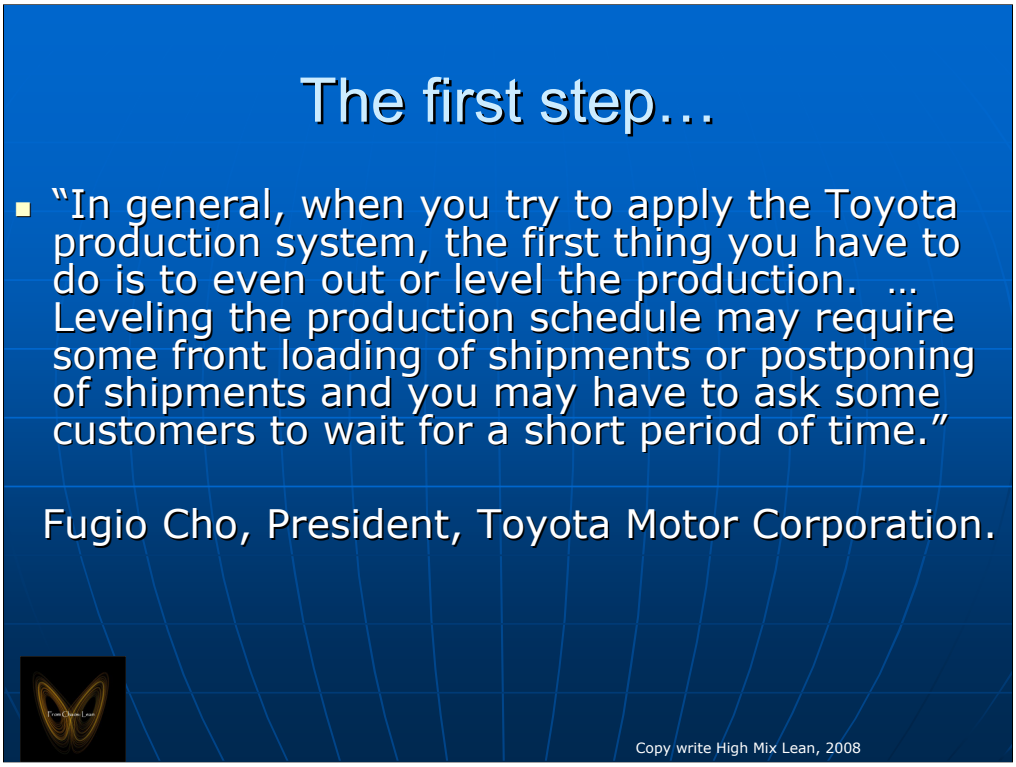
Buffering Value Streams

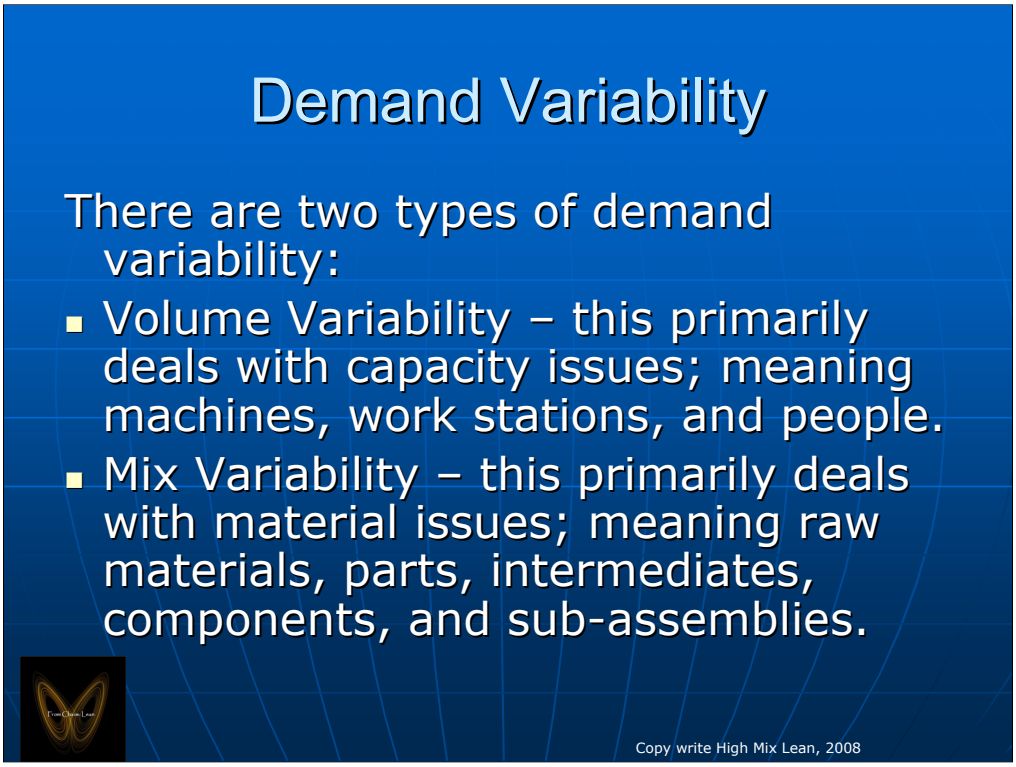
Bill Kerber, CFPIM
High Mix Lean



It is important to understand that even though we have equated lean with removing waste, this is just one element of TPS. From Wickipedia: For many, Lean is the set of TPS of 'tools' that assist in the identification and then steady elimination of waste (*muda*), quality is improved, production time and costs are reduced. To solve the problem of waste, Lean Manufacturing has several 'tools' at its disposal. These include continuous process improvement (kaizen), the "5 Whys" and mistake-proofing (poka-yoke). In this way it can be seen as taking a very similar approach to other improvement methodologies.

There is a second approach to Lean Manufacturing which is promoted by Toyota in which the focus is upon implementing the 'flow' or smoothness of work (*mura*) through the system and not upon 'waste reduction' per se. Techniques to improve flow include production levelling, "pull" production (by means of kanban) and the *Heijunka* box.

The difference between these two approaches is not the goal but the prime approach to achieving it. The implementation of smooth flow exposes quality problems which always existed and thus waste reduction naturally happens as a consequence. The advantage claimed for this approach is that it naturally takes a system-wide perspective whereas a 'waste' focus has this perspective assumed. Some Toyota staff have expressed some surprise at the 'tool' based approach as they see the tools as work-arounds made necessary where flow could not be fully implemented and not as aims in themselves.



This somewhat matches the S & OP and MPS detail in a traditional planning and scheduling.

Volume Variability

- Volume variability is a measure of how consistently customers order a total volume of product for a given production line (value stream).
- It is measured against the entire product family, not against any single SKU.

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Mix Variability

- Mix variability is a measure of how often a specific product, and its variants, is ordered by customers for a specific value stream.
- Mix variability greatly affects materials: Raw materials, sub assemblies and finished goods.

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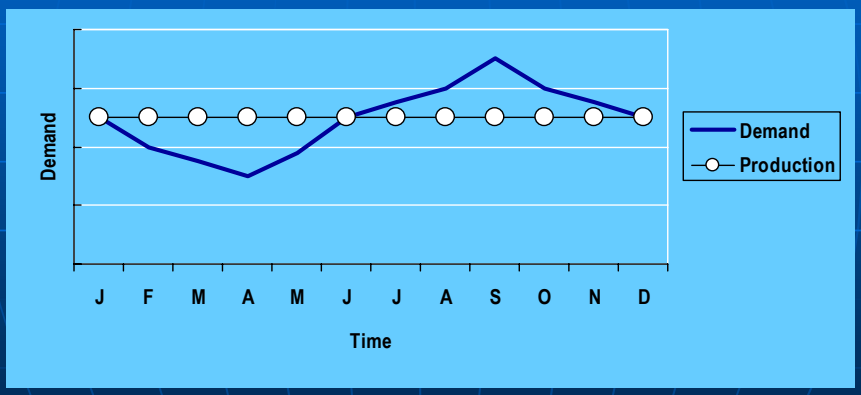
Toyota

- Levels both volume and mix in very short time frames, freezes schedule over medium time frame



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An example of mix leveled production

- Body type: Camry 360 per day, 80 %, Sienna 90 per day, 20%.
- Colors: red, 25%, blue 25 %, white 25%, midnight underwater yellow 25%.
- Audio/video: CD 50 %, DVD, 50%

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The Resulting schedule

Vehicle Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Body Type	C	C	C	C	S	C	C	C	C	S	C	C	C	C	S	C	C	C	C	S
Color	R	B	W	Y	R	B	W	Y	R	B	W	Y	R	B	W	Y	R	B	W	Y
Audio/Video	C	D	C	D	C	D	C	D	C	D	C	D	C	D	C	D	C	D	C	D

Key: Body Type: C= Camry, S=Sienna

Color: R=Red, B=Blue, W=White, Y=Yellow

Audio/Video: C=CD Player, D=DVD Player

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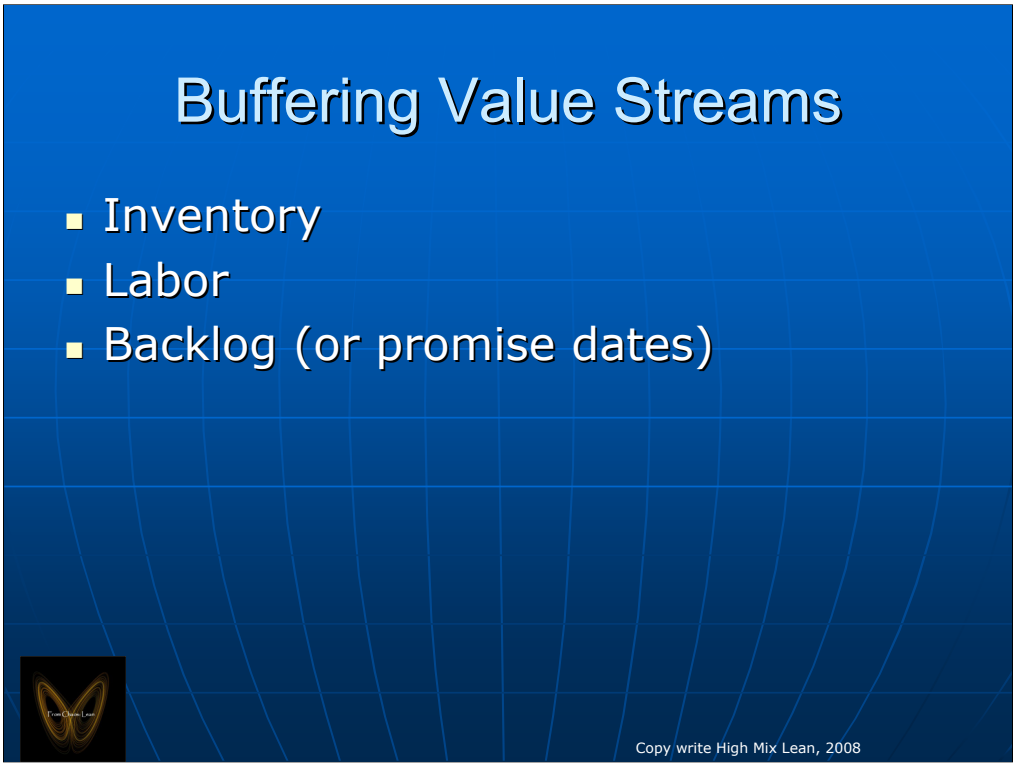
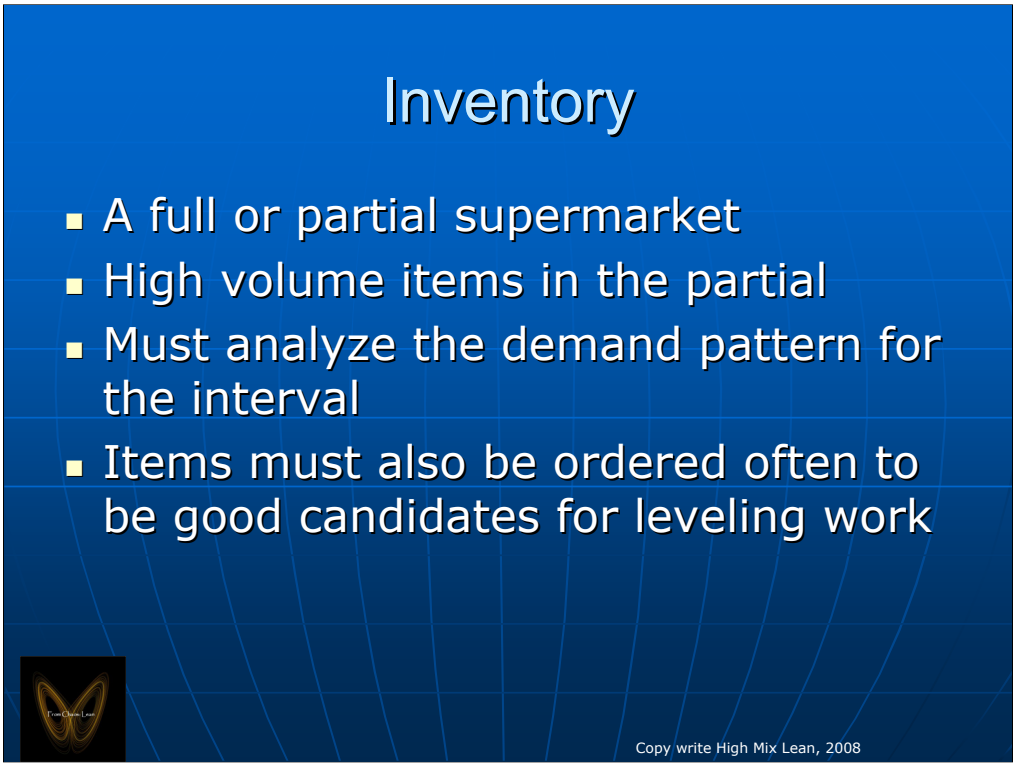


The choice depends on several factors, such as where in the four quadrant chart the value stream falls, and the comparison of demand lead time to production lead time. It is also fair to factor in such things as the cost of inventory and the cost of labor when deciding on what strategy will be used for leveling production in the factory.



Deciding between a full or partial supermarket depends largely on the demand pattern from the customer . If it is common for all items to be ordered in each interval , then a full supermarket with all items present may be an effective strategy and have minimal waste involved . If however, demand tends to be more intermittent on many items , then a partial supermarket may be a way to level the value stream with less waste than a full supermarket would have.

Supermarket reality

- A supermarket of finished goods simply serves to allow the value stream to build to order without the customer waiting for the production lead time.

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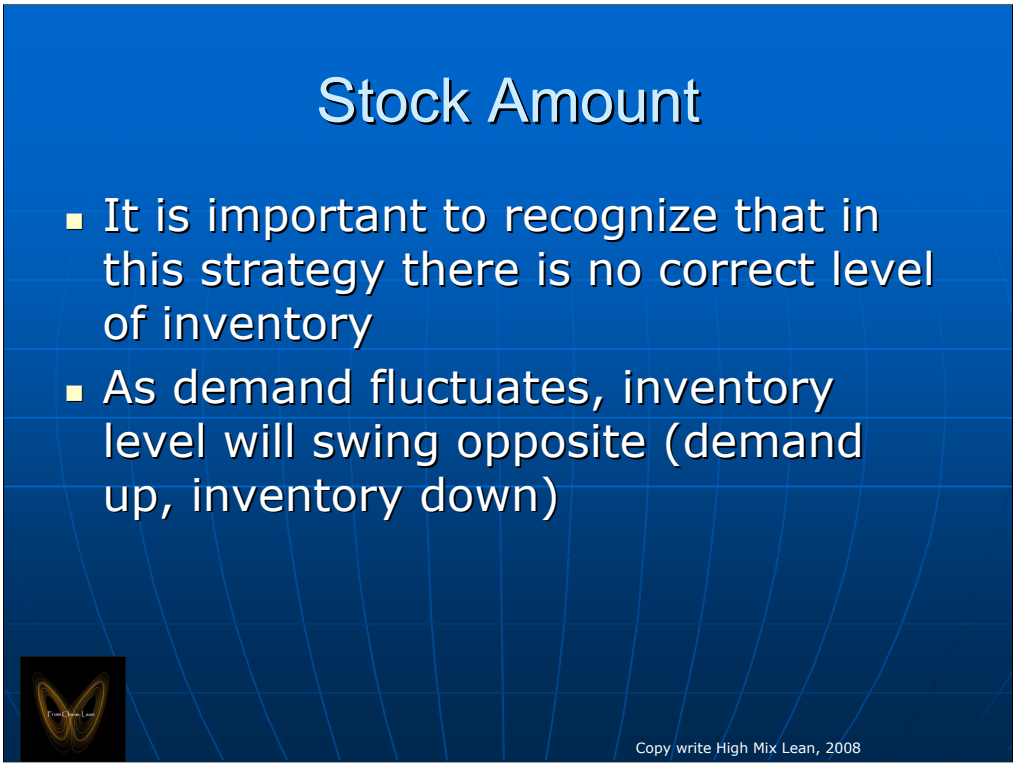
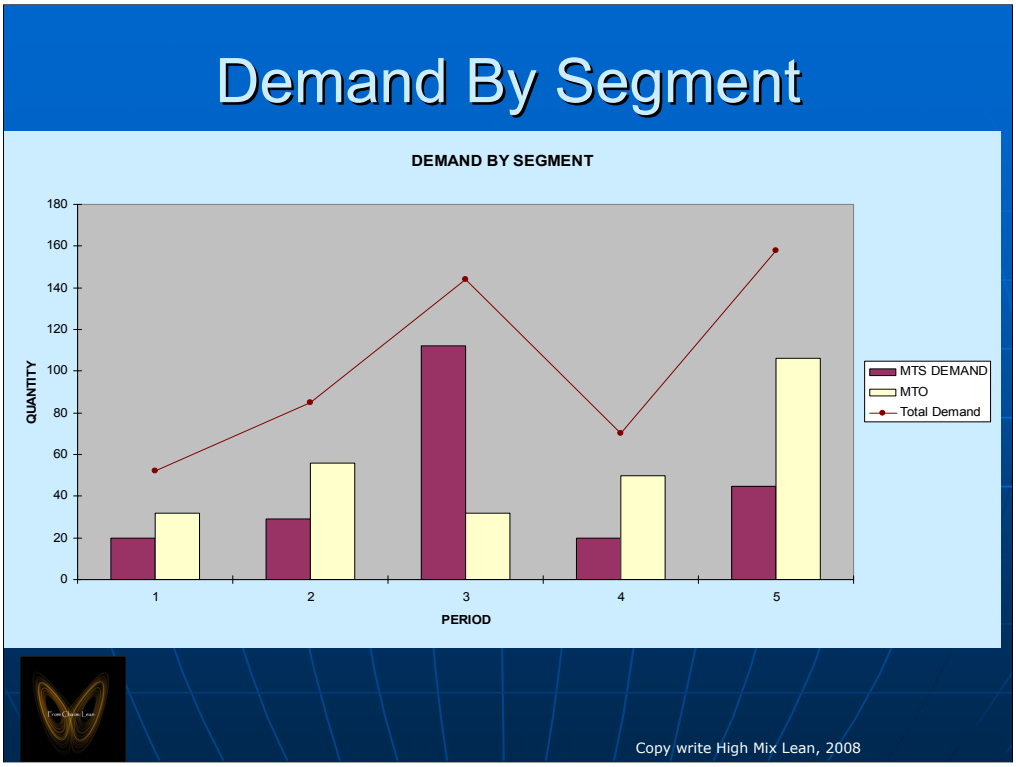
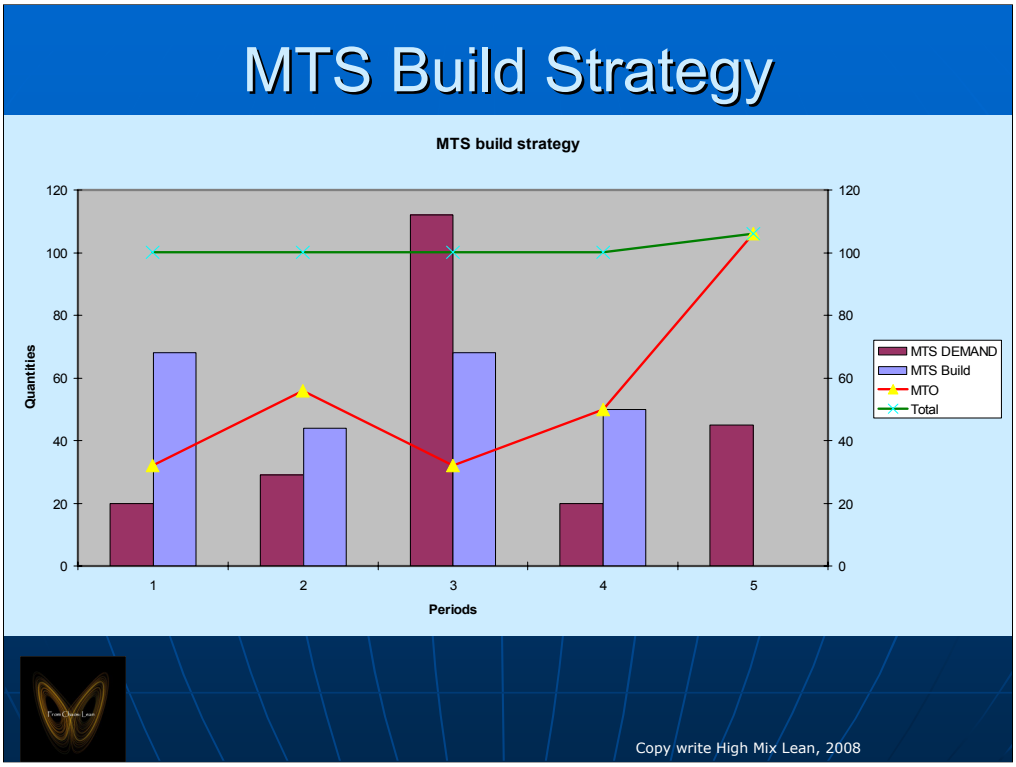


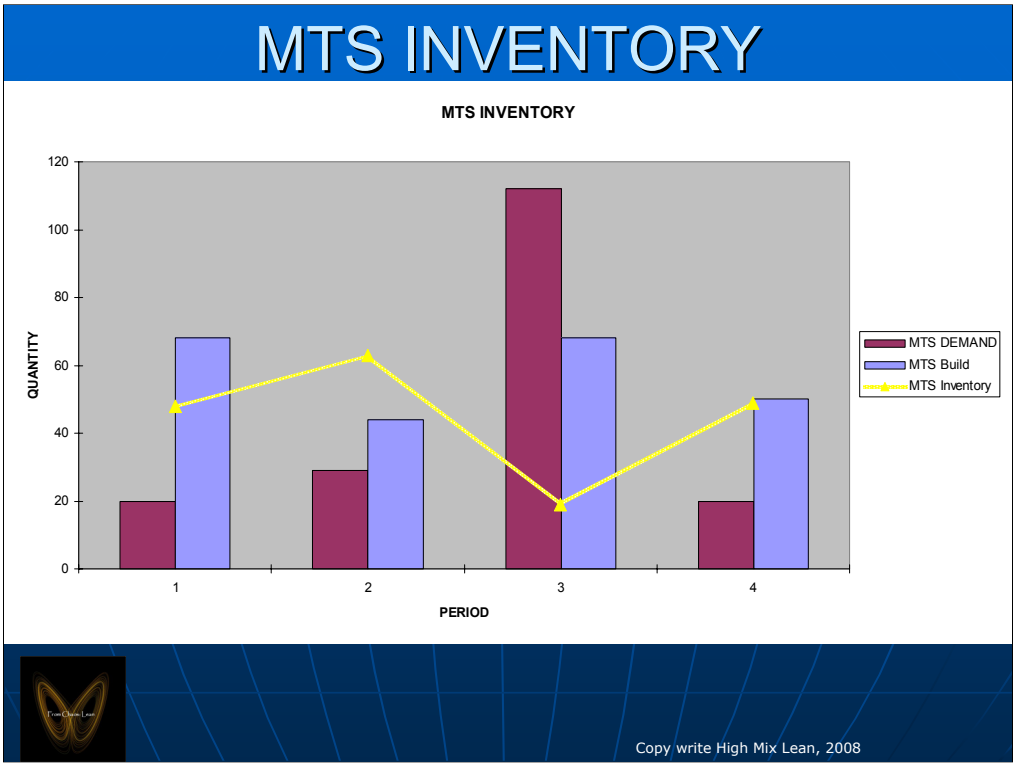
There is no target level for this type of supermarket: it is there to smooth demand into production, and therefore will grow and shrink as demand changes. Minimums and maximums should be monitored as a way to check on the overall sales volumes in the value stream. Reaching a boundary should trigger an S&OP review. Reaching the minimum (usually zero on hand) indicates the need to work overtime to satisfy customer demand. Reaching the maximum (supermarket full) indicates that production must be run at less than established capacity.



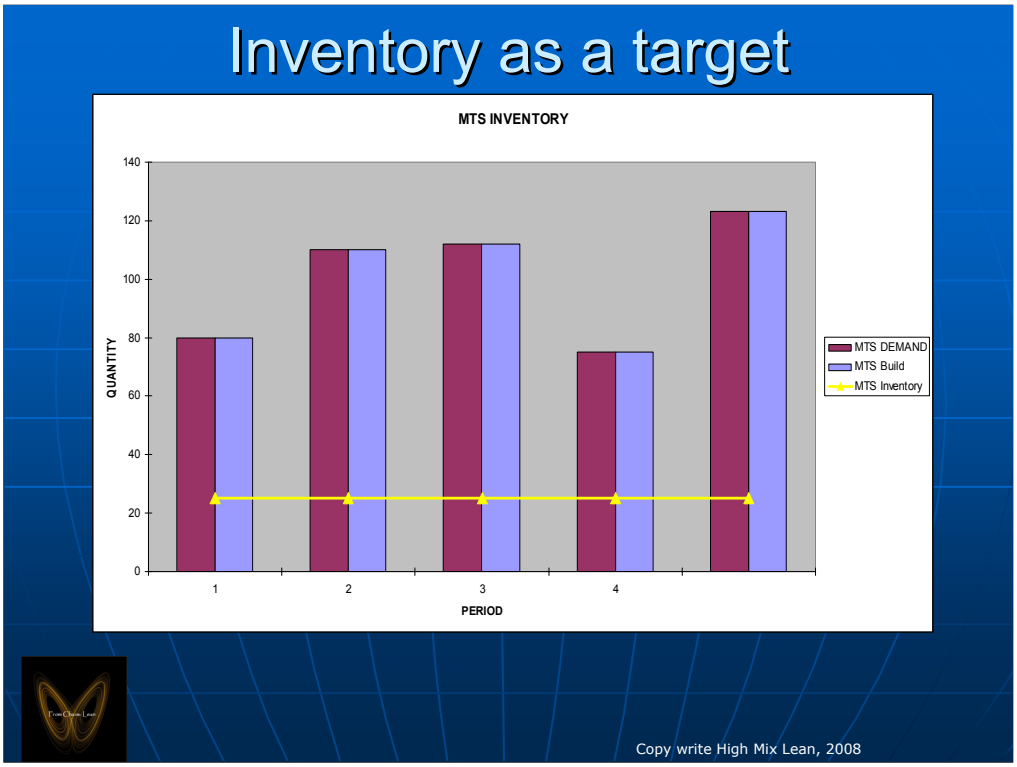
This chart shows how demand varies between intervals between the two bars for high and low inventory, and a line representing the total sales volume. Note the variability.



This chart illustrates varying the high volume item production to keep the total production constant. Red bar is demand for high volume parts, blue bar is production, red line is low volume item sales and production, and the blue line is the total production.

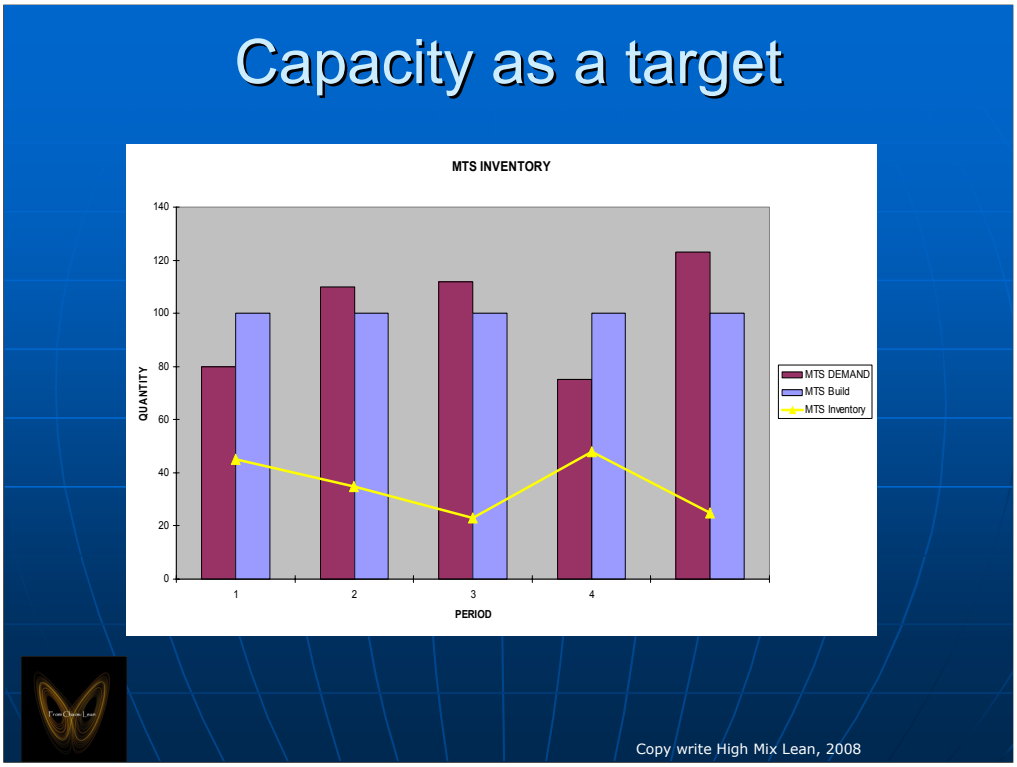


This chart shows how the inventory of the high volume parts will vary by interval as we level the production volume using this strategy. Red bar is demand for high volume parts, blue bar is production, yellow line is the inventory.

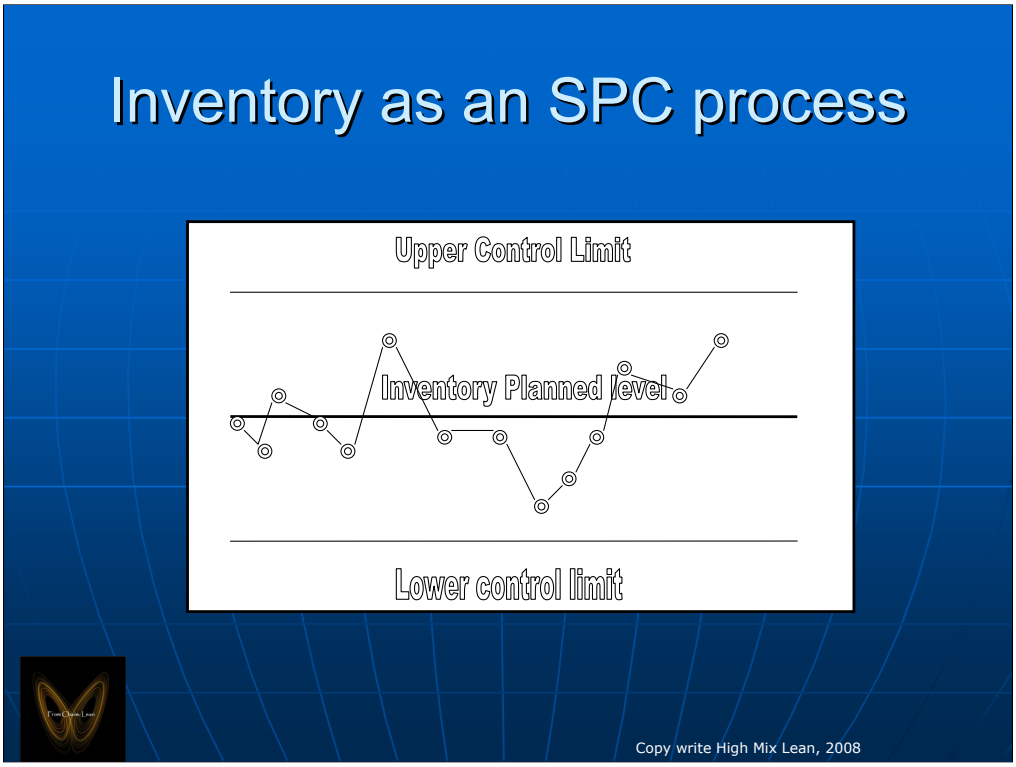


In general, I think it's fair to say that most approaches to linking demand with supply treat inventories as a fixed target, with the idea being that if we have the correct amount of inventory we will have the desired level of customer service. The result of this, as seen in the graph above, is that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

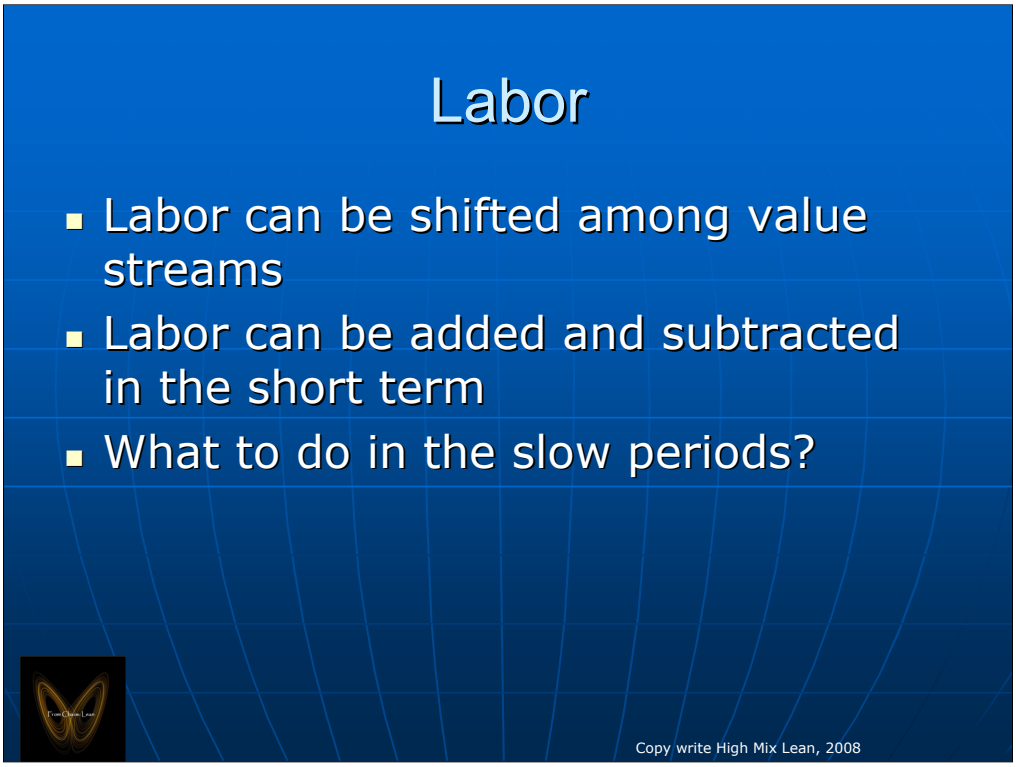
An even worse scenario is created when a system is put in place which wants inventories to increase as demand increases, resulting in a phenomenon which is known as the bullwhip effect. What happens in this case is that as demand goes up, not only does production have to increase to meet increased demand, 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 first chart below illustrates the concept of managing inventory within a range. Even though the inventory level is changing quite a bit over time within this profile, it has consistently stayed within the expected range as set by the upper and lower control limits. This means that there is no reason to change the production rate for this value stream, unless some significant change in demand is known in the future, such as a seasonal demand change.



Having train schedules for all of the shared resources may be a way to identify the source of extra labor for certain periods. All of these options require good coordination and tight control of the various value streams involved. Another option is to staff for peak volumes, or near peak volumes, then use spare time in lesser periods to make improvements in flow.

Labor

- Staff to be able to satisfy the higher level of expected business
  - Try to find productive activities in slower periods
- Alternately, vary staff as demand varies
  - Requires a flexible work force or perhaps temporary employees

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Backlog

- Often referred to as having a variable customer order backlog
- In order to keep capacity leveled, each customer order gets its own promise date sometime in the future according to when capacity is available

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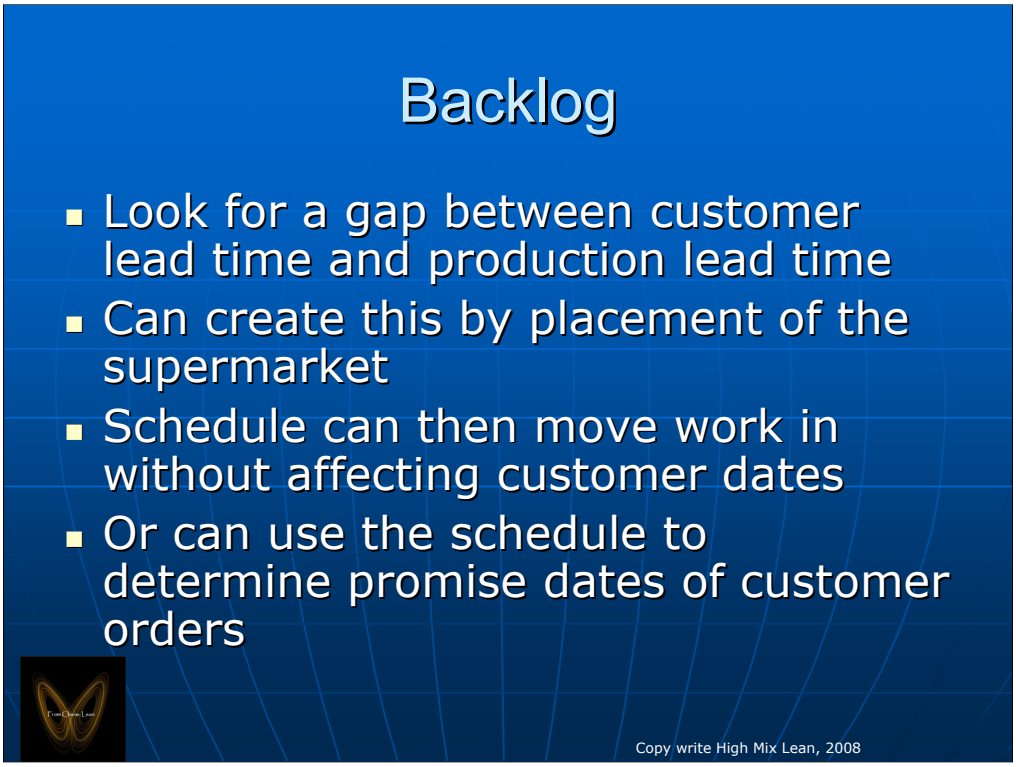
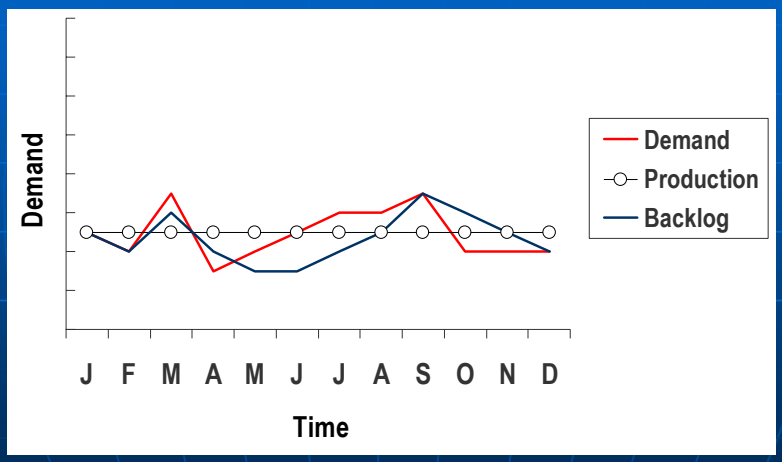


Create heijunka exercise to manipulate promise dates.

Create slide of lead time gaps and interval.

Backlog



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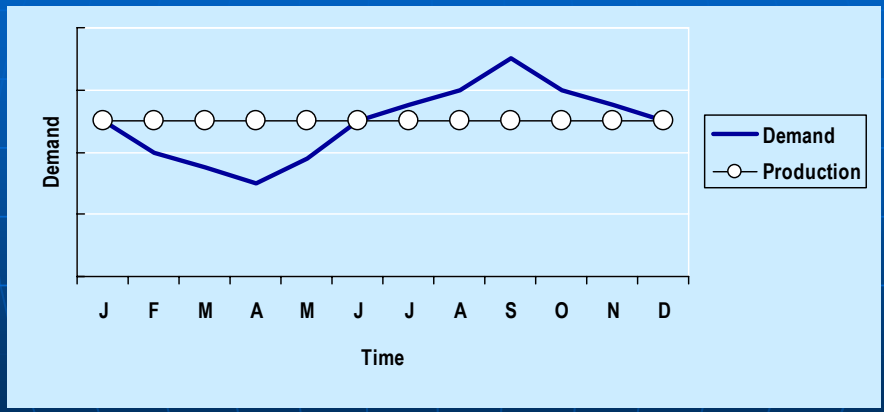
The strategies as charts

Capacity constant: vary inventory or backlog as sales vary



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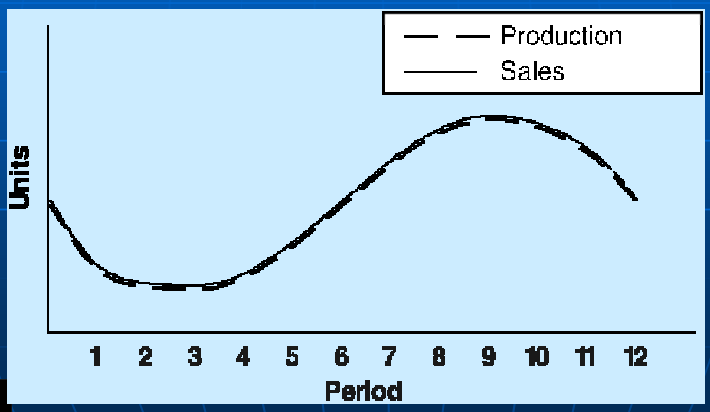
The strategies as charts

Inventory or Backlog constant, vary capacity to equal sales



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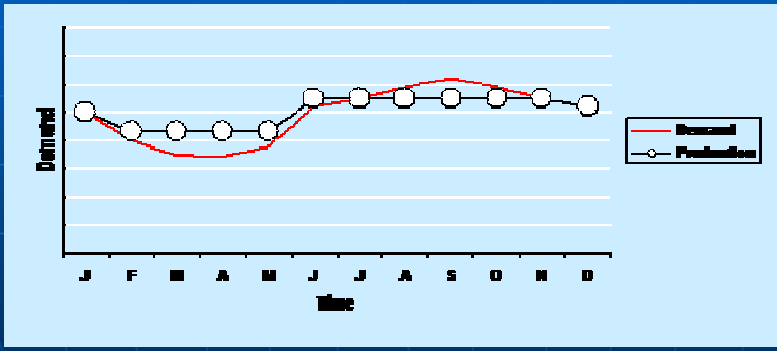
The strategies as charts

A hybrid strategy of varying capacity occasionally and inventory or backlog the rest of the time



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MPS versus Lean

MPS	Lean
Demand	Demand
Inventory	Capacity
Supply	Supply
Capacity	Inventory

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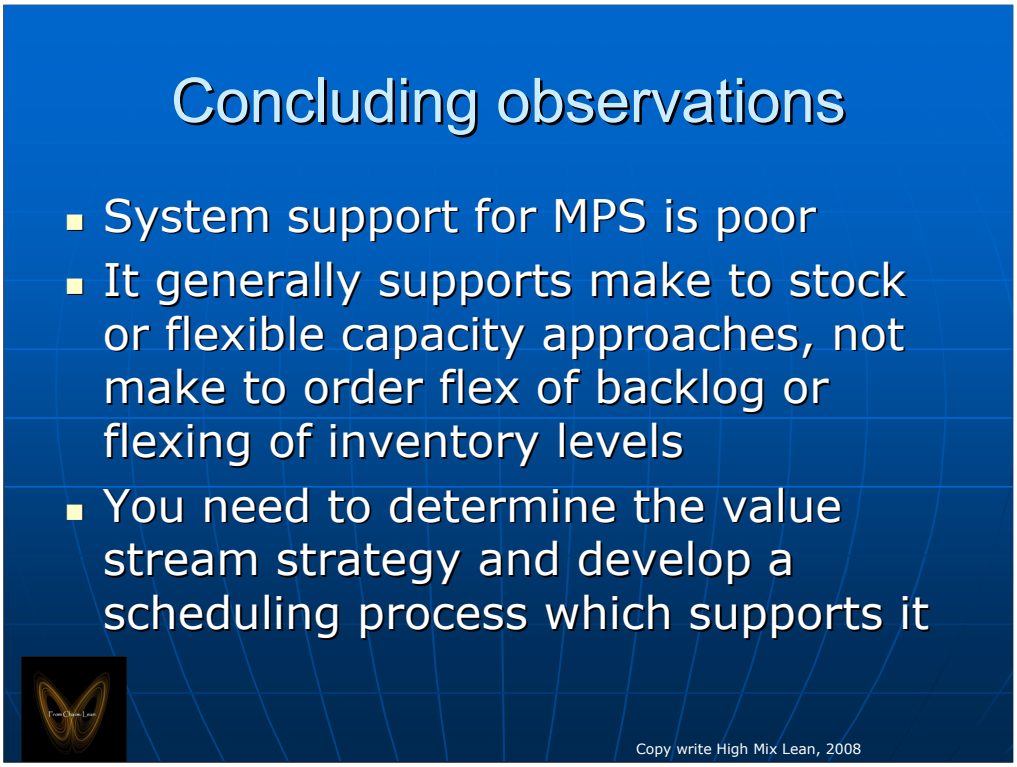
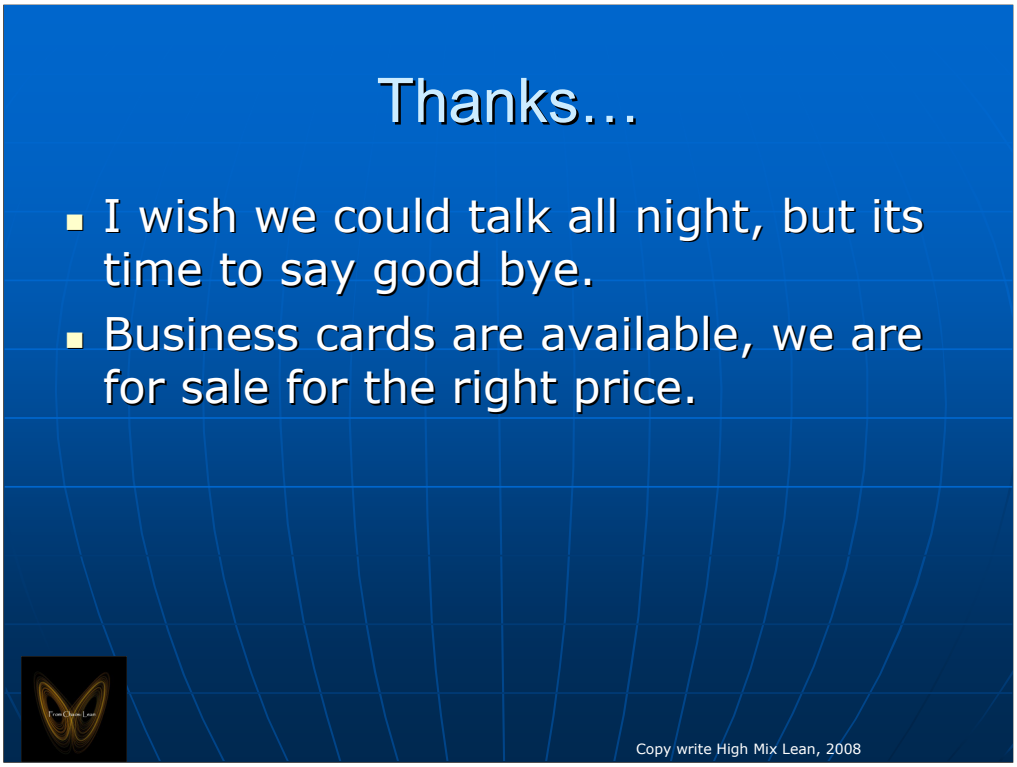


The concluding observations are just to refocus the audience back on the original topic, which was to provide some insight into whether Master Production Scheduling was an acceptable substitute in the lean world for the Heijunka process. The first point is that if the major concern is to load work to 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.



Please send your checks to :

Bill Kerber care of High Mix Lean, 7 Prickett Ct, Medford, NJ 08055 .

Thank you .