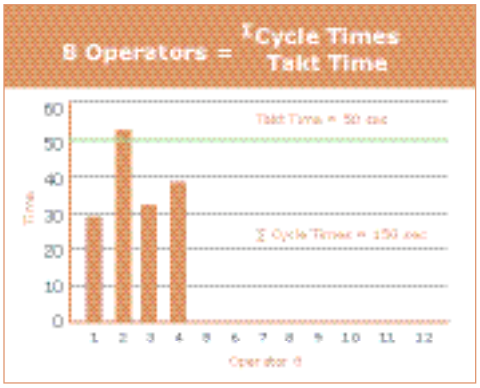
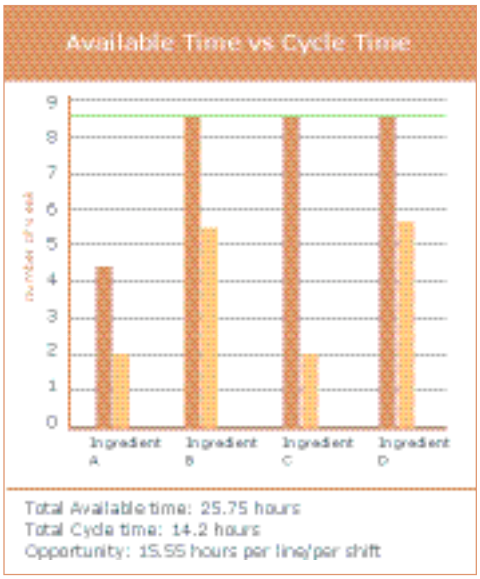
Calculating Takt Time in the Process Industry





Not all of the lean tools used in discrete manufacturing translate easily to the process industry. This is especially true with regard to the takt time/cycle time (TT/CT) chart. Because the process industry is usually capital intensive, we often don't conduct labor productivity kaizen events. Instead we conduct events to maximize the utilization of capital equipment, such as TPM or set-up reduction, or we conduct events to maximize raw material utilization, such as Six Sigma or leak events. But there are some parts of process industry that require high labor intensity, such as in packaging or areas where operators have to add a lot of ingredients to create a food product. In the latter example, although all ingredients might be added to the product automatically, it requires a lot of labor to prepare those ingredients. We recently held an event to improve labor productivity of operators who prepare ingredients for addition to a food product.

In discrete manufacturing, we would first calculate takt time, then derive cycle time for each operator by using a time observation form. From these observations, we can then calculate the total numbers of operators required for a particular process. In the case described below, we would need three operators instead of four, an "instant" productivity improvement of 25 percent. Of course, if we can make physical improvements and reduce cycle times further, we can make additional improvements and eventually reduce operator counts to two or fewer. These are basic steps taken in discrete manufacturing to improve productivity.

In the process industry, however, takt time for each unit is not usually calculated, for there are no individual units. Production is continuous. Rather we calculate takt rate, because even when producing individual food products, the production rate is so fast (e.g., one item every 0.2 seconds) as to be essentially continuous. We try to understand how many of a particular food item customers want, then convert that into the number of that item that must be produced per time period. For this particular kaizen event it was 14,000 food items per nine-hour shift. As you can see, takt rate is a reciprocal of takt time. In takt time, we have time in numerator and unit in denominator. But takt rate has unit in numerator and time in denominator. This gave me the idea to reverse the role of takt time and cycle time.

To improve labor productivity in the process industry, we should calculate what I would call "available time vs. cycle time" (AT/CT). First, just like in discrete manufacturing, we calculate takt rate to understand how much raw material is being consumed to satisfy customer demand.

In food production for example, if you need to produce 14,000 food items per shift, you might need six 600-kg tubs of ingredient B. Say the time required for an operator to get one tub of ingredient B to the production line is 30 minutes. The same operator could provide six tubs of ingredient D to the line in 10 minutes. So in a nine-hour shift, the total operator cycle time is 240 minutes. A nine-hour shift includes an hour for lunch and breaks, leaving a total available time (AT) of eight hours (480 minutes). In our example of an operator preparing ingredients B and D, available time is 480 minutes and the total cycle time is 240 minutes, providing a labor efficiency of only about 50 percent. The top chart shows actual calculations for four different operators.

During the kaizen event, we observed four operators on one line. Each operator, except one, has an AT of 8.5 hours per shift. AT includes a 30-minute break instead of the hour available because sometimes operators do not take breaks. The other operator has only 4.25 hours of AT because that operator actually works on two lines. The total AT for four operators on one line is 29.75 hours. The total cycle time is 14.2 hours, leaving 15.6 hours of idle time. From this calculation, you can see that this line really needs just two operators. If we can also make physical changes to reduce the total cycle time, then we can further reduce the number of operators needed, just as in the discrete model. ■

—Ku Ho (Jonathan) Chong
TBM Senior Management Consultant