April 20, 2005

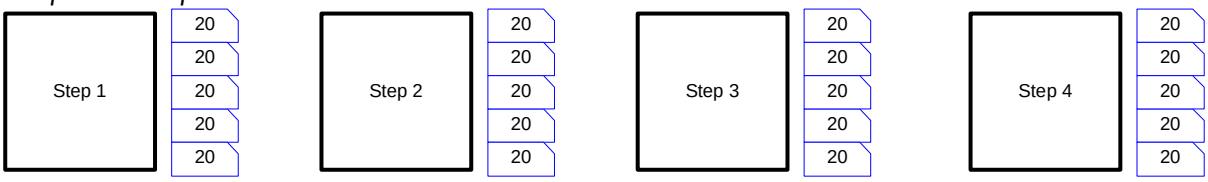
LEAN: RECALCULATE THE KANBANS OR THE CAPACITY?

One of the things we hear the most often is the necessity of recalculating the number of Kanban cards to insure that there will be enough WIP to support a new production rate, either higher or lower than the current one. Should the number of Kanbans be recalculated every day, every week or every month?

The best answer is probably: don't recalculate them at all! Within very large limits, the same number of Kanbans containers or cards can support a higher or lower production rate. The containers circulate faster or slower, period. The key is not the number of Kanbans—which represent in-process inventory—but the capacity or the velocity of the process to cover demand which is higher or lower.

Imagine for example the following flow (you may want a calculator!): 4 production steps connected by Kanbans, 5 Kanbans after each step, each Kanban being a container of 20 parts. In total, there can be a maximum of 4 X 5 X 20 = 400 parts in the process if all 20 containers were full at the same time.

The production process:



If demand on the process is 100 products per 6-hour day, or 21600 seconds, the takt time is 21600'' / 100 = 216 seconds between the consumption of two products. If the cycle time is defined as being 10% less, to cover small flow problems, it will be 216'' – 22'' = 194 seconds between the production of two products.

Each day, the process must turn out 5 containers of 20 parts to cover the demand for 100. The pitch, equivalent to the takt time for the 20 products in a container, is 20 X 216'' = 4320 seconds or 72 minutes. Every 72 minutes a materials handler will come to the end of the line to take away a container full of 20 good products. He or she will make 5 pickups per day to take away product (21600'' / 4320'' = 5).

Suppose that demand increases by 20% to 120 products per day; the takt time becomes 21600'' / 120 = 180 seconds. The cycle time becomes 180'' – 18'' = 162 seconds. Each day, the process must turn out 6 containers of 20 parts to cover the demand of 120. The pitch becomes 20 X 180'' = 3600 seconds or 60 minutes. There will be 6 pickups per day (21600'' / 3600'' = 6).

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The table below summarizes these numbers and shows the results for demand increases of 40%, 60% and 100%:

	U/M	Number	Number	Number	Number	Number
1day (6h)	*seconds*	21600	21600	21600	21600	21600
Demand	***Quantity***	**100**	**120**	**140**	**160**	**200**
Takt time	*seconds / product*	216	180	154	135	108
Cycle time (10%) = Takt - 10%	*seconds / product*	194	162	138	121	97
N° of containers to cover demand	*containers (20 pieces)*	5	6	7	8	10
Pitch	*seconds*	4320	3600	3086	2700	2160
	minutes	72	60	51	45	36
Number of pickups		5	6	7	8	10

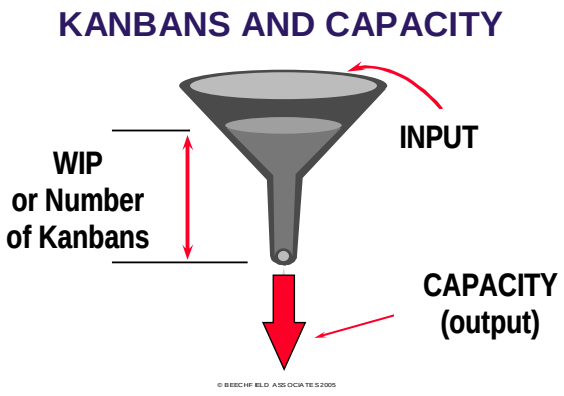
If the demand rate increases from 100 to 120 (+20%), the production rate must also increase by 20%. But the takt time (for demand) decreases only 17%, and the cycle time (for production) increases by 16% (see the table).

The number of Kanban containers that must be delivered each day increases by 20%, the pitch decreases by 17%, and the number of pickups increases by 20%.

However, the number of Kanban containers in the system has not changed. There are still 20 containers, still 20 parts per container, and still 400 parts in total. The containers turn around faster, that's all. At 100 products per day of 21600 seconds or 360 minutes, a container of 20 parts comes off the line every 72 minutes or 1 hour 12 minutes. At 120 parts per day, a container of parts comes off the line every 60 minutes, or 1 hour. Only container No. 1 out of the 5 containers will be used twice in the same day when 120 products are being produced in total.

In particular, increasing the number of containers or Kanban cards in the system will not make them go through the process faster; the *reverse* is true!

What counts is the output flow, not the level of water in the funnel.



Therefore the number of containers in the system, once calculated initially, should not change at each increase or decrease in demand. It's the takt time and the cycle time which change. In addition, the cycle time isn't going to change every day: that would cost too much, would disturb the process regularity necessary for Total Quality, and would introduce ups and downs in requirements transmitted to suppliers. None of that will contribute to better customer service.

A good practical guideline is to keep the same cycle time within the Firm Zone of the Master Production Schedule, typically one to four weeks. Shorter would be better, but even Toyota maintains its cycle time unchanged during one week. The following week's cycle time may be modified by +/-10%, and the week after that, +/-20%. In addition, an MPS managed at the family or flow level instead of by individual item, cushions the modifications even more. Anticipation can't be absent if a company wants to Accelerate. It's a necessary pre-condition.