

White Paper

Standardized Work: The Power of Consistency

Brian D. Krichbaum

January 23, 2008

© Process Coaching Inc. All Rights Reserved
www.processcoachinginc.com



Standardized Work: The Power of Consistency

One of the most important tools of lean manufacturing is standardized work. When starting a 5S program, the cleaning, organizing, and developing of sustainable practices is done so the elements of work can be standardized. In lean product development deployments, by developing and releasing design guidelines, we are in effect implementing standardized work for engineers.

The principles of lean and flow production do not work well when everyone is allowed to choose the method or sequence in which to do the job; quality suffers, and productivity drops. This reduces throughput and the carefully developed production system develops unanticipated bottlenecks.

Standardized Work: The Principles

Standardized work is a detailed, documented and visual system by which associates develop and follow a series of predefined process steps. It should be used whenever the work requires completing a series of tasks. Production workers, shipping departments, and warehousing teams all can benefit from implementing standardized work.

The detailed process steps which we call standardized work represent the current best practices for workers to follow in the completion of their jobs. They are designed to minimize process variation introduced by the worker and to eliminate unnecessary motion. This reduces waste, eases problem solving and enhances productivity within a particular job or set of jobs.

Without standardized work, continuous improvement activities are not manageable because processes which are in a constant state of change cannot be improved. Detailed understanding of the steps needed to be taken to complete tasks is necessary to eliminate root causes and permanently resolve issues. When workers utilize various methods to complete their work, it is not possible to develop this understanding. Therefore, standardized work provides the baseline required for continuous improvement.

Like everything in lean manufacturing, standardized work is focused on what workers need to do to satisfy the customer. Unlike the routers developed by engineering, which focus on the part and how it is processed, standardized work focuses on the workers and what steps they must take to produce the part. Maintenance and improvement of the standardized work documentation is the responsibility of the work teams.

With standardized work implemented, production workers, supervisors, and engineers no longer have to work from memory. The process documentation provides a baseline, a ***standard*** which is referenced whenever someone new is trained on the job. The standard provides consistent training results even if different managers or operators are used to train new workers.

The same principles apply even when new operators are not being trained to do the work. Over time, employees will develop shortcuts to the process, sometimes developing bad habits. But with the baseline of standardized work, it becomes straightforward and easy to complete regular process audits, following up by reinstructing workers on the proper and desired techniques or perhaps institutionalizing the improvement workers have developed.

Standardized Work: The Elements

1. 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.

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.

Takt Time Example:

- 2 - 8 hour shifts
2 shifts x 8 hours / shift x 60 minutes / hour = **960 minutes available per day**
- 2 fifteen minute breaks per shift
2 shifts x 2 breaks / shift x 15 minutes / break = **60 minutes of breaks per day**
- 10 minutes of clean-up at the end of the shift
2 shifts x 10 minutes cleanup / day = **20 minutes of cleanup per day**

960 minutes available – 60 minutes of breaks – 20 minutes of cleanup = **880 minutes available for production per day.**
- Production Requirement = 500 units per day.

Takt time = (880 minutes) / 500 units = 1.76 minutes / unit = 106 seconds / unit

2. 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 Example:

- 2 lines running 8 hour shifts
- Line 1 is staffed with 8 operators and produces 250 pieces / shift for 2 shifts
- Line 2 is staffed with 4 operators and produces 125 pieces / shift for 1 shift
- Total production = 250 + 250 + 125 = **625 / day**
Effective 2 shift cycle time = 880 minutes (see Takt time example) / 625 pieces = **1.41 minutes / piece**

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 elapsed 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 sets the pace.

3. Work Sequence - The Sequence of Tasks Followed to Complete the Job.

There is a best method and sequence of process steps to produce any product. Even when the most efficient method is yet to be found, we know it exists and that we can find it. This striving towards perfection is the foundation of lean thinking.

Focusing on work sequences is not unique to lean manufacturing. It has been a key part of manufacturing from the early days of the industrial revolution, and is essential to the development and management of all mass production plants. But lean thinking approaches are different in several ways.

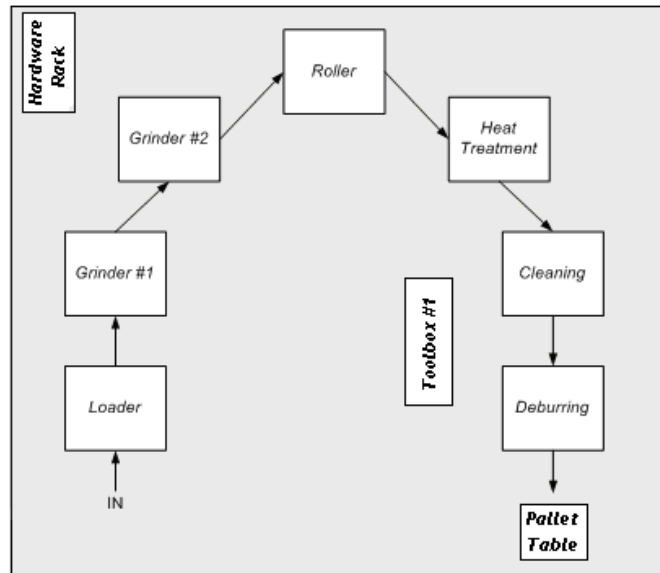
- Unlike traditional approaches, the work sequences are focused on the production workers, not the parts. They instruct the operator on exactly what he is to do next, not just which process is to be applied next.
- Work sequences are developed by those doing the work. Although it is typical for management or engineering to actually document the process steps, they are developed by the workers. Engineering, quality, and other functional groups are consulted to ensure the steps will yield the desired results, but the driving force is the production worker.
- Standardized work utilizes visual controls. The sequences are defined primarily by visual images. When done properly, the process should be able to be followed even by someone who does not speak the language well.
- Standardized work sequences are audited. Management communicates commitment and belief in the process by regularly checking to ensure it is being followed.

Standardized Work: The Tools

1. Standardized Work Analysis Sheet – Cell Layout

Organization of the workcell is an important part of the design of a process. When a cell or assembly line starts to degrade or be neglected, one of the initial symptoms is equipment and tools that are not being returned to their proper locations. The cell layout provides the baseline, or standard, for the cell. The team uses it as a reference when organizing or cleaning the work cell. Process audits include checking to ensure that the cell layout is being maintained.

When completing cell layouts, it is important to show everything in the workcell in their proper locations. This includes work tables, staging tables, storage and part racks, equipment locations, pallet locations and tool boxes. When the workcell has a containment area, it should also be shown on the layout.



**Standardized Work Analysis Sheet
"Cell Layout"**

2. Time Observation

Nearly a century ago, Fredrick Taylor started the practice of time observation when he began using the scientific method to establish time standards in manufacturing. In lean manufacturing, we focus more on system level performance than individual process efficiencies. But the understanding of work elements and the time required to complete them are an important part of lean manufacturing.

Time balancing processes so that cycle times closely match takt times is essential to eliminating wasted resources. All workers in a cell must have equal or nearly equal amounts of work, or productivity of the line will suffer. When the cycle time of a workcell exceeds the takt time for the cell, then late shipments, shortages, or excessive overtime will result. If the cycle time of the workcell is less than takt time, either overproduction or efficiency reduction will result. Without detailed knowledge of cycle times and set-up or change over times, such process balancing is not possible. Time observation is the tool that provides the detailed knowledge.

While time observation approaches are similar in lean and traditional manufacturing environments, there are significant differences.

- Lean manufacturing time observations are conducted to optimize and balance the work within the cell and to aid in the effort to reduce overall lead time - traditional manufacturing uses them to establish time standards. While it is true that lean manufacturing systems sometimes temporarily establish time standards, the overall continuous improvement activities will quickly render such standards obsolete.
- Lean systems use production workers to conduct the time observations. They aren't conducted by supervisors, manufacturing engineers, industrial engineers, or others who come into the workplace to judge or dictate how team members perform their jobs.
- In lean systems, we study the process, never the worker doing the job.

Task/Process Being Observed			Observer(s)										Day/Time Of Observation			
Step No.	Task Component	Observation Number												Assigned Component time	REMARKS	
		1	2	3	4	5	6	7	8	9	10	11	12			
Time For One Cycle															Total Time	

**Standardized Work Analysis Sheet
"Cell Layout"**

3. Standardized Work Combination Sheet

The standardized work combination sheet (SWCS) brings many of the lean tools together. It is a graphical representation of the process for visual control, emphasizing the work sequences of the operation. The SWCS brings together all elements of the process, including the time element, and shows the actual sequence of completing the work. It shows the manual work, the automatic or machine work, the walking or non-value added time, and the takt time. It is distinctly different from the work instructions or elements, which define the process methodology. Typically, hand work is denoted by a solid line, machine

time by a dotted or dashed line, walk and other non-value added time by a wavy or red line. Takt time is denoted by a vertical, solid line on the right side of the sheet.

In lean operations, we often find cycle clocks which display the elapsed time of the current cycle. Standardized Work Combination Sheets work with these cycle clocks to provide an excellent visual control mechanism. A glance at the SWCS can tell a worker where they should be in the work cycle and allow for proper pacing to stay on schedule. They provide a management tool which easily facilitates auditing of the process. Finally, they are a great aid to workers, especially when operations run close to takt time.

Part Number	98-097-654		Date Prepared	10-Mar-05	Daily Demand	231 Units																						
Part Name	HT Injection Manifold		Work Area	Manifold Assembly	Takt Time	117 Second																						
Work Sequence			Time																									
Step	Operation	Man	Auto	Walk	Operation Time (seconds)																							
					5 Sec	10 Sec	15 Sec	20 Sec	25 Sec	30 Sec	35 Sec	40 Sec	45 Sec	50 Sec	55 Sec	60 Sec	65 Sec	70 Sec	75 Sec	80 Sec	85 Sec	90 Sec	95 Sec	100 Sec	105 Sec	110 Sec	115 Sec	120 Sec
1	Obtain Manifold from conveyor	15		5	[Gantt chart bars for step 1]																							
2	Place in Wash Tub	10		1	[Gantt chart bars for step 2]																							
3	Press Button to start wash tub	1			[Gantt chart bars for step 3]																							
4	Wash Tub Cycle	10	10		[Gantt chart bars for step 4]																							
5	Obtain Manifold from wash tub	6			[Gantt chart bars for step 5]																							
6	Place manifold on work bench	2		5	[Gantt chart bars for step 6]																							
7	Obtain 4 valves from stock area	2		5	[Gantt chart bars for step 7]																							
8	Remove packaging from valves	10			[Gantt chart bars for step 8]																							
9	Place valves on manifold	8			[Gantt chart bars for step 9]																							
10	Obtain screws and hand tighten	7			[Gantt chart bars for step 10]																							
11	Obtain torque wrench and torque to 50 ft lbs	3			[Gantt chart bars for step 11]																							
12	Record torque values on tracker	8			[Gantt chart bars for step 12]																							
13	Mask off valve assembly	9			[Gantt chart bars for step 13]																							
14	Aside to pallet	4			[Gantt chart bars for step 14]																							
15	Move to conveyor to start next assembly			5	[Gantt chart bars for step 15]																							
		95	10	21																								

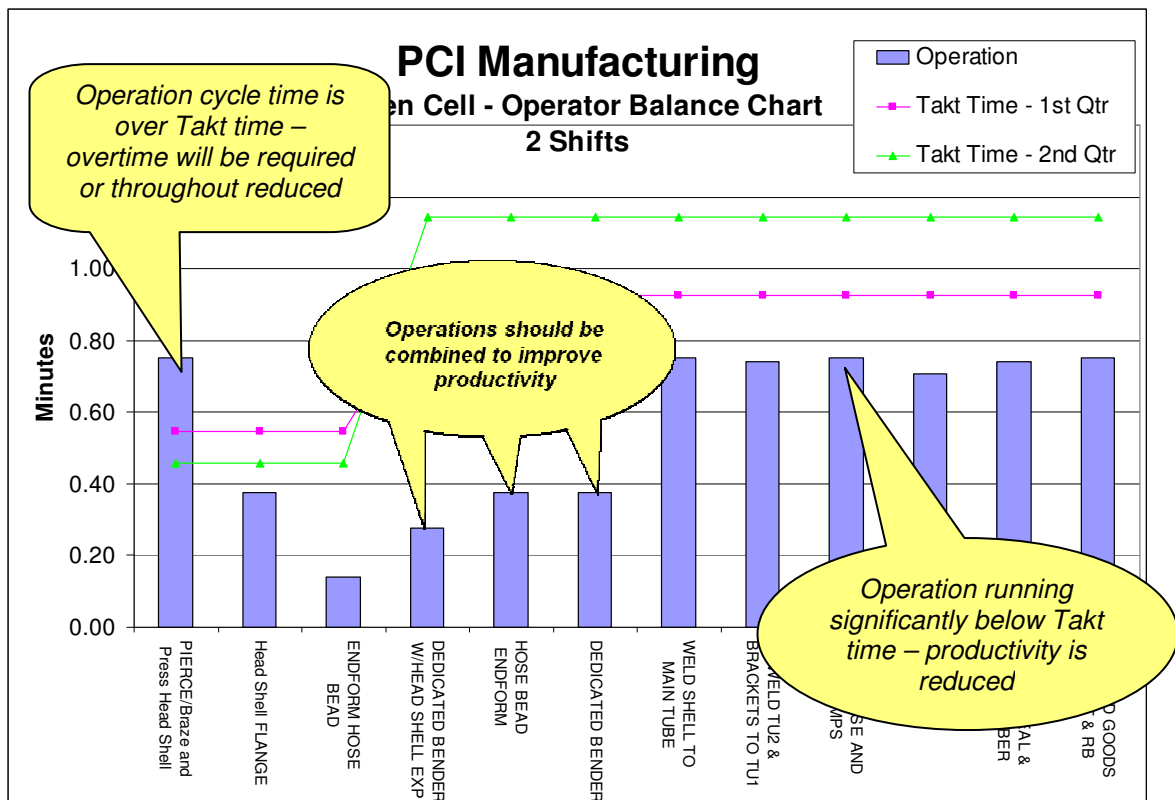
Standardized Work Combination Sheet

4. Operator / Machine Balance Charts

Many work cells and nearly all assembly lines require multiple operations and workers to do a variety of tasks or work sequences to actually produce products. The cycle time of each of these operations can be easily determined using the time observation methods discussed above.

The operator / machine balance chart is used to quickly compare the work load on the resources of the work cell to each other and to takt time. Like the other standardized work tools, it is a visual representation of the process. The operator balance chart provides a picture of the time required to conduct every operation in the work cell. Balance charts show operations which require more or less time than is available, and also show the relative loading of each operation. To be in balance, the operator / machine balance chart needs to provide nearly equal workload to each operator, and to develop a cycle time which closely matches the cell takt time.

A balance chart is a bar chart which shows the time required for each operation in the cell. The value of each bar is the time required for that particular operation. To be effective, the balance chart must also show takt time, which is represented by a horizontal line on the chart. Any deviation of the operation bars to the takt time line is waste; an opportunity for improvement using lean manufacturing methodologies.



Standardized Work: The Conclusion

Standardized work is a foundational element of lean manufacturing methodologies. Without it, the gains made from organizing work cells, creating flow production, and starting continuous improvement teams will only be temporary.

Implementing standardized work is never easy. The detail requirements and information have to be uncovered, revealing questions and new concerns. Time observation is time consuming, and often an unpopular activity on the plant floor. Standardized work activities are never finished. Lean manufacturing strives, but never achieves perfection, and with every new step towards perfection, the standardized work changes.

But the hard work and the constant striving to improve are worthwhile. Improved quality, productivity, safety and customer satisfaction is the reward.