What is Your Manufacturing or Process Cycle Efficiency?

In the world of production, there are truisms that never fail when tested. When you have excess WIP, you will have a longer product cycle time. When you have a low Cycle Time, you have your WIP under control. These are basic examples that are based on Little's Law, but there is another that is not as well known but is certainly equally true.

Cycle Time (CT) can be improved by reducing WIP or improving the output rate, but will you solve your production problems by just arbitrarily cutting inventory or hiring more people? The answer should be obvious to many managers but sadly, it is not. It is my experience in manufacturing that many managers look for easy answers that often slap them in the face later because they didn't use the correct value set to arrive at the conclusions that they based their decisions on.

For years, there has been a measurement that was used for some time by IBM manufacturing companies that practiced Continuous Flow Manufacturing (CFM). The measurement was called MCE and I don't remember just who in the CFM team came up with this measurement, but I did find it very powerful when I worked with the CFM team. It wasn't used much then, but I did resurrect this measurement in my simulation consulting while with IBM, and even used it in calculating the positive effects of potential process changes with my clients. I continued to use it after I formed my own company.

What I found then was that calculating the reduction in CTD was not enough! There had to be a way of calculating the "wisdom" involved in reducing it. Was the cycle time reduction the result of automation, meaning a faster machine? Was the reduction the result of adding resources? Or was it the result of reducing or eliminating non-value add steps in the process?

These are important questions when evaluating the wisdom of process change. It makes no difference whether the product is a widget or a piece of paper; if the process involves distinct actions, each of which have to be completed before the product moves on; HOW you arrive at a cycle time reduction of that process is very important.

As the product moves through the process, those process steps that directly contribute to the form, fit or function of the product are Value Add (VA) process steps. Those process steps that do not directly contribute to those three "F's" are Non-Value Add (NVA) steps. Examples of NVA steps are: Counting, Inspecting, Machine Setups and Documentation. Each of these might be considered important to the producer, but do not for a second confuse "Important" with "NVA". As important as it is to the product in terms of quality, reliability or accountability, it is still NVA and open for elimination or reduction.

Eliminating a NVA step can be accomplished two ways: Either eliminate the necessity for the step, in which case it simply goes away or is reduced, or move the step into a parallel position which does not extend the CT of the product. Working on removing those kinds of process steps can bring about improvements in CT, but they are usually not the kind of improvements that have the most impact on product CT.

The kind of NVA time that really has the most impact is not often calculated in most businesses. The kind of NVA step that has the most impact is not really a step at all, but rather is the result of inaction rather than action. Think of a conveyor that contains product that stops at 10 locations to allow the worker to perform a value add function. Now think of the fifth of ten persons along the line suddenly stepping away from the line for whatever reason. The product stops and waits for that person to return. The time that is consumed while the worker is away is precisely what I am talking about.

The CT of the product is extended numerous times in most plants and even in most offices when the product has to change hands numerous times. Work is placed in a queue and that queue could be a bin in a factory or an in-box on someone's desk. The product CT is extended while that product is waiting for attention. Many managers might blame the worker for such delays, but if they do, they are probably placing the blame where it doesn't belong. Speeding up the conveyor or the worker is not the wise solution. Eliminating the need or the possibility of something happening is where the wisdom is.

Now there has to be a way of determining just how many NVA steps are in your process and what the impact that those delays have on CT. That measurement is Manufacturing Cycle Efficiency (MCE), or in other businesses such as Banks, it is called Process Cycle Efficiency (PCE). MCE and PCE are calculated using the following equation: MCE = VA/CT and shown as a whole number (times 100). In a factory that has a 12 day CT with 1 day of VA, the MCE would be 8.

The best company that I worked with when I arrived there had a MCE of less than 10! A company with a MCE of 45 was considered "World Class"! Any company whose product moved through multiple departments had a low MCE and most one room assembly lines had a more favorable MCE. The best I have seen or heard of in a large company was an automobile manufacturer with a MCE of 45. The reason was that the product line was essentially a conveyor that rarely stopped. But in many manufacturing companies, the movement of product from one department to another, and then have the product wait for large periods of time before being worked on resulted in a long product CT.

Whenever I created a simulation model, I always measured CT, VA and MCE and made recommendations based on opportunities for reducing CT. The solutions were always readily apparent and when I ran experiments that compared "What could be" with "What was", I always showed the comparisons with the baseline metrics and the metrics of the potential solution. The reason that I did this was obvious then and has always proven to be true. Little's Law guided my actions. I knew that to reduce waste and reduce inventory would result in impressive changes in CT and MCE.

It is possible to calculate MCE without simulation, but it would not be as accurate. By tagging each product piece with the "CT" and "MCE" attributes and then recording the total CT of each entity as it exits the model, the result created was a stochastic representation of CT and MCE. Experiments were then designed that looked specifically at small potential process changes. It was then possible to create a plan for improvement that showed a series of process changes, each of which could be a prerequisite for the next change. This allowed management to evaluate the plan and implement it with less risk and cost over time.

I have helped quite a few companies improve using simulation modeling as a tool, but in each and every case, I always educated my clients on the importance of Little's Law and MCE. While it is true that the three most important elements of production are: Cycle Time, WIP and Output Rate, HOW each of them are improved is equally, if not more important. Quality of course is important but it is a given. By that I mean that any solution that even has the possibility of adversely affecting quality should be reconsidered. The proper solution will always improve quality. MCE is degraded when there is more Waste in the process and it is improved when there is less.

What could be clearer than that?

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