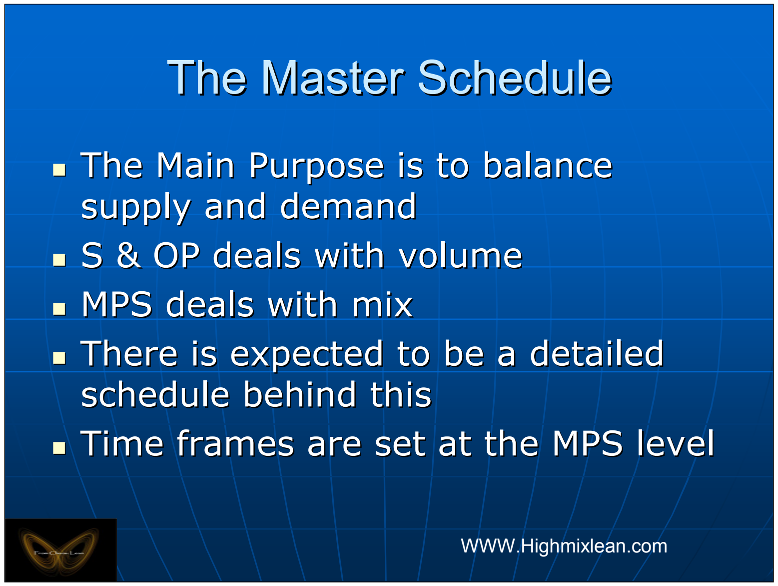
From the APICS dictionary:

Master Schedule: The master schedule is a format that includes time periods (dates), the forecast, customer orders, projected available balance, available-to-promise, and the master production schedule. The master schedule takes into account the forecast; the production plan; and other important considerations such as backlog, availability of material, availability of capacity, and management policies and goals. See: master production schedule.

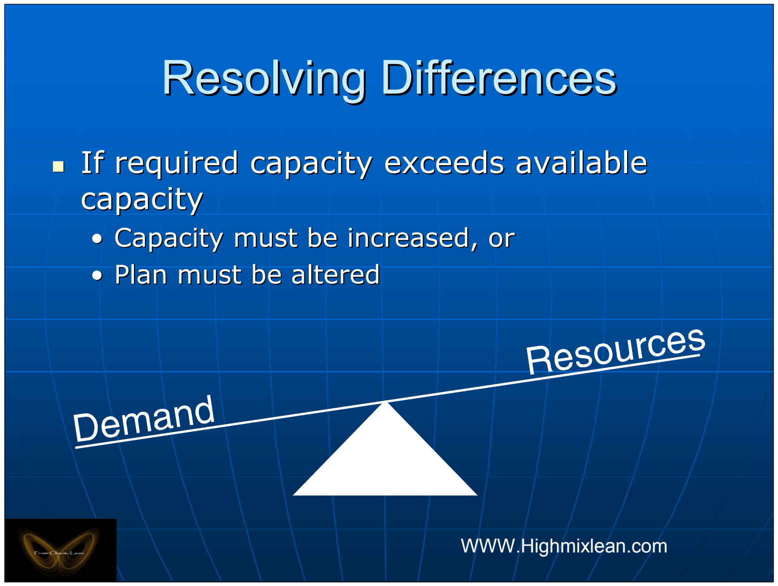
master production schedule (MPS) (C): The master production schedule is a line on the master schedule grid that reflects the anticipated build schedule for those items assigned to the master scheduler. The master scheduler maintains this schedule, and in turn, it becomes a set of planning numbers that drives material requirements planning. It represents what the company plans to produce expressed in specific configurations, quantities, and dates. The master production schedule is not a sales item forecast that represents a statement of demand. The master production schedule must take into account the forecast, the production plan, and other important considerations such as backlog, availability of material, availability of capacity, and management



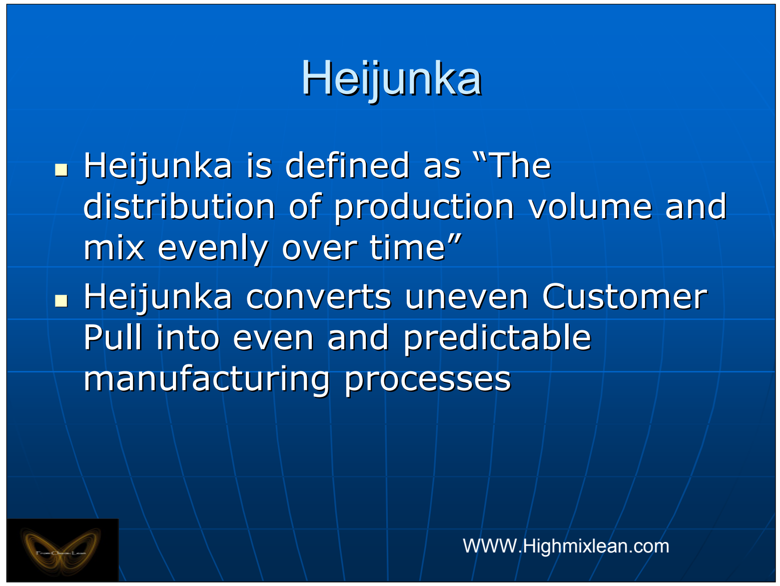
This slide is simply to show the various places that information needed to actually create a master schedule would come from. Most systems created to support Master Production Scheduling really only present the user with forecast, orders from customers, and additional independent demand as well as inventory levels. They do not show the aggregate sales and operations plan rate, nor do they generally show any capacity constraints. Those two considerations are generally handled at the rough cut capacity level which occurs after the master schedule has been created.



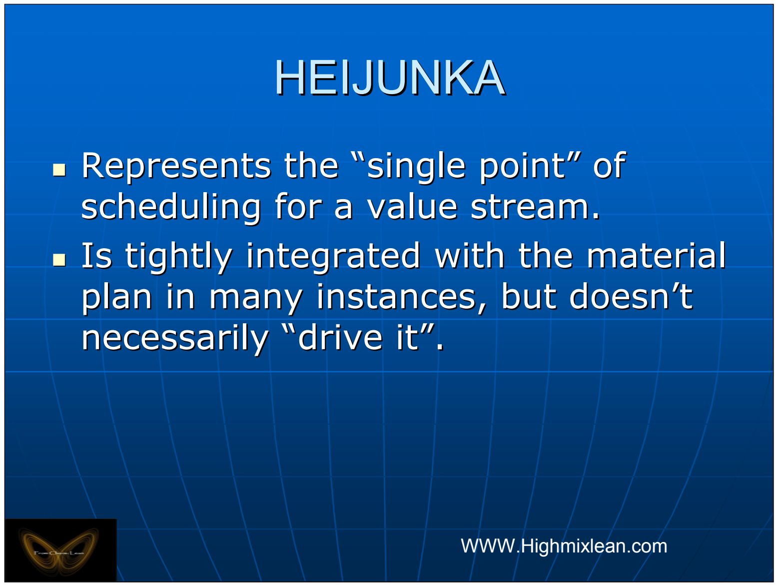
The slide is a summary of the role of the master production schedule in a production planning and control system. It is by no means comprehensive in describing the master schedule, but is meant instead to set up the contrast between the MPS and the Heijunka processes for later on in this presentation. The last two bullets probably need more clarification: in most instances, the master production schedule is generally viewed as simply driving the material requirements planning portion of the system. This material requirements planning then provides the input to a detailed scheduling process which actually provides the schedule for the factory floor. In most instances the MPS itself is often broken down to a further level of detail to become an end item, or perhaps an assembly level schedule for the factory. Second, timeframes in this sense means such considerations as the planning horizon for visibility of future requirements as well as any firm portions of the schedule where changes are limited.



The main point to be made here is that this imbalance would usually be the case at the end of the first iteration of the master production scheduling process, since in general there is no visibility to the resources required to produce the schedule as supply is entered to match demand. As anyone who has attempted to do this knows, it is often very difficult to go back and adjust the schedule and make it fit the resources available in production and materials. The result is that we usually see master production schedules which do not match the capacity which has been agreed to during the sales and operations planning process, or we get one which is very heavily loaded at the beginning of the planning horizon and is compensated for by under loading the latter portions of the horizon.



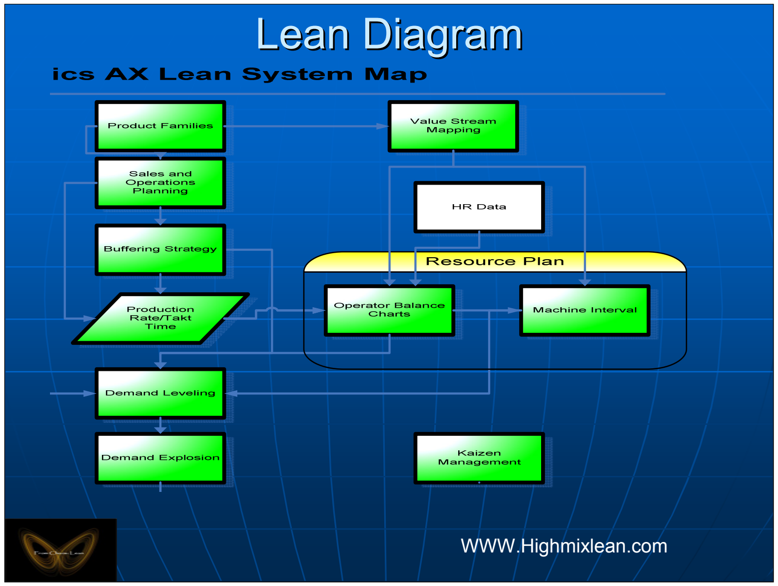
These are textbook definitions of the Japanese word Heijunka. It is important to note that in its purest sense Heijunka is meant to level not just volume but also product mix.



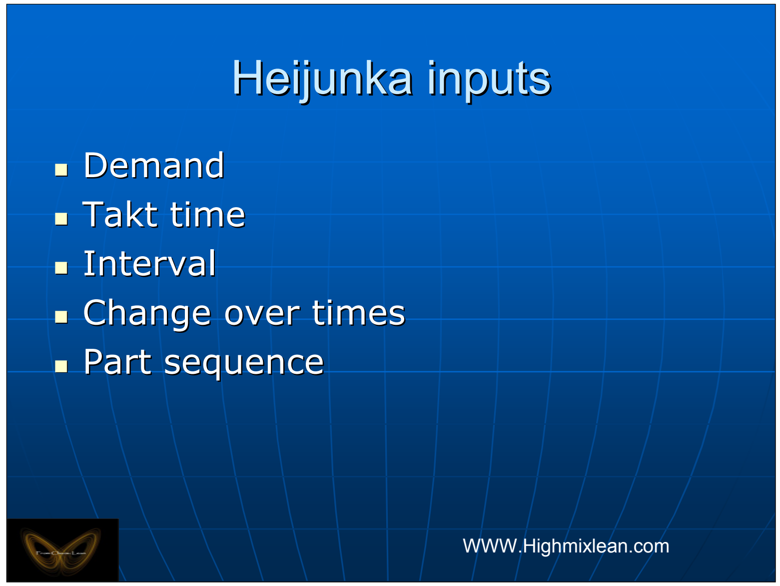
Both of these are rather subtle points but are also very important in understanding the difference between the two production systems, these being enterprise resource planning versus lean manufacturing. In the lean manufacturing world, a value stream has only one single schedule point, not a series of schedules represented by a master production schedule, an assembly schedule and then various detailed shop floor schedules for each process or machine.

In the ERP process the master production schedule "drives" the material planning process, meaning that all of the material plans directly depend upon the integrity of the master production scheduling process. The result of this is that if the master production schedule is overstated, there will either be more inventory than necessary to support the production process, priorities in the factory will be uncertain, or often both.

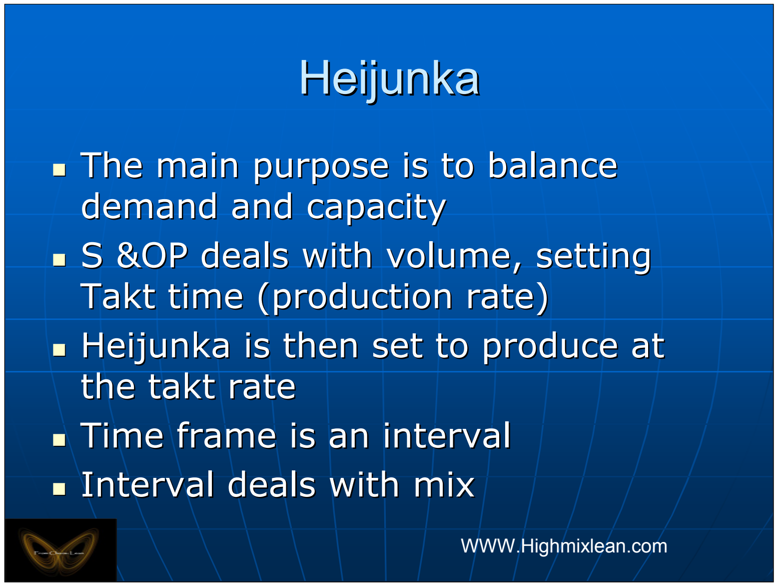
In the lean manufacturing process the schedule is placed at a single point in the value stream and all subsequent, downstream processes simply work on either one piece flow or via a first in first out process, and therefore need no schedule. Prior processes up stream of the schedule would be attached via a pull system, and would simply make what the schedule had pulled out of the supermarket that they supply, therefore also requiring no schedule. The result of this is that all processes are basically making to the exact same schedule that was put at the single schedule point, and no inventory is built other than that called for by replacing what was used in the supermarket.



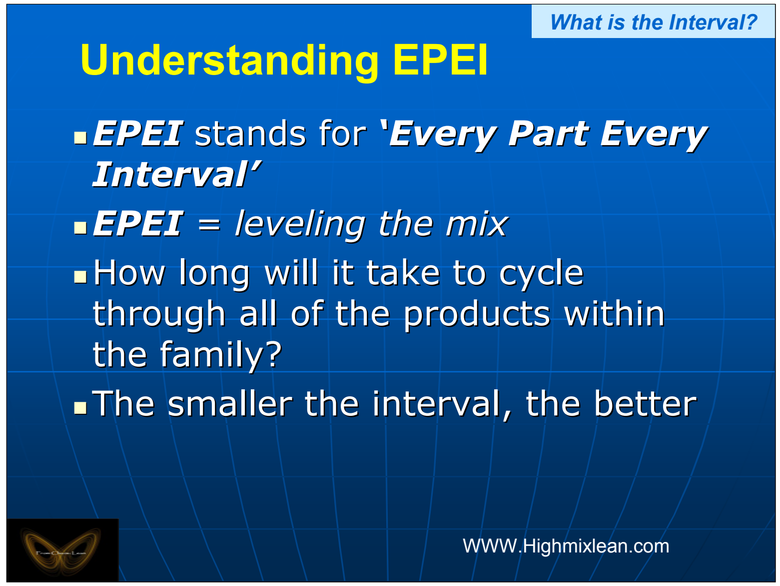
This is a diagram of the lean flow chart which would be the equivalent of the production planning and control flow chart. The emphasis on this chart should be the absence of any other schedule than the demand leveled, Heijunka schedule.



The Heijunka process requires some of the same inputs that the Master Production Schedule requires, although it does not require capacity inputs because the Heijunka process itself has the capacity of the process to be scheduled built into it, either In the form of the takt time or in the form of the interval for the process.

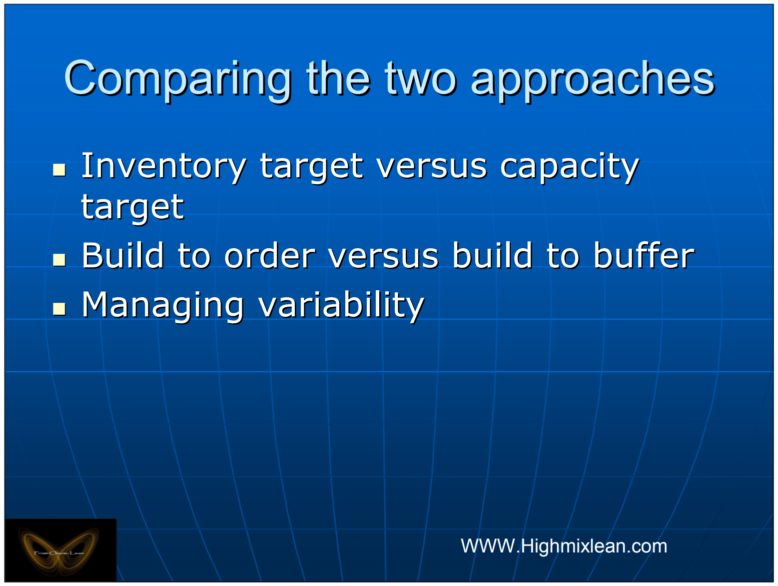


The difference between balancing demand and supply and demand and capacity is a subtle but powerful one. The latter is a much more straightforward way to look at the world, in that the job of the scheduler is to simply take customer demand and place it into the factory in the form of a single schedule. Because the Heijunka process is capacity oriented, it can directly translate the production rate from the sales and operations plan into a schedule, keeping the two control processes in sync. Because of the nature of the way that Lean thinks about capacity in the terms of setup capability of the process, the timeframe for a Heijunka schedule in most cases will be an interval, (or every part every interval.) The concept of interval defines how the product mix will be handled within the value stream.

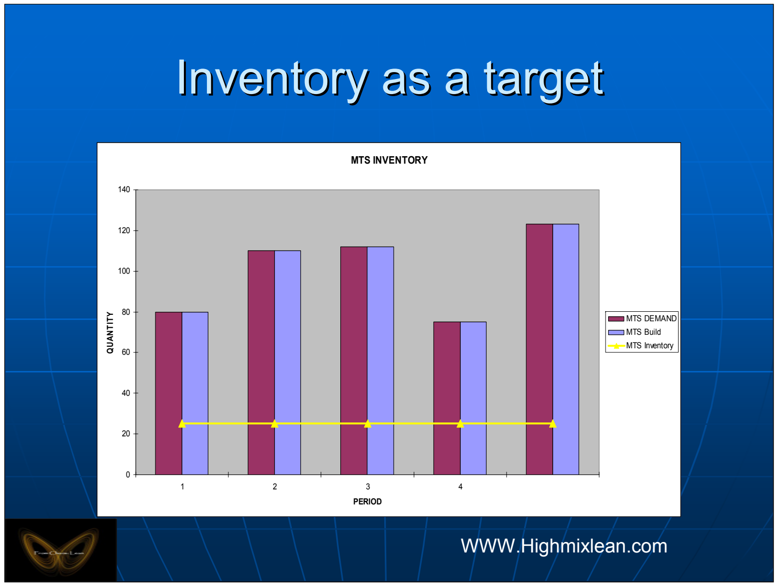


Interval is a concept which basically approaches lot sizing and the number of setups for a given mix of products in a much different way than something like economical order quantity would. It basically says that the desired production rate is set first, then the capacity is agreed upon, then a calculation is done to figure out the lot size for the parts based on how many setups can be accomplished within the agreed upon capacity.

In lean terms, the smaller the lot size the better because there will be less waste and better flow using small lot sizes. What this requires is reliable processes and short change over times, both of which are good things to achieve within a process.

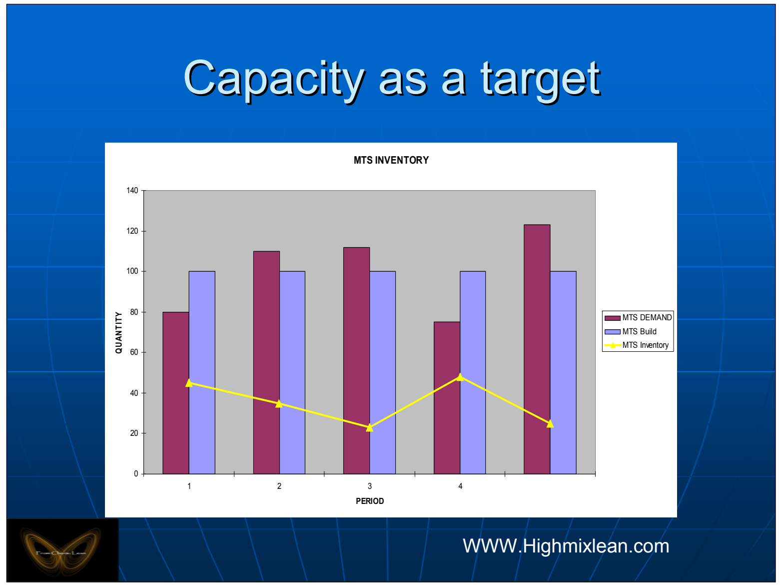


This part of the presentation will now begin to contrast the two approaches to connecting demand with supply inside of the factory. We will deal with three basic areas to the frame the contrast. First will be: what purpose do inventories serve for a manufacturer? Second will be the idea of building customer order versus building to a buffer, a buffer serving the purpose of being able to help level work into the value stream, and third being the idea of having an approach to managing the variability which is inherent in any value stream.

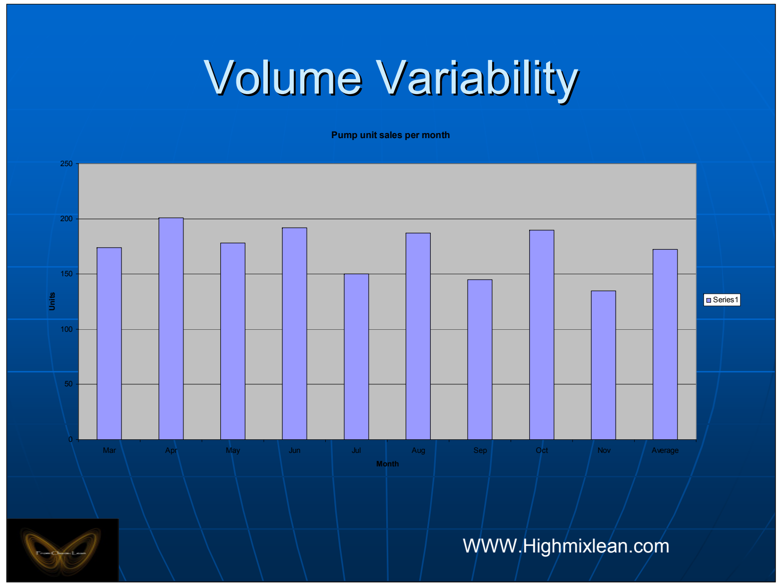


In general, I think it's fair to say that most approaches to linking demand with supply treat inventories as a fixed target, with the idea being that if we have the correct amount of inventory we will have the desired level of customer service. The result of this, as seen in the graph above, is that as demand varies supply will vary to equal it so that a fixed level of a inventory can be maintained.

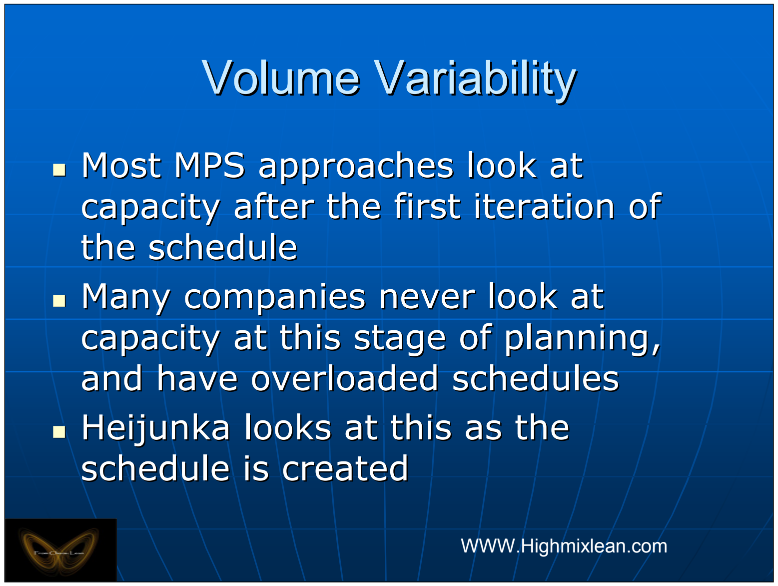
An even worse scenario is created when a system is put in place which wants inventories to increase as demand increases, resulting in a phenomenon which is known as the bullwhip effect. What happens in this case is that as demand goes up, not only does production have to increase to meet increased demand, but it has to increase even further to add more inventories at the same time. Of course the inverse is also the case, which results in many sad days when demand begins to go down slightly and inventories must decrease, meaning even less production.



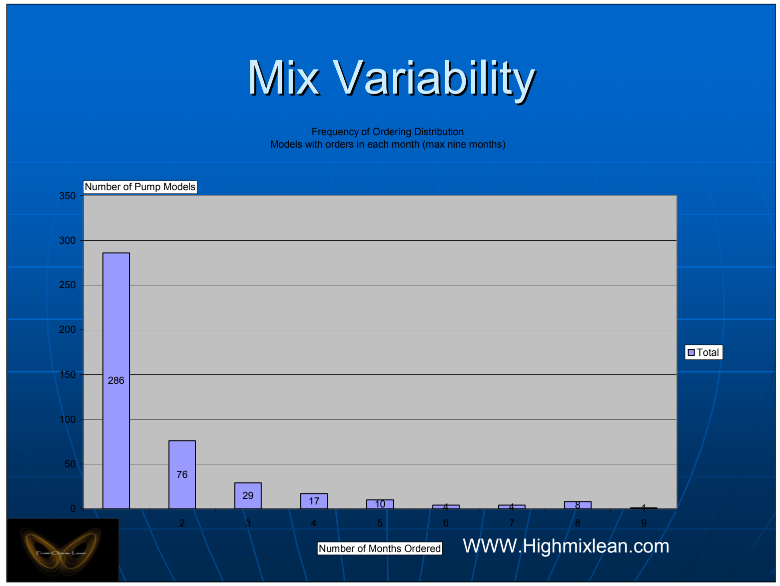
This chart represents the way the Heijunka process would approach the scheduling of demand into the value stream, in that it would treat the capacity as the target and treat inventories as a variable. Inventory in this case is simply the result of operating at one rate and selling at a different rate. Since there will be, in almost all markets, normal variability in both volume and mix in the sales in any period, this approach is a much easier way to ensure that the schedule matches the capacity of a value stream. This approach also more directly matches up with the way the sales and operations planning process thinks of inventories, namely simply as a result of comparing the sales rate with the production rate.



The next few slides are an attempt to elaborate a bit on the types of variability that these two approaches must deal with, namely volume variability and mix variability. This slide shows a graphical representation of Volume variability by simply charting the total sales of a product family by month. As we can see no two months are the same, which leaves us with the choice of either varying capacity in each month so that we can have constant inventories, or varying inventories each month so that we can operate with a constant capacity. This is a decision that occurs at the sales and operations planning level and then must be the constraint when scheduling mix in both the Master Production Schedule and in Heijunka.



The difference in the approach to volume variability is listed in this slide, in that in the production planning scenario capacity is looked at by the rough cut capacity planning process, which occurs after the master schedule has been created. If the rough cut capacity plan shows a problem, then a reiteration of the master production schedule must occur to adjust the production in the schedule. There is a potential for this loop to happen several times. In the world of Heijunka, however, since the schedule is created directly to the capacity of the value stream we can be sure that as long as we create the Heijunka as designed, then capacity will be fine for the value stream.



This is a graph showing mix variability for a value stream. The chart shows the frequency with which all of the parts in the value stream are ordered over the course of nine months. What it shows is that 286 part numbers were ordered in only one of the nine months and that one part number was ordered in each of the nine months. This shows a value stream which has a very high mix variability, in that there are very few items which are ordered frequently and many items which are ordered very infrequently.

The inventory approach to mix variability

- All parts have a bell shaped curve for demand distribution
- Service level is achieved by carrying a certain number of standard deviations of inventory as safety stock
- Have you ever charted the demand pattern for your end items?

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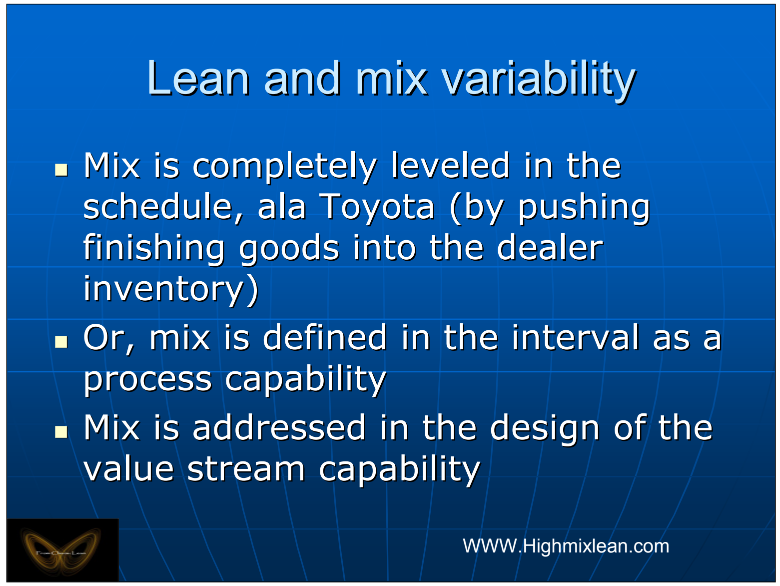
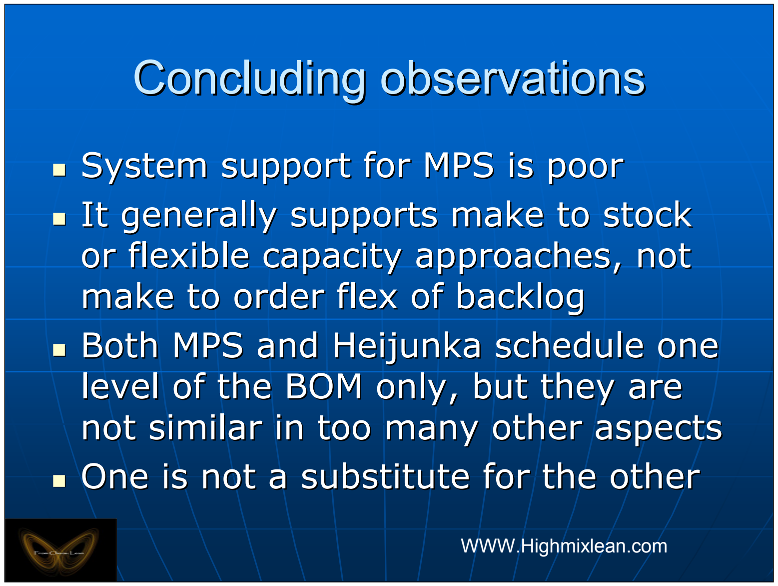
In the production planning and control environments mix variability is often handled via an inventory strategy. This strategy revolves around measuring the amount of demand variability present in each item, then placing safety stock as a way to the meet this demand variability. The problem with this is that a part generally needs to have a normal distribution pattern centered around it’s average usage for the technique to actually work, and in today’s world of manufacturing in the United States we have more and more parts which do not fit that bell shaped curve pattern. Thus we have higher and higher inventories returning less and less in terms of on-time customer delivery.



The very definition of Heijunka, if you recall, was to evenly distribute both mix and volume into the value stream. What this means is that the value stream itself will not experience any mix variability if the Heijunka is approached in this manner. On the other hand, because of the high mix variability which was cited in the previous slide, completely leveling mix is often an expensive strategy for producing products. In this case lean defines the capability to respond to mix via its definition of interval, which then becomes a definition of the processes capability in terms of volume and the number of parts which can be produced in a predefined period. The schedule is then created based on the actual customers orders which are received plus the use of a buffer to level the volume into the value stream, but not necessarily leveling the mix into the value stream.

The slide is a summary of the stated objectives of these two approaches to linking demand and supply. It would be best summarized by saying that the production planning and control environments think in terms of tradeoffs in the production environment while the lean environment thinks in terms of continuous improvement with only perfection as the end goal. Because of this difference in attitude, the two approaches almost by definition have a different emphasis on how to view customer demand going into the value stream.



The concluding observations are just to refocus the audience back on the original topic, which was to provide some insight into whether Master Production Scheduling was an acceptable substitute in the lean world for the Heijunka process. The first point is that if the major concern is to load work to a defined capacity, then the Master Production Scheduling process with its separate rough cut capacity plan is not the ideal environment to work in. Many of the programs and practices grew up in make to stock environments and are set up to handle either trying to keep a fixed inventory level as defined by safety stock, or to handle a flexible capacity approach where the company is committed to build to customer order and will vary capacity to meet those orders, such as in film developing. In lean, however, we’re mainly interested in trying to keep capacity fixed, while varying either backlog or inventories in response to variable customer demand. This model is often not supported in the systems which provide modules for the master production scheduling process.

While both of these approaches schedule one level of the bill of material, the master production schedule is generally accompanied by several other schedules, often driven by the material requirements planning. The Heijunka process provides the one and only schedule for the value stream.

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Thank you .