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ALL ABOUT TAKT TIME

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Abstract: Takt Time is a one of the key principles in a Lean Manufacturing Systems. Takt Time sets the "rhythm" of the organization in synch with customer demand. As one of the three elements of Just In Time, one-piece flow and production pull, Takt Time balances the workload of various resources and identifies bottlenecks. Takt Time is a simple concept, yet counter-intuitive, and often confused with cycle time or machine speed. In order for manufacturing cells and assembly lines to be designed and built Lean, a thorough understanding of Takt Time is required.

1. Introduction

Takt time as a concept and tool predates theory of constraints by decades. Takt time, in great contrast to the way some have misunderstood it, is not primarily for use on highly repetitive assembly lines! And its primary purpose is certainly not for staffing determination! Takt time was developed as a manufacturing flow tool in the 1930s. It was thoroughly developed by Toyota internally as a manufacturing management tool in the 1950s. By the late 1960s it was in widespread use throughout the Toyota supply base and was well known throughout Japanese industry by the mid-1970s. In the U.S., Takt time was a well-known concept by the mid-19802, well before the term "lean" was even introduced.

The purpose of takt time is, first and foremost, to serve as a management tool to indicate at a glance whether production is ahead or behind. It serves as an alignment tool, aligning proceeding with following processes, aligning resource requirements with demand, aligning corporate functions with real-time production needs

Rather than being limited to "repetitive production situations," takt time is actually most useful in helping establish flow under those very conditions when flow is especially difficult to establish or see. In fact, its first use (in 1930s Germany) was in the aerospace industry, where product flow was extremely slow and repetitive activities difficult to discern. Toyota adopted and further developed takt time in the 1950s to help them cope with their situation at that time, which was vastly different from their Detroit-based competitors, who were blessed with seemingly endless demand. Toyota at that time was producing volumes that were a tiny fraction of that of the Big Three (in 1950, Toyota as a company was producing in one month no more than each of the Big Three produced of one model on one assembly line in one day! And Toyota was producing numerous different models within that tiny volume).

From this you can probably see that another common comment – that takt time has no application in "low-volume job shops" – is also a misconception. Most of Toyota's early suppliers were "job shops" and many of them still are. A purpose of takt time – the "alignment" issue mentioned above – is to bring them into the flow. Takt time *is* useful in situations where the product mix is complex, the flows are complex, the demand changing, and in various processing environments – Toyota's Taiichi Ohno proved out almost all of the concepts in his machining shop before expanding to other areas.

2. Takt Time - The Demand Rate of Production.

"Takt" is a German word which refers to the pace or drumbeat of a musical composition. Imagine the chaos if each member of a band were to play the music at their own pace. The power of the music would never be realized. Similarly, when production operations do not work at the same pace, chaos ensues.

Takt time provides definition to the relationship between work time available and the customer requirements, and enables us to be aware of the time available to complete the job.

You can never measure Takt Time with a stop watch. You must calculate it. The formula for Takt Time is:

$$\text{Takt Time} = \text{Available time per day} / \text{customer demand per day} \quad (1)$$

It is common to confuse takt time with cycle time, which is the actual elapsed time required to complete a task. However, they are distinctly different concepts, and are not related. Takt time is impacted only by customer demand and the amount of time available for production. When demand rises, takt time drops. When available production time increases, takt time increases as well.

3. Cycle Time – The Production Rate

Cycle time tells us how often we can produce the product with current resources and staffing. This isn't the same as capacity or even detailed process analysis, but an accurate representation of how the line is currently set up to run.

Cycle time calculations take into account the entire production quantities. When multiple lines are producing the same product, then the composite cycle time is less than the actual lapsed time of any individual line. The cycle time is the expected or historically average total production time per unit produced. On an assembly line or in a workcell with multiple operators, each operator will have a time associated with completing the work he is doing.

However, when referring to the cycle time of the line, we are referencing the longest of these individual cycles. To reduce the cycle time of the line, we won't have to revamp the entire line, only the operation which is sets the pace.

4. Takt Time vs Cycle Time

In practice the difference between takt time and the cycle time should be made this way:

- takt time represents the maximum time allowed to meet the customer demand,
- cycle time is the time necessary for an operator to perform an activity.

People often confuse Takt time with the cycle time. They look at Takt time as the amount of time they have to get the job done. When Takt time is 60 seconds, (or whatever it might be) people think they have just 60 seconds to complete a job that may take more than three hours to perform. Thus the claim, "Takt time does not apply to us."

The 60 seconds is actually an indicator that their system needs to be adjusted to yield a part or activity every 60 varying amounts of time. To balance the flow, each task needs to be reviewed in terms of the 60 second Takt time and actions need to be taken to bring tasks

within Takt. This creates even, predictable flow, but it does not suggest or drive the touch time to be completed within 60 seconds.

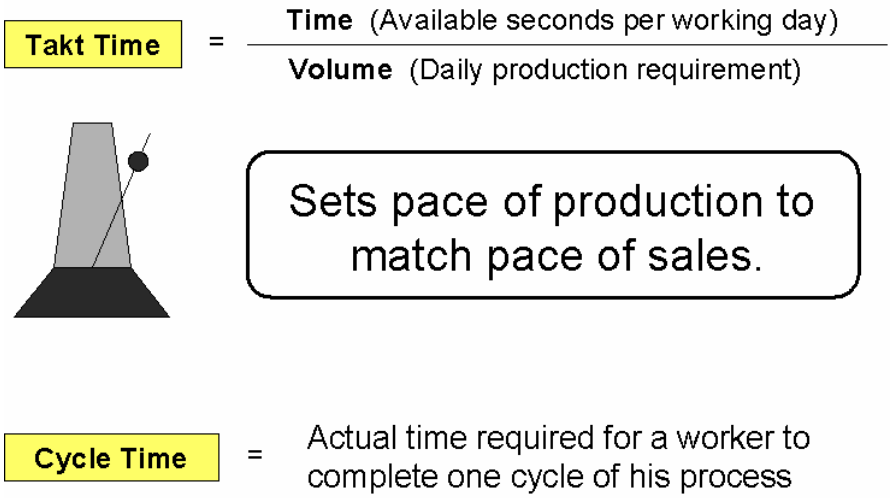

***fig.1*. Takt time vs Cycle time [5]**

Takt is not a number that can be measured, and is not to be mistaken with Cycle Time, which is the time it takes to complete one task. Cycle Time may be less than, more than, or equal to Tak Time.

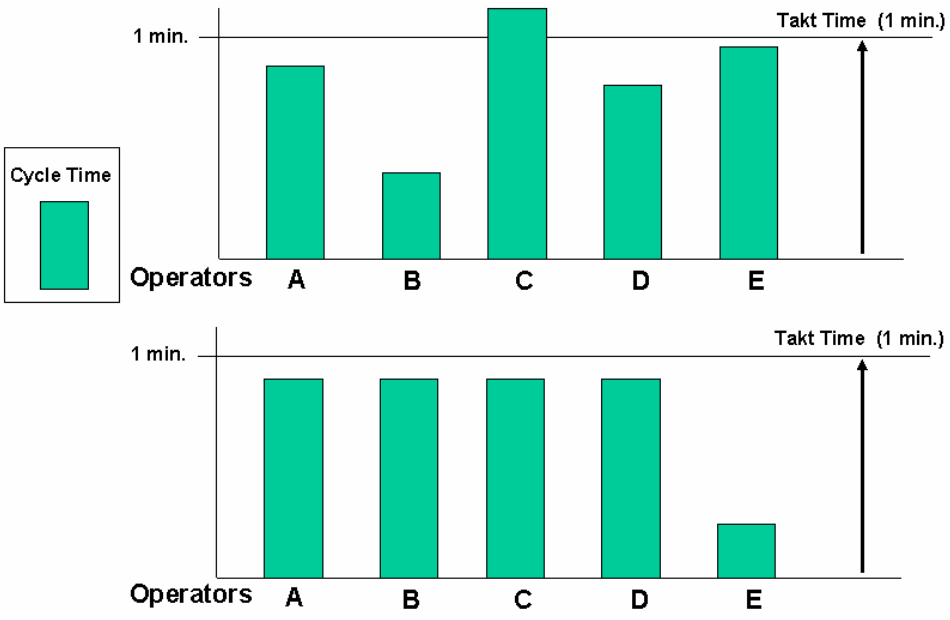

***fig. 2* Relation between Takt time and Cycle Time[5]**

Takt Time and Cycle Time are determined by customer demand, for which we usually have little control. So we adjust Cycle Time to meet Takt Time, by adjusting:

- Available production time (the number and length of shifts)
- The number of work cells making the same item (thereby increasing the Takt Time for each)

- The number of end items produced in a cell (thereby increasing or decreasing demand for that cell)
- The number of operators in the work cell

5. Limitations of Takt Time

- Takt time is useful for simple cells **-** These are typical of the workcells at Toyota and what most people think of when they picture a cell. Such cells have:
  - Minimal Setups
  - A Single Routing
  - Identical Work Times for All Products
- Takt time has little relevance for job-shops and other low-volume, high-variety operations
- Problems can result from an unjustified preoccupation with Takt time.
  - Designers who think only of Takt time may conclude that certain products cannot use Cellular Manufacturing and their companies lose the many benefits.
  - Can lead to unsuitable process designs

6. Conclusions

The simplicity of the concept belies its extraordinary effects. Among these are:

- Production Stability - by limiting overproduction, it stabilizes the system and prevents buildups of inventory and the subsequent stops and starts.
- Workcell Design - Takt time helps cell designers. In an ideal workcell, all tasks are balanced, they all require the same time to execute and that time equals the Takt time. If any operation requires more than the Takt time, the cell cannot produce at the necessary rate.

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