

It's About Time!

By Ken Feldman, PhD
OptecConsulting, LLC

In the lexicon of Lean Six Sigma, Operational Excellence and Industrial Engineering, there are several metrics and definitions relative to the concept of time. Among the most common ones are **lead time**, **process lead time**, **cycle time**, **takt time**, **throughput**, and **work center time**. The problem and confusion are that some of these terms are used interchangeably, or the definitions are so similar it is hard to distinguish between them. I will try to compare the terms and provide an alternative term that might be easier for people to understand, especially your customers.



The first thing I want to do is define what a customer is. One simple definition is that the customer is the person or entity that is the receiver of the output of a process or service whether they be the final consumer, next department, government agency or next step in the process. If we are dealing with time as it relates to process performance and want to meet the customer's expectations, then we need to understand when the clock starts and stops in the mind of the customer.

Let us look at some definitions of the terms above and see which ones might best reflect what the customer feels is important. Everyone might not agree with my definitions but that would only reinforce my comment about the confusion associated with the terms.

Lead Time

Lead time refers to the total amount of time it takes for a product to be manufactured or delivered after an order has been placed. This also applies to the rendering of a service. It includes all the processes or activities involved in production, procurement, and transportation of goods from the *initial placement of the order until it is delivered to the customer*.

A term that is sometimes confused with Lead Time is **Turnaround Time**. The difference between the two are:

- Turnaround time typically refers to the *total time it takes to complete a specific task or process from the moment it is initiated until it is finished and delivered back to the requester*.
- *It is often associated with service-oriented processes*, such as processing requests, completing tasks, or providing services.
- Turnaround time focuses on the duration of the process itself and measures how quickly a task or request is fulfilled.
- Lead time, on the other hand, refers to the total time it takes for a product or service to be delivered from the initiation of an order or request to its completion and delivery to the customer.

- It encompasses all the activities involved in fulfilling the order, including procurement, production, transportation, and delivery.
- *Lead time includes both processing time (the time required to complete the work) and waiting time (the time spent waiting for the next step in the process).*

Process Lead Time (PLT)

Process lead time, sometimes referred to as lead time, is the total time it takes for a process to be completed from start to finish. It includes all the steps and activities involved in the process, from the initiation to the completion of the task or project. Process lead time encompasses both value-added activities (such as actual work on the task) and non-value-added activities (such as waiting time or administrative tasks). It is defined as **Work in Process (WIP)/Exit Rate (units per time period)**. Exit rate is also referred to as throughput.

Cycle Time



Cycle time refers to the total time it takes to complete one cycle of a specific task or process. It includes all the steps and activities involved in completing the task or process, from start to finish. In manufacturing, cycle time often refers to the time it takes to produce one unit of a product.

Difference between Lead Time and Cycle Time

- Lead time is the total time it takes from the initiation of an order or request to the delivery of the final product or service to the customer.
- It encompasses all the activities involved in fulfilling the order, including procurement, production, transportation, and delivery.
- Lead time includes both processing time (the time required to complete the work) and waiting time (the time spent waiting for the next step in the process).
- Lead time is often measured from the customer's perspective, focusing on the time taken from placing an order to receiving the product.
- Cycle time, on the other hand, is the total time it takes to complete one cycle of a specific task or process, from start to finish.
- It measures the time required to produce one unit of a product, complete one operation, or perform a specific task within a larger process.
- *Unlike lead time, cycle time does not include waiting time; it focuses solely on the time spent on value-added activities.*
- Cycle time is typically measured from the perspective of the process itself, focusing on the time taken to complete the work once it has started.

Takt Time

Takt time represents the available production time divided by the customer demand. It is the rate at which a product needs to be produced to meet customer demand while utilizing all available production time efficiently. Mathematically, takt time can be expressed as:

$$\text{Takt Time} = \text{Available Production Time} / \text{Customer Demand}$$



Takt time is often used as a pacing mechanism for process performance whether it be manufacturing or service delivery. It helps to synchronize the production process with customer demand, ensuring that products are produced at the right rate to meet customer needs without overproduction or underproduction.

Available Production Time is the scheduled hours for a time period minus such things as meetings, equipment downtime, breaks etc. that reduce the time available for production of customer demand. By aligning production with demand, takt time helps to reduce waste, minimize inventory levels, and improve overall efficiency in manufacturing operations.

Throughput

Throughput generally refers to the rate at which a system, process, or resource can process or produce items within a specified period of time. Recall this was used as the denominator in the formula for process lead time (exit rate).

Work Center Time (WCT)

In the context of manufacturing, Work Center Time refers to the amount of time spent on a specific task or operation at a particular work center within a manufacturing facility.

Work centers are specific locations within a manufacturing facility where specific operations or processes are performed. These can include machining centers, assembly stations, welding stations, painting booths, and more.

WCT measures the time taken to complete the tasks or operations at these work centers, including setup time, processing time, and any other time spent on value-added activities. It does not include non-value-added time, such as waiting time or downtime.

Below is a summary table of the various time terms defined above:

Metric	Definition	Focus	Measurement Unit
Lead Time	Total time from order placement to product delivery.	Customer perspective	Time (e.g., hours)
Process Lead Time	The time from when an item enters the process until it exits the process. This includes all value added and non-value-added activities.	Process perspective	Time (e.g., hours)
Cycle Time	Total time to complete one cycle of a specific task or process.	Task/process perspective	Time (e.g., seconds)
Takt Time	Rate at which a product must be produced to meet customer demand.	Synchronization with demand	Time per unit (e.g., seconds per unit)

Metric	Definition	Focus	Measurement Unit
Throughput	Rate at which a system or process can process or produce items within a specified time frame.	Efficiency of processing/production	Units per time (e.g., items per hour)
Work Center Time	Time spent on a specific task or operation at a work center.	Efficiency of work centers	Time (e.g., hours)



While the terms above are pretty mainstream and simple to understand, I prefer to use the concept and term **“wing-to-wing.”** The “wing-to wing” terminology was developed at GE aircraft engines. Although GE was gaining efficiency in aircraft servicing, their customers were complaining that they were not seeing or feeling any improvement.

The primary reason was that GE was focusing on efficiencies from the time the engine arrived at the plant until it was ready to go back to the customer. The customer’s clock started when an engine was removed from the wing and the plane was grounded until the engine was back on the wing and the aircraft put back into service. To rectify the perception of their customers that nothing was improving, GE looked at the process from the customer’s perspective which was “wing-to-wing”the time an aircraft was out of service due to an engine off the wing until an aircraft was back in service with an engine on the wing. This allowed them to focus on the activities prior to arrival at the facility and those from exiting the facility to reinstallation on the wing.

Another example can be found in the Emergency Room (ER) in a hospital. Hospital metrics focus on the turnaround time from when the patient is brought into triage until they are given discharge paperwork. But the patient’s experience starts when they enter the hospital parking lot. If they must ride around looking for a parking spot, then that is when their clock starts. It ends not when the discharge paperwork is done but when everything is completed including any payments and they pull out of the parking lot or are admitted and in a patient bed upstairs.

Years ago, hospitals offered a promise that if the time from when you are put in an examination room until the doctor sees you, is greater than 30 minutes, that portion of the cost will be waived. Of course, waiting in the lobby for two hours or waiting hours for any tests or procedures and then waiting hours for the doctor to discharge you or admit you was not included in the deal. Hospitals stopped making the promise since the patient was not happy despite the promise. Their “wait time” was from the time they tried to park until they left or were admitted. The doctor’s time was a very small component of their overall experience.

Another example might be when the operator on the manufacturing line reports that they have run out of a specific raw material. That is when the clock starts in their mind. The company may view the time they place the order until it is received on the loading dock as the critical time to measure. But what about the time from when the operator reports the need for material until it

goes through the approval and procurement process until an order is finally placed? Or the time from when it arrives on the receiving dock until it is finally received line side ready for use? When the operator can actually pull the material for use is when their clock stops. A wing-to-wing mentality would include all the time on either side of the actual ordering and receiving process. The supplier may be very consistent with their process, but the internal processes may be disruptive to the operation.

The good news is that TSA is working hard to reduce the time it takes to examine your bag once it is put on the belt until you remove your bag from the belt. But what about all the time you spend waiting to put it on the belt or the time to retrieve it if your bag is diverted for hand inspection? Or the time going through the metal detector or x ray machine?

I will bet that when you go to your favorite restaurant your clock starts when you give the order to your server. Your clock probably stops when the drink or food plate is put on the table in front of you. But the kitchen is measuring the time from when the ticket is put in the system and is retrievable until the finished item is put on a counter or shelf for the server to pick up. Staring at your drink on the bar top while your server is running around will probably be an irritation.

As you can see, the customer's definition of clock start and stop is often different than what the organization may perceive is the critical metric to measure. A **wing-to-wing** mentality may help reduce or eliminate customer frustration and dissatisfaction concerning your organization's process performance.

In summary, I have tried to provide some clarity for understanding the variety of metrics that organizations use to measure their process performance. The key will be to understand how the customer defines the start and stop of their clock when assessing the performance of the process. That does not mean you should not also measure some internal measures of time such as Takt Time, but frankly, the customer probably does not care. They want to know what you are doing to reduce the time from when their clock starts until they can stop their clock. Therefore, think wing-to-wing to better align your metrics to that of your customer.